I-1302

He^3 (Cp) 1958.

Brueckner K.A., Gammel I.L.

Phys.Rev., 1958, 109, N 4, 1040-1046

(снгл.)

Properties of liquid He^3 at low temperature.

PX, N19, 1958, 63621

I-3194 Вф-5079-I 1958

He^3 (Ср в крит. обл.)

Goldstein L.

Thermal excitations in liquid He^3.

Phys. Rev., 1958, 112, № 5, 1465-1482

Б

Есть ф.к.

Т-1306

1958

H_e^3 (Δ S_m)

Hammel E.F., Sherman R.H., Kilpatrick J.E., Edeskuty F.J.

Physica, 1958, 24, Suppl.I-8 (англ.)

Entropy-temperature phase diagram for ^3He.

РХ, 1959.

48709

есть ф.к. Ф-1

I-3121 1958

He^3 (кр.), He^4 (ж.) (Б)

Mills R L., Grilly E.R.

The Volume Change on Melting of He^3 and He^4 up to 3500 kg/cm^2

Low temperature Physics and Chemistry.

Proceedings of the fifth internationale conference. 1958, 106–108.

Кажутся за- ...

есть ф. к.

К

I-3119 ВФ-5381-I 1958

He^3 и He^4 (P)

Sreedhar A.K., Danut J.G.

Low temperature Physics and Chemistry.

Proceedings of the fifth internationale conference. 1958, p. 168-170.

К

I-3203 Вф-5511-I 1959

He^3(Cp, S)

Brewer D.F., Dannt J.G., Sreedhar A.K.

Low-temperature specific heat of liquid He^3 near the saturated vapor pressure and at higher pressure

Phys.Rev., 1959, 115, N 4, 836-842

Ann.Rev.,1960,Therm.,32

Б

φ

^3He
^4He

~1959

Mills R. L.
Grilly E. R.

p. 106-108.
The volume change on melting of ^3He and ^4He...

p, T, ΔV, ΔS.

фаз. диагр. He^3

Bφ - 5364 - I

He^3

1960

16Б321. Термодинамические свойства жидких смесей $He^3 — He^4$, полученные на основе измерений теплоемкости между 0,4 и 2° K во всем диапазоне концентраций. De Bruyn Ouboter R., Taconis K. W., Le Pair C., Beenakker J. J. M. Thermodynamic properties of liquid $^3He — ^4He$ mixtures derived from specific heat measurements between 0,4° K and 2° K over the complete concentration range. «Physica», 1960, 26, № 11, 853—888 (англ.).—Измерена теплоемкость жидких смесей $He^3 — He^4$ при 0.4—2° K для конц-ий He^3, равных 0,0466, 0,094, 0,15, 0,291, 0,39, 0,478, 0,575, 0,638, 0,70, 0,75, 0,805, 0,847, 0,894, 0,954, 1,00 мол. долей. Описана конструкция калориметра и методика измерений. Результаты представлены подробными таблицами и графиками. Особое внимание уделяется дополнительному вкладу в теплоемкость вследствие теплоты смешения. Построена фазовая диаграмма для всех исследованных т-р и конц-ий. Результаты сравниваются с литературными данными (РЖФиз, 1958, № 2, 3230; 1960, № 3, 5768). Теплоты смешения получены из измерений теплоемкости. Библ. 38 назв. Б. Егоров

Р.Ж. Химия

1961. 16Б321

1960

He^3

Thermodynamic properties of liquid He^3–He^4 mixts. derived from specific-heat measurements between 0.4 and 2°K. over the complete concentration range. R. deBruyn Quboter and K. W. Taconis (Kammerlingh Onnes Lab., Leiden, Neth.). *Proc. Symp. Liquid Solid Helium Three, 2nd, Columbus, Ohio* 1960, 133–9. As expected, a discontinuity was found at the λ temp. The jumps in sp. heat at the λ points are in good agreement with those previously calcd. Based on the sp. heats and the detn. of the heat of mixing for various mixts. at 0.9°K., the heat of mixing between 0.4 and 2°K. was calcd. A. G. Cacoso

C.A. 1963 · 59 · 8
8187e

I-3088 ВФ-5516-I носле 1960

He^3 (ρ, T_m)

Edwards D.O., Baum J.L., Brewer D.F.,
Daunt J.G., McWilliams A.S.

Proceedings of the VII-th International Conference on Low Temperature Physics, p.610-613.

University of Toronto, Canada.

Кн.

√ Е476 Ф

He^3

1960

The dielectric constant, density, expansion coefficient, and entropy of compression of liquid He^3 below 1°K. D. M. Lee, H. A. Fairbank, and E. J. Walker (Yale Univ.). *Proc. Symp. Liquid Solid Helium-Three, 2nd, Columbus, Ohio* 1960, 15–21. By use of a Clapp oscillator the dielec. const. of liquid He^3 was detd. The d. was calcd. from the Clausius-Mossotti equation. The thermal expansion coeff. was detd. at several pressures. The entropy of compression was calcd. from the relation, $S_p - S_{svp} = \int_{svp}^{p} V\alpha_v dp$, where subscripts *svp* and *p* signify satd. vapor and exptl. pressures, resp. The results are given in graph form covering a temp. range of 0.14 to 1°K. and a pressure range of 0.2–29 atm. The melting-point curve min. is at 0.32 ± 0.1°K. and 29.1 ± 0.1 atm. Alayne A. Adams

C. A. 1963 · 59 · 6
5790 c

XI – 2254

1960

He³ – He⁴

терм. св-ва

Excess thermodynamic properties of liquid He^3–He^4 mixtures. T. R. Roberts and B. K. Swartz (Los Alamos Sci. Lab., Los Alamos, N. Mex.). *Proc. Symp. Liquid Solid Helium Three, 2nd, Columbus, Ohio* **1960**, 158–72. Relations used to calc. thermodynamic properties are developed and the results obtained are compared with those of the literature and with the theoretical calcns. based on the Prigogine theory. R. De Deurwaerder

C.A. 1963. 59. 11
12204 h

55493. Давление пара смесей He^3-He^4. (1960)

Sydoriak S. G., Roberts T. R. Vapor pressures of He^3 — He^4 mixtures. «Phys. Rev.», 1960, 118, № 4, 901—912 (англ.).— На аппаратуре, некоторые детали которой описаны ранее (РЖХим, 1957, № 24, 76575; РЖФиз, 1959, № 11, 24796; 1960, № 2, 3273, 3278), измерено давление пара над р-ром He^3 — He^4 относительно давления пара над чистым He^3 при мол. долях He^3 0,1—0,9 и т-рах 0,6—2,4° К. Результаты представлены графиками и подробно табулированы. Отношение давления пара над р-ром к давлению над чистым He^3 изменяется медленно и плавно в зависимости как от давления, так и от т-ры, за исключением резкого излома вблизи т-ры расслоения и λ-точки р-ра. В отличие от результатов других исследований излома в λ-точке He^4 не обнаружено. Результаты сопоставлены с литературными данными. Обнаружено очень хорошее совпадение (за некоторыми исключениями) для точек, лежащих вблизи λ-точки He^4. Из резюме авторов

(He)

XI.1961.

55493

1960

He^3

2Б326. Соотношение между давлением, объемом и температурой для жидкого He^3. Sherman R. H., Edeskuty F. J. Pressure-volume-temperature relations of liquid He^3 from 1.00 to 3.30° K. «Ann. Phys. (USA)», 1960, 9, № 4, 522—547 (англ.).—С помощью аппаратуры, сходной с описанной ранее (РЖХим, 1956, № 3, 6297), исследована $P - V - T$-зависимость жидкого He^3 при 0,98—3,32° K, в интервале от давления насыщения до давления плавления. Ур-ние кривой плавления при 1,07—3,1° K имеет вид: $P = 24{,}559 + 16{,}639\ T^2 - 2{,}0659 \cdot T^3 + 0{,}11212\ T^4$, где P — в *атм* и T — в °K. Подробно исследовано положение нуля коэф. объемного расширения на $P - V - T$-поверхности. Коэф. объемного расширения и сжимаемость определены по данным об объеме. Вычислены значения энтропии сжатия и теплоемкостей. Результаты представлены подробными таблицами и графиками. А. Алмазов

ВФ-5378-1

х·1961·2

^3He

1960

Sydoriak S.G
Mills R.L
Grilly E.R.

„Phys. Rev Letters"
1960, 4, N10, 495-97

PVT anomalies in ^3He near its melting curve.

^{3}He 1961.

Anderson et al.

„Phys. Rev. Letters"

Cp 1961, 6 № 7, 331-4.

Вр-8512 I/1

17 Б 284. | ВФ-5513-I | 1961

He^3

Anderson A. C и др.

„Теплоемкость He^3 под давлением"

Ср

„Phys. Rev. Letters", 1961, 7, №8, 295-298 (англ.)

Ж, 1962. 17

$^{3}He-^{4}He$ ВФ — XI-3024 1961

He

(т.д.св-ва) Де Bruyn Ouboter R.,
Taconis K. W.

Physica, 1961, 27, 155-162

Есть ф.к. М, Б

1961

Franck J. P.

He³

21Б304. Фазовое превращение $\beta \rightarrow \gamma$-твердого He^3. Franck J. P. Beta-gamma phase transformation in solid He^3. «Phys. Rev. Letters», 1961, 7, № 12, 435—437 (англ.).—В адиабатич. калориметре под высоким давлением в интервале т-р 3—30° К изучалось $\rho \rightarrow \gamma$-фазовое превращение твердого He^3 на двух образцах с мол. объемом V (в *см³/моль*) 11,70 и 11,56. Т-ра измерялась угольным сопротивлением Аллена — Бредли с точностью 0,01°. Измерены: т-ра T (в °К), теплота L (в *кал/моль*) и давление P (в *атм*) фазового превращения, равные соответственно 17,800 ± 0,015; 0,067 ± 7%; 1626,8 для первого образца и 17,878 ± 0,015; 0,067 ± 2%; 1715,7 для второго образца. На основе эксперим. значений dP/dT, L и T при использовании ур-ния Клаузиуса — Клапейрона найдены: изменение энтропии $\Delta S = 0{,}0041$ энтр. ед. и мол. объема $\Delta V = 1{,}4 \cdot 10^{-4}$ *см³/моль* ($1{,}27 \cdot 10^{-3}$% от V). Р. Сафиуллин

В-р-5020-I

Х. 1962. 21

1961

He^3

Specific heat of He^3. Gerhard Ludwig Salinger. *U.S. At. Energy Comm.* TID-15196, 161 pp.(1961); cf. *CA* 56, 8082*h*, 10936*h*. Arthur Fleischer

Cp

C.A. 1963. 58. 6

5103 f

He^3

Bφ - 5524 - I

1961

3575 SPECIFIC HEAT OF SOLID He^3. E. C. Heltemes and C. A. Swenson (Ames Lab., Ames, Iowa). Phys. Rev. Letters, 7: 363-5(Nov. 15, 1961). (IS-372).

The thermal capacity of solid He^3 was measured. Data were obtained for 7-17 volumes in the alpha phase and for 10-17 volumes in the beta phase. Techniques used were checked by measuring the solid He^4 thermal capacity at 12 different volumes. A low-temperature anomaly for both He^3 and He^4 (or for the calorimeter used) was found. Data are represented graphically. (L.N.N.)

Cp

N.S.A., 1962, 16, 3

^3He 1961

Mills R.L.
Grilly E.R et al.

el-ba

BФ-5365-I

„Annals of Physics"
1961, 12, 41-55,

^{3}He | Бер-5357-7 | Osborne D. M. et al. | 1961

Pm

p - 263 - 64.

He³

1961

2Б363. Теплоемкость жидкого He³ при температурах до 0,054° К. Strongin Myron, Zimmerman George O., Fairbank Henry A. Specific heat of liquid He³ down to 0.054° K. «Phys. Rev. Letters», 1961, 6, № 8, 404—406 (англ.).—Измерена теплоемкость жидкого He³ под давлением насыщ. пара при 0,054—0,4° К. Точность измерений ±3%. Кратко описана методика измерений. Приведен график температурной зависимости теплоемкости в указанном диапазоне т-р. Теплоемкость линейно изменяется с т-рой ниже 0,09° К. По полученным данным вычислена энтропия (в энтр. ед.) жидкого He³, равная 4,38 T (где T — абс. т-ра) 0,4378, 0,524, 0,606, 0,683, 0,756, 0,824, 0,918 при т-рах 0—0,09, 0,10, 0,12, 0,14, 0,16, 0,18, 0,20 и 0,23° К соответственно.

Б. Егоров

Cp

х. 1962.2

Вф-5379-I

He³

XI — 1658
ВФ — 5517 — Е

1962

10 Б392. Калориметрические измерения на He^3 вблизи кривой плавления. Edwards D. O., McWilliams A. S., Daunt J. G. Calorimetric measurements on He^3 near the melting curve. «Phys. Letters», 1962, 1, № 3, 101—104 (англ.)

Измерялась теплоемкость смеси жидкого и твердого He^3 в области т-р, превышающих 0,1° K. На основе предположений о том, что фазы находятся в равновесии и что замерзание происходит при постоянной плотности, вычислено полное число молей, находящихся в калориметре. Наблюдаемые величины оказались примерно на 3% больше, что подтверждает гипотезу об изменении плотности изучаемой системы. Полученные данные свидетельствуют также об отсутствии фазовых переходов при т-рах выше 0,1° K. И. Звягин

X·1963·10

He^3

1962

BQ0-5517-I
XT-1658

Calorimetric measurements of helium-3 near the melting curve. D. O. Edwards, A. S. McWilliams, and J. G. Daunt (Ohio State Univ., Columbus). *Phys. Letters* 1(3), 101–4(1962) (Eng). Heat capacity measurements at 0.1–0.5 K. were carried out on ^3He. Margarete Lindsley

Cp

C.A. 1965.62.7
7175e

I-3234

He^3

1962

Ср

ВФ-5525-1

18 Б244. Теплоемкость твердого He^3. Heltemes E. C., Swenson C. A. Heat capacity of solid He^3. «Phys. Rev.», 1962, 128, № 4, 1512—1519 (англ.)

Измерена уд. теплоемкость твердого He^3 при 0,3—2° К и давлениях до 1800 *б*. Данные для β-фазы описываются ф-лой $C_v = AT + 3RD(\Theta'/T)$, а данные для α-фазы — ф-лой $C_v/3R = D(\Theta/T) + 2E(\Phi/T)$, где R — газовая постоянная; A — константа, Θ', Θ и Φ — характеристич. т-ры, $D(\Theta/T)$ — функция Дебая, $E(\Phi/T)$ — функция Эйнштейна. Член AT описывает низкотемпературную аномалию, обнаруженную в теплоемкости β-He^3. Такая же аномалия обнаружена у твердого He^4 в соответствующей фазе. Установлено, что Θ', Θ и Φ убывают с увеличением молярного объема по линейному закону. При фазовом переходе α-He^3→β-He^3 дебаевская характеристич. т-ра скачком меняется приблизительно на 20%, а молярный объем лишь на 0,5%. Полученные данные и значения термодинамич. параметров на кривой плавления (РЖХим, 1960, № 16, 64565; 1961, 20Б316) использованы для расчета ур-ния состояния для α-He^3 и сжимаемости как функции т-ры и давления. Оказалось, что сжимаемость α-He^3 значительно превышает сжимаемость жидкого He^3 или β-He^3 при одном и том же молярном объеме.

Н. Попов

X·1963·18

$^{3}He - ^{4}He$ (смесь) 1962

Pait C.L., Taconis K.W.

кривые плавлен.

„Physica"

1962, 28, N3, 305-308

ВФ-536-1

I - 3089 ВФ-5363-I ~1962

He^3 (p, v, T)

Mills R.L., Sydowak S.G., Grilly E.R.

Proceedings of the VII-th International Conference on Low Temperature Physics, p.613-617.

University of Toronto, Canada.

K √ Eyz (Ф)

I-3248

1962

He^3

Cp

3616) SPECIFIC HEAT OF LIQUID He^3. Myron Strongin, George O. Zimmerman, and Henry A. Fairbank (Yale Univ., New Haven). Phys. Rev., 128: 1983-8(Dec. 1, 1962).

The specific heat of liquid He^3 was measured at saturated vapor pressure and at three elevated pressures in the temperature range 0.054 to 0.3°K. No evidence of a transition to a correlated superfluid phase was found. At the lowest temperatures the specific heat was nearly proportional to T in agreement with other recent measurements. Entropy values are calculated at each pressure. Measurements at pressures above the minimum in the melting curve show no anomalous behavior. Measurement of the expansion coefficient of the liquid below 0.1°K confirms that the expansion coefficient is negative. (auth)

NSA · 1963 · 17 · 3

He^3 (C_p) XI 2276 1962

Saliпger G. L.
Dissert. Abstrs., 1962, 23, N2, 663 (англ.)
Specific heat of He^3.

РЖФиз., 1964, N1, 1Е56Д.

Саф

Б Ч

1962

H_2^3

2

He^3 vapor pressures: A standard for improved thermometry below 1°K. R. H. Sherman, T. R. Roberts, and S. G. Sydoriak (Los Alamos Sci. Lab., Los Alamos, N. Mex.). *Probl. Low Temp. Phys. Thermodyn.* **3**, 125–32(1960)(Pub. 1962). The vapor pressure of He^3 provides a reliable and precise secondary standard for thermometry or paramagnetic salt calibrations. For a specified accuracy, the min. observable temp. of a manometer or a McLeod gage using He^3 will be one-half to one-third as great as that for He^4. The calibration of a paramagnetic salt thermometer, directly related to $1/T$, has the range of $1/T$ extended by use of He^3. He^3 is less subject to the superfluid film of He^4 (1°K. and below) and Kapitza resistance than He^4. The development of a new He^3 temp. scale is not yet complete. The new data obtained from vapor pressures and isotherms of He^3 and He^4 can be used to remove the scatter and thermodynamic inconsistency near 1°K. obtained earlier (Abraham, *et al.*, *CA* **45**, 409*a*). C. B. Murphy

C.A. 1963 · 59 · 8
8145 fg

He³ 1962

17 Б227. Теплоемкость жидкого He³. Strongin Myron, Zimmerman George O., Fairbank Henry A. Specific heat of liquid He³. «Phys. Rev.», 1962, 128, № 5, 1983—1988 (англ.)

Измерена теплоемкость жидкого He³ в температурном интервале от 0,054 до 0,3° K при давлении насыщающих паров, а также при давл. 27,9, 28,5 и 14,7 *атм.* Не обнаружено предсказываемого квантовой теорией ферми-жидкости при 0,08° K перехода в сверхтекучую фазу. При малых т-рах зависимость теплоемкости от т-ры линейна, что согласуется с данными других работ (РЖХим, 1962, 14Ж21; 17Б284). На основе полученных и ранее известных данных для всех давлений, кроме 14,7 *атм,* вычислены кривые температурной зависимости энтропии. Измерения выше миним. давления кривой плавления не обнаружили перехода в сверхтекучее состояние. Коэф. теплового расширения при 0,07—0,135° K и несколько более высоких т-рах отрицателен. С. Шушурин

Cp

X·1963·17

^3He 1962

41371 (LA-DC-6032) THE 1962 He^3 SCALE OF TEMPERATURES. II. DERIVATION. S. G. Sydoriak, T. R. Roberts, and R. H. Sherman (Los Alamos Scientific Lab., N. Mex.). [1962]. Contract [W-7405-eng-36]. 30p.

An Experimental Thermodynamic Equation (ETE) temperature scale valid from 0.2 to 2.0°K has been calculated for ^3He. The scale is based on new comparisons, (P_3, P_4), of ^3He and ^4He vapor pressures above 0.9°K; on the 1958 ^4He temperature scale; and on the best available data for several thermodynamic properties of ^3He from 0.2 to 2.0°K. The T_{62} Full-range Working Equation (FWE) scale, $\ln P_3 = -2.49174/T + 4.80386 - 0.286001\,T + 0.198608\,T^2 - 0.0502237\,T^3 + 0.00505486\,T^4 + 2.24846 \ln T$ fits the ETE scale and the (P_3, T_{58}) data and is therefore valid for use from 0.2 to the critical point, 3.324°K. The maximum deviation from the ETE scale is 0.4 mdeg and the standard

NSA-1964-18-23

deviation from the input data is 0.25 mdeg. The fit to the seven recalculated isotherms of Keller in the range of the 1962 ^{3}He scale can be determined by converting Keller's P_4's to equivalent P_3's, using direct P_4 to P_3 interpolation equations. The fit of the 1962 ^{3}He scale is as good as the fit of the 1958 ^{4}He scale to the same isotherms, the average displacements of the two scales both being 1.5 mdeg below the isotherms. The average standard deviation for $(T_{62} - T_{iso})$ and for $(T_{58} - T_{iso})$ is 1.2 and 1.0 mdeg, respectively, for these seven isotherms. (auth)

He3

He4

15952 (LADC-5711) THE T_{62} He^3 TEMPERATURE SCALE. I. NEW VAPOR PRESSURE COMPARISONS. S. G. Sydoriak and R. H. Sherman (Los Alamos Scientifc Lab., N. Mex.). [1962]. Contract [W-7405-eng-36]. 51p.

1962

A comparison of He^3 and He^4 vapor pressures, (P_3, P_4), has been made in an apparatus designed to reduce the number and magnitude of corrections associated with the refluxing film in the He^4 pressure sensing tube and the attached bulb. The critical pressure of He^3 has been redetermined to be at 877.0 ± 1.5 mm Hg at 0°C and standard gravity; the corresponding temperature as measured by a He^4 thermometer is 3.3240°K on the 1958 He^4 scale. These (P_3, P_4) comparisons and the T_{58} scale are the basis of the T_{62} He^3 temperature scale to be derived and evaluated in future work. Empirical interpolation equations containing only P_3 and P_4 are described by means of which existing P_4 measurements may be converted to an equivalent P_3. A comparison has been made between this one-step interpolation and a two-step conversion in which the T_{58} and T_{62} scales are used as an interpolation parameter. Deviations between the two procedures are within the estimated errors of the (P_3, P_4) measurements. (auth)

NSA·1963

17·10

BQ-KI-2079a

1963

He^3

Properties of He^3 at pressures greater than the minimum in the melting curve. A. C. Anderson, W. Reese, and J. C. Wheatley (Univ. of Illinois, Urbana). *Phys. Rev.* 130, 1644-86(1963). Measurements of the sp. heat and velocity of sound in He^3 as functions of pressure and temp. were obtained for temps. from 0.02 to 0.3°K. and pressures greater than the min. in the melting curve. These measurements indicate that only 2 phases, liquid and α-solid, exist in this region of the phase diagram. The melting curve was measured to 0.03°K. The thermodynamic consistency of the data is discussed in terms of a two-phase model. The data are compared with predictions which assume the solid entropy to be $R \ln 2$, and qual. agreement is obtained. Addnl. evidence from magnetic measurements is given in support of the 2-phase description. RCPJ

C.A. 1963. 59. 1

37d

He³ | 1963

4 Б354. **Свойства He^3 при давлениях, больших минимума, на кривой плавления.** Anderson A. C., Reese W., Wheatley J. C. Properties of He^3 at pressures greater than the minimum in the melting curve. «Phys. Rev.», 1963, 130, № 5, 1644—1653 (англ.)

Экспериментально определены теплоемкости, скорости звука и магнитные свойства He^3 в зависимости от давления и т-ры в интервале т-р от 0,02 до 0,3° К и давлениях, бо́льших давления, соответствующего минимуму на кривой плавления. Измерения указывают на существование в исследованной области только двух фаз: жидкой и α-твердой. В этом предположении выполнен ряд термодинамич. расчетов, в которых принимается, что энтропия твердой фазы равна $R\ln 2$. Расчет кривой плавления качественно согласуется с непосредственными измерениями; количественно наблюдаются расхождения, увеличивающиеся при понижении т-ры. Расчет производных $(\partial p/\partial t)$ (пл.), p — давление, t — т-ра, а также теплоемкость при постоянной плотности двухфазной систе-

X·1964·4

мы указывают на качеств. правильность сделанных предположений и на отсутствие термодинамич. согласованности эксперим. данных. Указаний о существовании области аномального поведения не обнаружено. Магнитные измерения подтверждают принятую двухфазную модель.

Б. Кудрявцев

He^3 89-XI-2080 1963

18954 SPECIFIC HEAT, ENTROPY, AND EXPANSION COEFFICIENT OF LIQUID HELIUM-THREE. A. C. Anderson, W. Reese, and J. C. Wheatley (Univ. of Illinois, Urbana). Phys. Rev., 130: 495-501(Apr. 15, 1963). (TID-17389)

Cp.

The specific heat of liquid He^3 is measured over the temperature range 0.015 to 0.3°K at pressures of 0.12, 6.45, 14.6, 21.4, and 28.8 atm. The specific-heat curves are fitted to polynomials suitable for the calculation of absolute entropies. The isobaric thermal expansion coefficient is measured over the same temperature interval at pressures of 14.4, 21.1, and 28.5 atm, and is found to be negative over the entire region investigated. The thermodynamic consistency of these two sets of measurements is discussed. (auth)

NSA-1963-17-11

BP-XI-2080

1963

He^3

Specific heat, entropy, and expansion coefficient of liquid helium-3. A. C. Anderson, W. Reese, and J. C. Wheatley (Univ. of Illinois, Urbana). *Phys. Rev.* **130**, 495–501(1963). The sp. heat of liquid He^3 was measured at 0.015–0.3°K. and 0.12, 6.45, 14.6, 21.4, and 28.8 atm. The sp.-heat curves were fitted to polynomials suitable for the calcn. of abs. entropies. The isobaric thermal expansion coeff. was measured over the same temp. interval at pressures of 14.4, 21.1, and 28.5 atm. and was found to be neg. over the entire region investigated. The thermodynamic consistency of these 2 sets of measurements is discussed. CA

C. A. · 1963 · 58 · 11
10785 f

He³

1963

11 Б517. Теплоемкость, энтропия и коэффициент расширения жидкого He^3. Anderson A. C., Reese W., Wheatley J. C. Specific heat, entropy, and expansion coefficient of liquid helium-three. «Phys. Rev.», 1963, 130, № 2, 495—501 (англ.)

Теплоемкость жидкого He^3 измерена в области т-р 0,015—0,3° K и давл. 0,12—28,8 *атм.* Точность измерений ~3%. Составлены таблицы энтропии жидкого He^3 при различных давлениях. Измерен изобарич. коэф. теплового расширения при тех же т-рах и давл. 14,4—28,5 *атм.* Л. Межов

ВФ-XI-ЖЭ

X·1965·11.

XI – 2487

1963

^{3}He, ^{4}He

T_{tr}

Equilibrium diagram for the liquid-crystal ^{3}He–^{4}He system. N. G. Bereznyak, I. V. Bogoyavlenskii, and B. N. Esel'son (Phys.-Tech. Inst., Acad. Sci. Ukr. S.S.R., Kiev). *Zh. Eksperim. i Teor. Fiz.* 45(3), 486–95(1963). Measurements were made of the start in solidification of ^{3}He solns. in ^{4}He, and of the width of the liquid-crystal diagram at 1.4–4.2°K. The triple points in the equil. diagram corresponded to a polymorphic transition in the solid state as well as a transition from the α-phase to the γ-phase in solid ^{4}He. The calorimeter is 5 cc. in vol. and designed for working up to 150 atm. 25 references.

A. P. Kotloby

C.A. 1964. 60.3

2385 ab

He³

1963

The pressure dependence of the entropy of liquid ^3He down to 0.04°K. D. F. Brewer and J. R. G. Keyston (Clarendon Lab., Oxford, Engl.). *Proc. Intern. Conf. Low Temp. Phys., 8th, London* 1962, 27–8(Pub. 1963). Previously reported const.-pressure sp. heat data were integrated to obtain the entropy *vs.* temp. at 0.045 to 0.12°K. at pressures of 15 cm., 11.5, 17.6, and 27.6 atm. The reference entropy was taken as 2.41 j./mole-degree at 15 cm. pressure. Plots of entropy *vs.* temp. at 4 pressures are nonlinear through the origin. The quantity m_p^*/m_0 (ratio of effective quasi-particle mass of ^3He at pressure p to an ^3He atom at 15 cm. pressure) is plotted *vs.* pressure. There is close agreement with the results of others. Measurements of the change in temp. on adiabatic expansion and compression of liquid ^3He were done. The value of $d\alpha_p/dT$ (α_p is the isobaric expansion coeff.) near the vapor pressure is approx. $-0.1/\text{degree}^2$ at very low temp., which agrees with the results of others. At 25 atm., $-d\alpha_p/dT$ is $\sim 0.05/\text{degree}^2$. This is much lower than previous estimates by the same investigators. R. J. Reynik

C.A·1964·61·13
15421 d

1963

He^3, He^4

Calorimetric measurements on helium-3 and on solid helium-3–helium-4 solutions below 1°K. Alexander Scarborough McWilliams (Ohio State Univ., Columbus). *Univ. Microfilms* (Ann Arbor, Mich.), *Order No.* 63-2533, 150 pp.; *Dissertation Abstr.* 24, 356(1963). SNDC

C. A · 1963 · 59 · 13
14596 g

XI – 1587

1963

He^3
He^4

Thermodynamics of He^3 and He^4 solutions above the λ-temperature of pure He^4. R. Chandra and V. S. Nanda (Univ. Delhi, India). *Phys. Fluids* 6, 765–71(1963). The thermodynamic properties of He^3 and He^4 solns. at 2.2–2.6°K. were investigated on the basis of some of the classical theories of nonideal solns. Calcns. also were made of the excess chem. potentials from the vapor-pressure data by using some general thermodynamic considerations. These results are then compared with those obtained from the theories considered. RCPG

C.A. 1963 . 59 . 2
1105 bc

He³, He⁴

1963

XI - 1387

х. 1964.13

13 Б327. Термодинамика растворов He^3 и He^4 выше λ-температуры для чистого He^4. Chandra R., Nanda V. S. Thermodynamics of He^3 and He^4 solutions above the λ temperature of pure He^4. «Phys. Fluids», 1963, 6, № 6, 765—771 (англ.)

Значения термодинамич. функций для системы He^3 — He^4 вычислены в интервале т-р от 2,2 (λ-температура для He^4) до 2,6° К. Для расчета свободной энергии смешения g применена теория регулярных р-ров в предположении, что энтропия образования р-ра соответствует идеальной системе. При этом состав жидкости выражен через «параметры растворимости» Гильдебранда δ_i. На основании полученных ур-ний для g найдены ур-ния для вычисления хим. потенциалов μ_i и упругости пара-компоненты P_i, в которые, кроме величин δ_i, входит значение энергии взаимодействия компоненты W. Значения P_i также могут быть найдены из общих термодинамич. соотношений методом последовательных приближений. Необходимые для получения численных значений величины μ_i эксперим. данные об упругости пара смеси заимствованы из литературы (для содержания He^3 от 0 до 12 мол.%). Результаты вычислений обоими методами сопоставляются и обсуждаются. Изученная система близка к идеальной.

С. Огородников

^3He

4. He

XI – 1896

1963

Comparative properties of ^3He and ^4He. Donald P. Kelly and Walter J. Haubach (Mound Lab., Miamisburg, Ohio). *U.S. At. Energy Comm.* MLM-1161, 56 pp.(1963). The phys., thermodynamic, and quantum mech. properties of ^3He, ^4He, and their mixts. are reviewed. H. Niki

C. A. 1964 61 N5 4982 d.

He^3 1963

✓12 Е43 Д. **Применение теории многофермионных систем к жидкому He³.** Mills Roger Edward. An application of the theory of many-fermion systems to liquid helium-three. Doct. diss. Ohio State Univ., 1963, 156 pp. Ref. «Dissert. Abstrs», 1963, 24, № 3, 1208 (англ.)

Термодинамические свойства жидкого He^3 изучены с помощью теории фермионных ф-ций Грина типа Матсубары. Результаты для $T = 0°$ K, полученные в приближении Хартри — Фока, расходятся с опытными данными, но согласуются с вычислениями Брюкнера и Гаммеля.

ф-1964-12 Е

1963

He^3

He^4

3 Б467. **Переход от гексагональной плотноупакованной к кубической объемноцентрированной структуре в He^3 и He^4.** Schuch A. F., Overton W. C., Jr., Brout R. Phenomena along the hcp-bcc transition line of He^3 and He^4. «Phys. Rev. Letters», 1963, 10, № 10, 429—431 (англ.)

Обсуждается теоретич. интерпретация переходов в твердой фазе He^3 и He^4 от гексагон. плотноупакованной к объемноцентр. куб. структуре. Найдено, что вдоль кривых перехода как для He^3, так и для He^4 $M\theta_C R^2=\text{const}$, где M — масса, R — расстояние между соседними молекулами, θ_C — дебаевская т-ра (указаны эксперим. работы, по данным которых получены значения R и θ_C). Отсюда вытекает, что переход соответствует точке изгиба кривой потенциальной энергии как функции R и приводит к усилению роли нулевых колебаний. В. Урбах

X. 1964 · 3

He³ 1964

4 Б397. Термодинамические свойства растворов He^3 и He^4. II. Температуры выше границы сверхтекучести в растворе. Chandra R., Nanda V. S. Thermodynamic properties of He^3 and He^4 solutions. II. Temperatures above the superfluid transition in solution. «Phys. Fluids», 1964, 7, № 1, 15—19 (англ.)

Исследуются термодинамич. свойства р-ра He^3 и He^4 между т-рой перехода для чистого He^4 и т-рой перехода для р-ра. Производится сравнение значений избыточного хим. потенциала, вычисленных на основе классич. теории р-ров и определенных из давления пара. Поведение He^3 может быть объяснено таким образом до 1° K, тогда как для He^4 такого совпадения нет. Это расхождение для He^4 в р-ре объяснено с помощью гипотезы Гортера предложенной для чистого He^4, согласно которой свободная энергия Гиббса является функцией доли атомов He^4, имеющих нормальную текучесть. Использование этой гипотезы и выбор соответствующего выражения для подсчета свободной энергии Гиббса позволили получить значения избыточного хим. потенциала, удовлетворительно согласующиеся с экспериментальными. Сообщение I см. РЖХим, 1964, 13Б327. Р. Ф.

X·1965·4

He3

1964

8 Е8. **Термодинамические свойства твердых и жидких гелия-3 и гелия-4 высокой плотности при температурах выше 3° К.** Dugdale J. S., Franck J. P. The thermodynamic properties of solid and fluid helium-3 and helium-4 above 3° K at high densities. «Philos. Trans. Roy. Soc. London», 1964, A257, № 1076, 29pp., ill. (англ.)

Проведены измерения уд. теплоемкости твердого He^3 при постоянном объеме между 3° К и точкой плавления для различных плотностей, соответствующих давлениям до 2000 *атм.* Измерения продолжены за область плавления до 29° К при постоянном объеме жидкой фазы. Для сравнения проведены аналогичные измерения для He^4 при четырех различных плотностях. Полученные данные вместе с *p—V—T* значениями по Миллсу и Гриллн (РЖФиз, 1956, № 6, 16448, 1961, 10Д28) позволили описать все термодинамич. свойства твердой фазы в рассматривавшихся интервалах давления и т-ры. Результаты могут быть осмыслены полуколичественно в понятиях квазигармонич. модели колебаний решеток и нулевой энергии твердых тел. Проводится также краткое рассмотрение уд. теплоемкости жидкой фазы.

Cp

ф. 1965. 8Е

He^3

1964

библиография

Helium-3. An annotated bibliography. C. F. Eck, K. J. Kaminski, and W. A. Wakat. *U.S. At. Energy Comm.* MLM-1190, 452 pp.(1964)(Eng). 1486 references. SNVC

C.A. 1965. 62. 1

43 b

^3He K. Fokkens, W. Vermeer, K.W. 1964г.
^4He Taconis. R. De Bruyn Ouboter.
Physica 1964, 30, 2153-2174.
Теплота проводимости
^3He и ^4He и их смеси
в газообразном состоянии
между 0.5 и 3°K.

3He

1964

(Cp)

Heat capacity of the exchange bath in solid ^3He. R. L. Garwitz and H. A. Reich (Columbia Univ.). *Phys. Rev. Letters* 12(13), 354–6(1964); cf. *CA* 60, 8802*a*. Exchange heat capacity measurements showed that heat enters the exchange bath through the Zeeman system, whereas the contribution from the lattice is negligible. BGJN

C.A. 1964 60 N13 15158 e

^3He

1964

Some thermodynamic properties of liquid helium-3 below 1.0° absolute. John Edgar Rives (Duke Univ., Durham, N. Car.), *Univ. Microfilms* (Ann Arbor, Mich.), *Order No*. 63-879, 108 pp.; *Dissertation Abstr*. 24(10), 4243(1964). SNDC

C. A. 1964 (?) N3 2510 g.

He3 1964

20 Б310. **Температуры минимального объема и областей расслоения смесей He^3—He^4.** Kerr Eugene C. Temperatures of the volume minima and stratification regions for ^3He—^4He mixtures. «Phys. Rev. Letters», 1964, 12, № 8, 185—187 (англ.)

Исследуется причина расхождений в определении λ-точек смесей He^3—He^4 при различных способах наблюдений. Построенная по данным измерений кривая зависимости т-ры миним. объема смеси (T мин.) от конц-ии расположена выше линии λ-переходов; при конц-ии $He^3 > 40\%$ разность т-р достигает нескольких сотых градуса. Возможность возникновения за счет этого конвективных потоков вблизи T(мин.) и является, по мнению автора, причиной расхождений при наблюдениях λ-перехода в смеси.

Л. Межов

Ж. 1964. 20

196

^3He в ^4He

11 Б436. **Осмотическое давление He^3 в жидком He^4 с предложениями процесса для холодильной машины, работающей при температуре $< 1°$ K.** London H., Clarke G. R. Osmotic Pressure of He^3 in Liquid He^4, with Proposals for a Refrigerator to Work below 1° K (англ.)

Экспериментально определено осмотич. давление P изотопа He^3, растворенного в жидком He^4, при т-рах 0,8, 1,0 и 1,2° K. В качестве полупроницаемой мембраны служил слой тонкоизмельченного порошка высотой 50 *мм*, помещенной в нейдильберовую трубку диам. 0,3 *мм* и высотой 86 *мм*, порошок спрессовывался под давлением коэф. линейного расширения мембраны и трубки были близки, поэтому при глубоком охлаждении мембрана не разрушалась. Мембрана пропускала лишь сверхтекучий He^4. Смесь He^3 и He^4 известного состава через мембрану сообщалась с чистым жидким He^4, находящимся при более высокой т-ре, причем P уравновешивалось гидростатич. давлением жидкого He^4. Найденные величины имели порядок 30—50 *мм* рт. ст., и измерялись с точностью ± 0,2%.

См. н/ог.

X. 1964. 11

При т-ре <0,87° К жидкая смесь He^3 и He^4 расслаивается. Поскольку при таких т-рах энтропия He^4 практически равна нулю, а для He^3 составляет конечную величину, смесь изотопов может рассматриваться как однокомпонентная система, в которой жидкая фаза, богатая He^4, представляет собой «квазипаровую» фазу, а другая жидкая фаза «квазижидкую». При адиабатич. разбавлении последней происходит поглощение тепла, аналогичное тепловому эффекту адиабатич. испарения жидкости, а величина *P* аналогична упругости пара этой жидкости. Эти соображения положены в основу предложенной схемы холодильной машины, работающей при т-рах порядка 0,1° К. Поглощение тепла в этой машине осуществляется за счет разбавления р-ра He^3 в He^4, с последующей регенерацией хладоагента путем перегонки.

С. Огородников

He^3 (жидкий)

1964

Теплоёмкость.

2 Б365. О сверхтекучести He^3. Пешков В. П. «Ж. эксперим. и теор. физ.», 1964, 46, № 4, 1510—1513

Измерялась теплоемкость жидкого He^3 при 0,0033—0,011° К. Для получения в He^3 самых низких т-р разработан прибор с трехступенчатым размагничиванием парамагнитных солей. Теплоемкость He^3 получалась из графита отогрева, как разность теплоемкостей пилюли, заполненной 1,12 *см*³ жидкого He^3 и 0,058 *см*³ He^3. Характер кривых теплоемкости, полученных таким образом, а также резкое увеличение теплопередачи через He^3 к церий-магниевому нитрату (третьей ступени охлаждения) ниже 0,0055° К едва ли можно объяснить иначе, чем переходом жидкого He^3 при т-ре 0,0055° К в сверхтекучее состояние. Л. Межов

х. 1965. 2

He³ XI-2252 1964

термод. св-ва

12 Е41 Д. Некоторые термодинамические свойства жидкого He^3 ниже 1° К. Rives John Edgar. Some thermodynamic properties of liquid helium three below 1.0° absolute. Doct. diss. Duke Univ., 1962, 108 pp. Ref. «Dissert. Abstrs», 1964, 24, № 10, 4243 (англ.)

Измерена плотность жидкого He^3 в области т-р 0,045—1,3° К и при давлениях ниже 28 *атм*. Найден минимум плотности при давлениях выше 15 *атм*. Исследован также коэф. теплового расширения жидкого He^3.

ф-1964-12б

3He

1964

7434 THE 1962 He^3 SCALE OF TEMPERATURES. III. EVALUATION AND STATUS. T. R. Roberts, R. H. Sherman, and S. G. Sydoriak (Los Alamos Scientific Lab., N. Mex.). J. Res. Natl. Bur. Std., 68A: 567-78(Nov.-Dec. 1964). (LADC-6217)

The 1962 ^3He Scale of Temperatures is evaluated both as to its precision and its deviations from the thermodynamic Kelvin Scale. Various thermodynamic quantities of ^3He consistent with the 1962 ^3He Scale are derived and listed. The correction to an observed vapor pressure for small amounts of ^4He is discussed and tabulated. A description is given of the method of multiple variable least squares analysis used for deriving the final scale equation and for re-analysis of isotherm data. Finally the present status of the 1962 ^3He Scale is discussed along with some considerations for the future. (auth)

NSA · 1965 · 19 · 5

He^3, He^4

1964

7433 THE 1962 He^3 SCALE OF TEMPERATURES. I. NEW VAPOR PRESSURE COMPARISONS. S. G. Sydoriak and R. H. Sherman (Los Alamos Scientific Lab., N. Mex.). J. Res. Natl. Bur. Std., 68A: 547-58(Nov.-Dec. 1964).

A comparison of ^{3}He and ^{4}He vapor pressures, (P_3,P_4), was made in an apparatus designed to reduce the number and magnitude of corrections associated with the refluxing film in the ^{4}He pressure sensing tube and the attached bulb. The critical pressure of ^{3}He was redetermined to be at 873.0 ± 1.5 mm Hg at 0°C and standard gravity; the corresponding temperature as measured by a ^{4}He thermometer is 3.3240 ± 0.0018°K on the 1958 ^{4}He scale. Empirical interpolation equations containing only P_3 and P_4 are described by means of which existing P_4 measurements may be converted to an equivalent P_3. A comparison was made between this interpolation and a conversion in which the 1958 ^{4}He and 1962 ^{3}He scales are used as parameters. Deviations between the two procedures are within the estimated errors of the (P_3,P_4) measurements. In subsidiary

NSA·1965·19·5

experiments on techniques for ^4He thermometry a typical vapor pressure bulb arrangement was tested. It is shown that the refluxing film introduces a heat flux, $\dot{Q}_f$, and a resulting Kapitza temperature drop, ΔT_k, between the He(II) and its container, which may amount to many millidegrees. The feasibility of calculating ΔT_k for a particular ^4He vapor pressure bulb was studied. The necessity of measuring $\Delta T_k/\dot{Q}_f$ at least once in situ is pointed out. In addition, it is necessary to redetermine the film flow rate periodically at the same time that ^4He vapor pressure measurements are being made. (auth)

3 He

1964

7435 THE 1962 He^3 SCALE OF TEMPERATURES. IV. TABLES. R. H. Sherman, S. G. Sydoriak, and T. R. Roberts (Los Alamos Scientific Lab., N. Mex.). J. Res. Natl. Bur. Std., 68A: 579-88(Nov.-Dec. 1964). (LADC-6218)

The detailed tables of the 1962 ^3He Scale of Temperatures are presented. The vapor pressure of ^3He is tabulated in steps of 1 millidegree from 0.2 to 3.324°K, the critical temperature. A table giving temperature, to 0.1 millidegree, as a function of pressure is included, as well as the temperature derivative of the vapor pressure. (auth)

NSA . 1965 . 19 . 5

He^3 – He^4 1964

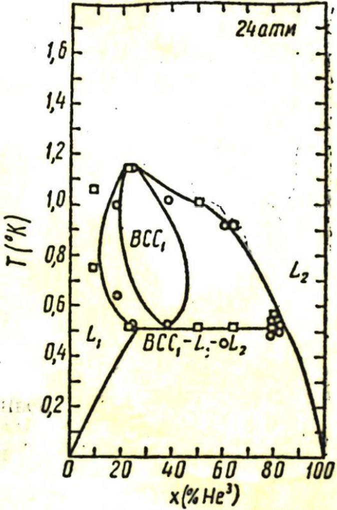
6 Б642. Фазовая диаграмма смесей He^3—He^4. Tedrow P. M., Lee L. M. Phase diagram of He^3—He^4 mixtures. «Phys. Letters», 1964, 9, № 2, 130—132 (англ.)

По эксперим. данным, опубликованным ранее (РЖФиз, 1963, 4Е35), с учетом правила фаз построена фазовая диаграмма смесей He^3—He^4: проекция диаграммы P—T—X на плоскость P—T и 8 изобарич. сечений T—X при давл. 19,1—30 *атм*. Показано, что в системе He^3—He^4 существует 5 фаз: 2 жидких р-ра на основе He^3 и He^4, 2 твердых р-ра с куб. объемноцентр. структурой на основе He^3 (BCC_1) и He^4 и твердый р-р с гексагон. плотноупакованной структурой. Особенностью диаграммы (см. рис.) является наличие области твердой фазы, замкнутой моновариантной кривой. При понижении т-ры твердая фаза на основе He^4 плавится, распадаясь на две жидкости.

Г. Пересада

См. изоб.

Ж·1965·6



24атм
T (°K)
1,6
1,4
1,2
1,0
0,8
0,6
0,4
0,2
BCC₁
L₁
L₂
BCC₁-L₁-oL₂
0
20
40
60
80
100
x(% He³)

^3He XI-1544 1965

Low-temperature heat capacity of liquid ^3He. W. R. Abel, A. C. Anderson, W. C. Black, and J. C. Wheatley (Univ. of Illinois, Urbana). *Phys. Rev. Letters* 15(23), 875-8(1965) (Eng). The heat capacity, C, of ^3He was measured at magnetic temps. $T^* < 0.05°K$. at 0.28 and 27.0 atm. in the absence of calorimeter background. The results show a dependence of C/n_3RT^* on T^*, where n_3 is the no. of ^3He moles and R the gas const. Such a dependence is either linear or logarithmic.

BGJN

C.A. 1966. 64.5

5828 f g

XI – 1544

1965

He³

15 Б537. **Низкотемпературная теплоемкость жидкого He^3.** Abel W. R., Anderson A. C., Black W. C., Wheatley J. C. Low-temperature heat capacity of liquid He^3. «Phys. Rev. Letters», 1965, 15, № 23, 875—878 (англ.)

Приводятся результаты измерений величины $c/n_3 \cdot RT^*$ (c — теплоемкость, n_3 — число молей He^3, R — газовая постоянная, T^* — магнитная т-ра) для He^3 в области т-р $4 \cdot 10^{-3}$—$50 \cdot 10^{-3}$° К. В отличие от уже имеющихся экспериментов по определению этой величины примененный метод (кратко описана конструкция прибора) дал возможность исключить теплоемкость калориметра и магнитного термометра. Полученную величину c/n_3RT^* нельзя описать параболич. зависимостью от т-ры, к-рую следовало бы ожидать, исходя из теории жидкости Ферми. Точный вид этой зависимости не установлен.

П. Кондратенко

C_p

x · 1966 · 15

^3He XI – 1545 1965

The heat capacity of liquid ^3He. B. M. Abraham, M. Durieux, C. J. N. van den Meijdenberg, and D. W. Osborne (Argonne Natl. Lab., Argonne, Ill.). *Proc. Intern. Conf. Low Temp. Phys. 9th, Columbus, Ohio* 1964(A), 133–6(Pub. 1965)(Eng). Measurements were made on the heat capacity of liquid ^3He at 0.04–0.5°K. in order to improve the precision in the detns. of the effective mass ratio, m^*/m. A value of $m^*/m = 2.38 \pm 0.25$ was detd. The entropy at 0.4°K. was $S/R = 0.682$. JDJN

Cp

C. A. 1966. 65 - 11
16145 be

He^3

1965

13 Б599. **Теплоемкость адсорбированного He^3 при низких температурах.** Lambert Marcel H. Adsorbed ^3He: heat capacity at low temperatures. «J. Chem. Phys.», 1965, 43, № 8, 2913—2914 (англ.)

Измерена теплоемкость адсорбированного на цеолите He^3 при т-рах 0,3—0,8° K. Получена квадратичная зависимость теплоемкости от т-ры в этом интервале. Делается вывод, что при небольшой (менее одного слоя) плотности покрытия адсорбента He^3 проявляет св-ва тв. состояния. Вплоть до 0,1° K не наблюдается ядерный вклад в теплоемкость. Адсорбентом служил цеолит в виде дробин диам. 1/16 дюйма. Н. Иноземцев

C_p

х · 1966 - 13

He^3

($P_{кр}$, $T_{кр}$)

Моисеева Н.Ф.

Критические параметры гелия-3, 7 с.

He^3

He^4

1965

12 E59. Теплоемкость He^3 и He^4 вблизи критической точки. Moldover M. R., Little W. A. Specific heat of He^3 and He^4 in the neighborhood of their critical points. «Phys. Rev. Letters», 1965, 15, № 2, 54—56 (англ.)

Установлена логарифмич. особенность теплоемкости $C_v/R = -a \ln[(T_c - T)/T_c] + b$ He^3 и He^4 ниже критич. точки в интервале т-р 10^{-4}° К $< T - T_c <$ 1° К, где $a = 0{,}37$ и 0,62, а $b = 1{,}7$ и 2,0 для He^3 и He^4 соответственно. Характер зависимости выше T_c установить не удалось. Отмечается совпадение a с аналогичным коэф. в теплоемкости He^4 вдоль кривой насыщения вблизи λ-точки. Предварительные результаты свидетельствуют о том, что $d^2\mu/dT^2$, где μ — химич. потенциал, не стремится к нулю при $T \to T_c$. Ю. Дмитревский

ф. 1965 · 12 Е

^3He u He^4

1965

35340 SPECIFIC HEAT OF He^3 AND He^4 IN THE NEIGHBORHOOD OF THEIR CRITICAL POINTS. Mcldover, M. R.; Little, W. A. (Stanford Univ., Calif.). Phys. Rev. Letters, 15: 54-6(July 12, 1965).

The question of whether for a real gas the specific heat behaves in a manner similar to that of a lattice gas is investigated. A study is made of the specific heat at constant volume of both helium-3 and helium-4 at densities close to the critical density. The results confirm the view that quantum effects would reduce the magnitude of the singular contribution to the specific heat in helium. (J.F.P.)

NSA · 1965 · 19 · 18

^{3}He

1965

^{4}He

Specific heat of helium-3 and helium-4 in the neighborhood of their critical points. M. R. Moldover and W. A. Little (Stanford Univ., Stanford, Calif.). *Phys. Rev. Letters* 15(2), 54–6(1965) (Eng). The sp. heat at const. vol. (C_v) of both ^{3}He and ^{4}He at d. close to the crit. d. were studied for 2 reasons: to observe whether the He is like Ar, and to investigate the detailed nature of the singularity in the pressure-d. plane, not only on the crit. isochore but on its immediate vicinity. The C_v at 3.3 and 5.2 K. and their crit. d. were detd. and plotted *vs.* temp. In the 2-phase region below T_c, C_v indicates logarithmic behavior similar to Ar and O_2. The postulate of Yang and Yang (*CA* 61, 13892*g*) that the quantum effects would reduce the magnitude of the singular contribution to the sp. heat in He is verified.

Margarete Lindsley

C.A. 1965 · 63 · 13

17162e

1965

$^3He-He^4$ раствор в He

18 Б352. **Плотность слабого раствора He^3—He^4.** Птуха Т. П. Густина слабкої суміші He^3—He^4. «Укр. фіз. ж.», 1965, **10**, № 3, 353 (укр.)

В температурном интервале 1,3—4,0° K проведены измерения плотности слабого р-ра изотопов He с содержанием He^3 10^{-2}%. Зависимость плотности слабых р-ров от т-ры оказалась подобной такой зависимости для чистого He^4, однако при т-рах ниже λ-точки плотность уменьшается при охлаждении. Р. Ф.

Ж-1965 18

^3He

Х/-2442

1965

Properties of ^3He at low temperatures. John C. Wheatley (Univ. of Illinois, Urbana). *U.S. At. Energy Comm.* COO-1198-306, 72 pp.(1965)(Eng). Exptl. values and methods are given for detg. the heat capacity, the magnetic susceptibility, the self-diffusion coeff., the velocity and attenuation of sound, the thermal cond., and the transfer of energy across the surface between solid and liquid ^3He. Since only the heat capacity, self-diffusion coeff., and magnetic susceptibility were measured to very low temps., parameters were detd. for comparison with those calcd. for a Fermi liquid. Only the parameters of the heat capacity deviate from those expected for a normal Fermi liquid. E. W. Nadig

Cp

C.A. 1966. 64. 8

10425de

He³ – He⁴

1965

3 Е517. Теплоемкость смесей He^3—He^4 в твердом состоянии. Zimmerman George O. The specific heat or ^3He—^4He solid mixtures. «Low Temperat. Phys., LT 9. Proc. IXth Internat. Conf., Columbus, Ohio, 1964. Part A». New York, Plenum Press, 1965, 244—247 (англ.)

Измерена теплоемкость C_v смесей He^3—He^4, содержание He^3 в которых менялось от 0 до 11,8%, в интервале т-р 0,06—0,7° K при давл. до 63 *атм*. Обнаружено, что C_v проходит через несколько экстремумов, часть из которых может быть отнесена за счет фазового перехода от α-фазы к β-фазе. Установлено, что число этих экстремумов зависит от величины давления. Л. Бергер

(Cp)

Ф. 1967. 3 ?

^{3}He

XI – 1549

1966

Low-temperature heat capacity of liquid ^{3}He. W. R. Abel, A. C. Anderson, W. C. Black, and J. C. Wheatley (Univ. of Illinois, Urbana). *Phys. Rev.* 147(1), 111–18(1966)(Eng). The heat capacity of pure ^{3}He was measured using a difference method from 6 to 50 $\times 10^{-3}$°K at 0.28 atm. and from 4 to 30 $\times$ 10^{-3}°K. at 27.0 atm. In neither case is the ratio of heat capacity to temp. const. over the range of temp. of the measurements. The high- and low-pressure heat capacities seem to have qual. different temp. dependences. The raw heat-capacity data down to a temp. (on the magnetic temp. scale valid for powd. Ce Mg nitrate (CMN) in the form of a right circular cylinder with diam. equal to height] of 2 $\times 10^{-3}$°K. at 0.28 atm. and 4 $\times 10^{-3}$°K. at 27.0 atm. show no evidence for anomalous behavior. As a by-product of the measurements the heat capacity of the CMN cooling salt was obtained. RCPJ

C.A. 1966. 65. 4

4735 cd

1966

^3He

^4He

C_p

51334q **Heat capacity of helium-3 and helium-4 monolayers and partial monolayers from 0.25 to 4°K.** Dash, Jay G.; Goodstein, David L.; McCormick, William D.; Stewart, G. A. (Univ. of Washington, Seattle, Wash.). *Tr. Mezhdunar. Konf. Fiz. Nizkikh Temp., 10th* 1966(Pub. 1967), 1 496–9 (Eng). Edited by Malkov, M. P. VINITI: Moscow, USSR. Measurements of the heat capacity of adsorbed monolayers and partial monolayers of ^3He and ^4He in the range 0.25–4.0°K. were studied. Nearly complete monolayers of ^3He and ^4He show T^2 temp. dependence. The heat capacity/atom increases markedly as coverage is reduced, and the temp. dependence is no longer quadratic. For ^4He films of 0.57 and 0.28 monolayer, and ^3He at 0.46 monolayer, the heat capacities below 2°K. show a combination quadratic and linear terms. The combination below 2°K. and a strong max. at about 3°K. for the 0.57 monolayer ^4He film are ascribed to coexistence of mobile and condensed surface phases having temp.-dependent concns., with a latent heat of transformation. D. V. Anders

C. A. 1969. 70. 12 (+1)

XI-458 1966

^3He

Cp

69481n Heat capacity of solid ^{3}He. Howard Harshaw Sample (Iowa State Univ. of Sci. & Technol., Ames). AEC Accession No. 40013, Rept. No. IS-T-84. Avail. Dep. mn; CFSTI $3.00 cy, 139 pp.(1966)(Eng). Sp. heat measurements were made from 0.2°K. to the melting line for solid ^{3}He at 9 densities and for solid ^{4}He at 1 density. The results, which cover molar vols. from 23.80 cm.^{3} to 11.42 cm.^{3}, everywhere were accurate to better than 1% in an equiv. θ_D. The relatively high precision of these expts. and their wide temp. range enabled a detn. of the thermal equations of state of both hexagonal close packed (hcp) and body-centered cubic (bcc) solid ^{3}He quite unambiguously. The $\theta_0(V)$ relation which was obtained for (hcp) ^{3}He gave values of γ which varied from 2.0 at 11.42 cm.^{3}/mole to 2.6 at 19.05 cm.^{3}/mole. For (hcp) ^{4}He, the value of $\theta_{04}(V)$ and previous data can be obtained from the simple relation $\theta_{04}(V) = \theta_{03}(V)/1.18$. The const. in this relation was quite close to the Debye value of 1.154. In all other aspects (hcp)^{3}He and (hcp)^{4}He behave quite like

C.A. 1967. 66.16

the heavier more classical inert gas solids Ar and Kr with a Grueneisen γ which increased slowly with temp. The results for (bcc) ^{3}He indicated that the sp. heat contains a large, apparently exponential anomalous contribution which is superimposed on a Debye-like behavior as reported previously. Low-temp. anomalies (smaller than but resembling the linear anomalies in previous work) were found in all the data, and are believed to be due to unknown app. problems. From *Nucl. Sci. Abstr.* 20(21), 4863–4(1966). TCNG

3He

1966

Instability of Fermi systems and heat capacity of liquid ^{3}He. D. A. Kirzhnits and Yu. A. Nepomnyashchii. (P. N. Lebedev Phys. Inst., Moscow). *Zh. Eksperim. i Teor. Fiz., Pis'ma v Redaktsiyu* 4(3), 86–90(1966)(Russ). The anomaly of the heat capacity of ^{3}He is studied on the basis of a reconstruction of the system not in the channel "particle-particle" as in the case of superfluidity, but in the channel "particle-hole." In this case the system passes into a special spatial inhomogeneous state. The anomaly is the forerunner of such a transition. A simple model is considered theoretically. The same results can be obtained by analogy with the theory of supercond. and by description of the condensation of the correlated "particle-hole" pairs. As in the case of electrons moving in the field of the lattice, the

C. A. 1966. 65. 13,
19364de

excitation spectrum has a slit of the dielec. type. Within the Fermi sphere many Brillouin zones are located. In the model considered, the usual superfluidity is strongly suppressed and the reconstructed vertex function has no imaginary pole in the "particle-particle" channel. The fluctuations which are connected with the "particle-hole" pair are considerably more essential than the superfluid fluctuations. The energy of such a pair is relatively small.

L. Holl

^{3}He

^{4}He

1966

Quantum corrections to critical-point behavior. Michael E. Fisher (King's Coll., London). *Phys. Rev. Letters* 16(1), 11–14 (1966)(Eng). The exptl. evidence suggesting that the behavior of ^{3}He and ^{4}He at their crit. points deviates qual. from that observed with classical gases for which the de Boer parameter Λ^* is small is explained by assuming that the ideal crit. point exponents of the coexistence curves defined elsewhere, in the limit $T = T_c$ (T_c = crit. temp.), are probably discontinuous functions of Λ^*. E. Grunhut

C. A. 1966. 64. 6

7381 gh

He-3, He-4, Ne, Ar, Kr, Xe (, Pm) 1966

Vaidya S. N., Gopal E. S. R., XI 1350

Cryogenics, 1966, 6(6), 372-3.

Melting of inert gas solids at high pressures.

Б 9 CA, 1967, 68, N14, 59114 f

^3He (C_p) XI 969 1967

Brenig W., Mikeska H.J.,

Phys. Lett., 1967, A24(6), 332-3.

Low-temperature specific heat of liquid ^3He.

Б (ф)

CA, 1967, 67, N2, 6299;

^3He, ^4He (Cp) Ч XI 1006 1967.

Dash J.G., Goodstein D.L., McCormick W.D., Stewart G.A.

In 10th Межд. Конф. по Физике Низких Темп., 1966, (Опубл. 1967) 1, 196-9.

Теплоемкость ^3He и ^4He ...

...

Есть ф. к.

Б З

РЖ 1969, 10, Д12, 51334 ф

1967

3He XI-1/89

p-V-T - Cb - Ca

S

ΔH; ΔG

C_v

C.A. 1970-73-4

19178t Thermodynamic data of helium-3. Gibons, R. M.; Nathan, D. I. (Res. and Develop. Div., Air Prod. and Chem., Inc., Allentown, Pa.). *U.S. Air Force Syst. Command, Air Force Mater. Lab., Tech. Rep.*, *AFML* 1967, TR-67-175, 171 pp. (Eng). The *PVT* properties, entropy, enthalpy, internal energy, thermal conductivity and viscosity of ^{3}He have been tabulated at 1–100°K at selected pressures ≦100 atm. Measurements were made on the *PVT* properties and the sp. heat at const. vol. of gaseous ^{3}He at 4–20°K and a modified Strobridge equation was obtained which represented the *PVT* data within ±1%. Using this equation, the *SVT* and *HVT* surfaces were obtained at 4–20°K. A correlation based on the quantum version of the principle of corresponding states was used to calc. the thermodynamic properties of ^{3}He at 20–100°K. Similar correlations were developed for the viscosity and thermal cond. of ^{3}He at ≦100°K. Tabulations of thermodynamic properties of ^{3}He along the vapor-liq. boundary and in the compressed liq. region are also included in the tables. An *H-S* diagram of the data with *P*, *V*, and *T* as parameters is included.

RCTT

(+1) Бацдуз

^3He Tb

57786y The heat capacity of solid ^3He. Howard Harshaw Sample (Iowa State Univ. of Sci. & Technol., Ames). *Diss. Abstr. B* 27(9), 3250(1967)(Eng). *Univ. Microfilms* (Ann Arbor. Mich.), *Order No.* 67-2052, 163 pp.; cf. *CA* 66: 69481n.
SNDC

1967

C_p

C.A. 1967. 67. 12

^3He in ^4He

C_p

1967

94565w The specific heat and phase separation curve of dilute solutions of liquid ^3He in ^4He. Matthew Michael Skertic (Ohio State Univ., Columbus). *Diss. Abstr. B* 27(11), 4092 (1967)(Eng). *Univ. Microfilms* (Ann Arbor, Mich.), *Order No.* 67-6369, 139 pp. SNDC

C.A. 1967 . 67 . 20

He - III

1967

He^3

He^4

термод. устойчивости; Ttr (предположение)

+1

15 Б687. Термодинамика гелия-3 и гелия-4 при низких температурах. Семенченко В. К., Бадра Х. М. «Ж. Физ. химии», 1967, 41, № 8, 2050—2053

Характер диаграммы термодинамической устойчивости D_T для He^3 и He^4 подобен и подтверждает предположение о существовании фазового перехода у He^3, аналогичного λ-переходу He^4 в узком интервале т-р вблизи абсолютного нуля, а именно, от 0,015 до 0,025° К.

Резюме

х. 1968. 15

He-3

XI-1357

1967

99294n Melting curve of helium-3. James R. Thompson and Horst Meyer (Duke Univ., Durham, N. Car.). *Cryogenics* 7(5), 296(1967)(Eng). A calcn. of the melting curve of He-3 below 0.04°K. is presented. The calcn. uses the sp. heat data of Abel, *et al.* (1966) and takes into account the spin exchange interaction in the solid as detd. from N.M.R. relaxation data. The calcn. uses: (*1*) the entropy of liquid He-3 at 27 atm. obtained from sp. heat data measured to 0.004°K. and extrapolated to $T = 0$°K., (*2*) the entropy of compression S_{liq} (melting curve)-S_{liq} (27 atm.) calcd. from thermal expansion data, and (*3*) the molar vols. for the liquid and the solid as a function of pressure corrected for thermal expansion. The self-consistent computer calcn. numerically integrated the Clausius-Clapeyron equation having taken into account the pressure variation of the

C.A. 1968-68-22

various thermodynamic quantities along the melting curve. The pressure was normalized to $P = 28.9$ atm. at $T = 0.32°K$. The exchange for the solid at the melting curve in the millidegree region is about $J/2\pi = 25$ MHz. This corresponds to a transition temp. $T_N = 0.0018°K$. The entropy was extrapolated to below 0.002°K., to the value of $S/R = 0.42$ at T_N. The inflection point of the melting curve is around 0.006°K. The max. of the melting curve is expected to occur around 0.0005°K. 12 references.

JDJN

He³

XI — 1357

1967

4 Е405. Кривая плавления He³. Thompson James R., Meyer Horst. The melting curve of helium-3. «Cryogenics», 1967, 7, № 5, 296 (англ.)

Путем численного интегрирования ур-ния Клапейрона—Клаузиуса рассчитана кривая плавления He^3 в области $T<0{,}04°$ K. Для расчета энтропии жидкой фазы использованы эксперим. данные Абеля и др. (РЖФиз, 1967, 1Е99) о теплоемкости и Андерсона и др. (РЖФиз, 1964, 2Е32) о тепловом расширении. Значения молярных объемов обеих фаз в зависимости от давления взяты из работы Миллса и др. (РЖФиз, 1961, 10Д28). Энтропия твердой фазы вычислена с помощью разложения Рашбрука и Вуда (РЖФиз, 1964, 5Е416) для

рф. 1968 · 4Е

объемноцентрированной решетки с антиферромагн. обменным взаимодействием, причем величина обменного интеграла определена по временам релаксации спина, найденным из ядерного магн. резонанса. Точка перегиба кривой согласно расчетам находится при $T = 0{,}006°$ K. Эксперим. наблюдение ее возможно и позволило бы уточнить значение обменного интеграла. Что касается максимума кривой плавления, то он получен при $T = 0{,}0005°$ K и слишком плоский, чтобы его можно было наблюдать.

А. Н. Козлов

^3He (C_p) XI 1395 1967

Sample H. H.,

Dissert. Abstrs., 1964, B27(9), 3250

The heat capacity of solid ^3He

(C_p)

Б

Ca1964

He 3

XV – 459

1967

11 E899. Теплоемкость ГПУ и ОЦК твердого гелия 3. Sample H. H., Swenson C. A. Heat capacity of hcp and bcc solid helium 3. «Phys. Rev.», 1967, 158, № 1, 188—199 (англ.)

Приведены эксперим. данные по теплоемкости ГПУ He^3 при 5 значениях. мол. объема (от 19,05 до11,42 *см*³) и ОЦК He^3 при 4 значениях мол. объема (от 20,11 до 23,80 *см*³). Полученные данные имеют одинаково высокую точность во всем диапазоне от области состояний, где справедлив закон T^3 ($T/\theta_0<0{,}03$) до линии плавления (не хуже 1% от θ_D). Благодаря этому могут быть определены ф-ции θ_0 (V) и θ (T) (или θ/θ_0 от T/θ_0). Сравнение с данными для He^4 дает $\theta_{03}/\theta_{04}=1{,}18$. Величина $\gamma_0=-d\ln\theta_0/d\ln V$ изменяется от 2,6 до 2,0 при уменьшении мол. объема для ГПУ He^3, для ОЦК He^3

(C_p)

Ф · 1967 · 11 Е

$\gamma_0=2{,}2$. Изменения формы приведенных кривых θ (T) для ГПУ-фазы может быть объяснено, если учесть изменение постоянной Грюнайзена γ с т-рой. Отношение γ/γ_0 в первом приближении не зависит от объема и возрастает до 1,07 при $T/\theta_0=0{,}12$. Форма приведенных кривых θ (T) при наименьших мол. объемах полностью идентична для ГПУ He^3 и ГПУ He^4. Эти данные согласуются с результатами для Ar и Kr при нулевом давлении и с теоретич. вычислениями Хортона и Линча. Данные для ОЦК He^3 хорошо описываются суммой члена дебаевского типа (с учетом θ_0 (V) и экспоненц. члена типа Шоттки (с учетом φ (V). В сравнении с данными для ГПУ He^3 данные для ОЦК He^3 не могут быть полностью объяснены с точки зрения динамики решетки. Библ. 44.

Резюме

^{3}He

XI – 459

1967

57787z Heat capacity of hexagonal close-packed (h.c.p.) and body-centered cubic (b.c.c.) solid helium. H. H. Sample and C. A. Swenson (Iowa State Univ., Ames). *Phys. Rev.* 158 (1), 188–99(1967)(Eng). Exptl. data are presented for the heat capacity of h.c.p. ^{3}He at 5 molar vols. (19.05 to 11.42 cm.^{3}) and for b.c.c. ^{3}He at 4 molar vols. (20.18 to 23.80 cm.^{3}). These data extend from the true T^3 region ($T/\Theta_0 < 0.03$) to the melting line in all cases with sufficient precision (at least 1% in Θ_D) so that the vol. dependence of both Θ_0 and the reduced Θ-*vs.*-T Θ/Θ_0-*vs.*-T/Θ_0) relation can be detd. When a comparison is made with other ^{4}He data, $\theta_{c3}/\theta_{04} = 1.18$. The quantity $\gamma_0 = -d\ln\Theta_0/d\ln V$ varies from 2.6 to 2.0 for the h.c.p. data with decreasing molar vol., while $\gamma_0 = 2.2$ for the b.c.c. phase. The changes in the shapes of the reduced Θ-*vs.*-T curves for the h.c.p.

C_p

C. A. 1967 · 67 · 12

phase can be understood in terms of a slightly temp.-dependent Grueneisen const. γ, the ratio γ/γ_0 being independent of vol. to a first approxn. and increasing to approx. 1.07 at $T/\Theta_0 = 0.12$. The shapes of these reduced Θ-*vs.*-T curves at the smallest molar vols. are almost identical for h.c.p. ^{3}He and for the 1 h.c.p. ^{4}He run, and agree with comparable previous data at relatively high temp. These shapes resemble closely the zero-pressure data for Ar and Kr and the theoretical calcns. of Horton and Leech (*CA* 60: 1128h). The b.c.c. ^{3}He data can be represented quite precisely as the sum of a Debye-like term [involving $\Theta_0(V)$] and an exponential Schottky-like term [involving a characteristic temp. $\phi(V)$]. When compared with the h.c.p. data, the b.c.c. data cannot be explained solely in terms of conventional lattice dynamics. RCPI

^{3}He (C_p) 11 XI 484 1967

Sverdlic A. M.,

Dissert. Abstr., 1967, B27(11), 4092

The specific heat and phase sepation curve of dilute solutions of liquid ^{3}He in ^{4}He.

5 (φ) √

CA, 1967, 67 34565W

^{3}He

конф.
Гренайзена

Vaidya S.N.,
Gopal E.S.R.

1967

Proc. Nucl. Phys. Solid State
Phys. Symp. 11th, Kanpur,
India, 1967,

Solid State Phys., 239-43

(См. H_2) I

^3He XI – 1390 1967

^4He

94559x **Heat capacity of dilute solutions of liquid ^3He in ^4He at low temperatures.** William Ronald Roach (Univ. of Illinois, Urbana). *Diss. Abstr. B* 27(11), 4090(1967)(Eng). *Univ. Microfilms* (Ann Arbor, Mich.), *Order No.* 67-6713, 104 pp.; cf. *CA* 67: 15550m. SNDC

C_p

C.A. 1967. 67. 20

He^3 XI-42 1968

117273m **Properties of helium-3 near the critical point.** W. Bendiner, D. Elwell, and H. Meyer (Duke Univ., Durham, N.C.). *Phys. Lett.*, *A* 26(9), 421-2(1968)(Eng). The crit. properties of ^3He and the indexes for the power laws were detd. from isobaric d. measurements above and below the crit. point: $T_c = 3.3094 \pm 0.001°K.$, $P_c = 861.8 \pm 0.5$ torr, $\rho_0 = 0.0413 \pm 0.0002$ g./cc., $\beta = 0.368 \pm 0.005$, $A = A' = 0.0348$ g./cc. $(°K.)^{-\beta}$, $\gamma = 1.20 \pm 0.04$, $B = 0.832(°K.)^{\gamma-1}$, $\delta_P = 3.7 \pm 0.2$ for $T < T_c$, 3.9 ± 0.2 for $T > T_c$. GXJN

C. A. 1968. 68. 26

³He

1968

Cp

79781q Ultrasonic studies of the physical properties of solidified gases. Bezuglyi, P. A. (USSR). *Sb. Nauch. Tr., Fiz.-Tekh. Inst. Nizk. Temp., Akad. Nauk Ukr. SSR* 1968, No. 2, 91–135 (Russ). A review with 75 refs. The phys. properties are discussed of solidified gases in crystals of noble gases (^3He, ^4He, Ar), H_2, D_2, N_2, O_2, CH_4, and NH_3. The calcd. and exptl. values agree for the molar heat capacity, Grueneisen coeff., and linear thermal expansion coeff. of CH_4 under the assumption of the existence of damped rotation of the mols. (libration) in crystals. Similar and other relationships and comparisons are presented for the other solidified gases and substances considered. S. A. Mersol

(+)

C.A. 1971. 74.16

He^3 (C_p, S, $H_T - H$, G) XII 1030/1968

Gibbons R. M., McKinley C.,

Advan. Cryog. Eng. 1967 (Pub. 1968), 13, 375-83

Preliminary thermodynamic properties of helium-3 between 1° and 100°K

5, 10 CA, 1968, 69, N18, 70798q

XI – 402 1968

He³

(Cp)

1 Е794. Теплоемкость и другие термодинамические свойства объемно-центрированного кубического He^3. Pandorf R. C., Edwards D. O. Specific heat and other thermodynamic properties of body—centered-cubic He^3. «Phys. Rev.», 1968, 169, № 1, 222—227 (англ.)

В калориметре с индиевым тепловым ключом измерена теплоемкость ОЦК-фазы твердого He^3 от 0,3° К до т-ры плавления. Из проведенных измерений получена кривая плавления и определены величины энтропии и $(dp/dT)_V$. Результаты находятся в хорошем согласии с данными других авторов. Вычислены также значения внутренней энергии при 0° К и в точке плавления при молярных объемах 24 и 20 *см³/моль* (способ вычисления приводится). Из изменений теплоемкости при плавлении определена сжимаемость, для которой получены значения от $4{,}8 \cdot 10^{-3}$ для $V=23{,}5$ *см³/моль* до $1{,}75 \cdot 10^{-3}$ $атм^{-1}$ при $V=19{,}7$ *см³/моль*. Библ. 29. А. К. Киконн

ФФ. 1969. 1 Е

^{3}He

Cp

C. A. 1968. 69.2

XI-1402

1968

57851t Specific heat and other thermodynamic properties of body-centered-cubic helium-3. Pandorf, R. C.; Edwards, D. O. (Ohio State Univ., Columbus, Ohio). *Phys. Rev.* 1968, 169(1), 222–7 (Eng). The heat capacity of body-centered-cubic ^{3}He was measured between about 0.4°K. and the melting curve. The results agree with the recent sp.-heat measurements of Sample and Swenson, and the 2 sets of data were used to calc. the entropy, the pressure coeff. $(\partial p/\partial T)_V$, and, in conjunction with melting-curve data, the internal energy at melting and at 0°H. The values of $(\partial p/\partial T)_V$ agree with direct measurements except in a small temp. interval close to the melting curve. The internal energy at 0°K., U_0/R, ranges from -1.05 °K. at 24.0 cm.^{3}/mole and $+1.93$°K. at 20.0 cm.^{3}/mole, and is about 4°K. below the theoretical values of Koehler and Horner and about 1.0°K. below those of Hansen and Levesque. Measurements of the discontinuous change in heat capacity on melting were used to obtain values for the compressibility of the solid which agree with those from other methods and which range from 4.8×10^{-3} atm.$^{-1}$ at $V = 23.5$ cm.^{3}/mole to 1.75×10^{-3} atm.$^{-1}$ at $V = 19.7$ cm.^{3}/mole. RCPJ

He^3 (T_m) " XI 469 1968.

Schribner R.A., Panczyk M.F., Adams E.D.

Phys. Rev. Lett, 1968, 21 (7), 427-9

Low-temperature helium-3 melting curve.

Б

CA, 1968, 69, n16, 61694a

^3He (C_p) XI 493 1968

Straty G.C., Adams E.D. 6

Phys. Rev., 1968, 169(1), 232-40

Compressibility, thermal expansion, and other properties of helium-3.

Б, Мх

 Ф, 1968, 6Ч, 42, 539 ом

^3He

^4He

плавление

54511k Low-temperature measurements of the helium-3 and helium-4 melting curves. Zeisse, Carl R. (Univ. of California, La Jolla, Calif.). *Phys. Rev.* 1968, 173(1), 301–6 (Eng). The melting curve of ^3He was measured to 12×10^{-3}°K. to see whether the exchange interaction has caused the solid entropy to fall below its completely disordered value of $R \ln 2$. For 12×10^{-3}°K $\leq T \leq 600 \times 10^{-3}$°K., the melting curve data are described by $P = 29.107 + 0.255\,37(t)^2 - 0.057\,00(t)^3 + 0.016\,25(t)^4$ atm, where $100t = T - 299.028$ and T is the abs. temperature in millidegrees. The data points fit this equation with a root-mean-sq. deviation of 0.06 atm. By using this information and previous results for the liquid and solid molar vols. and the liquid entropy, the Clausius-Clapeyron relation shows that $S_{solid} = R \ln 2 \pm 16\%$ for 12×10^{-3}°K. $\leq T \leq 320 \times 10^{-3}$K. This places an upper limit of 3×10^{-3}°K. on the magnitude of the exchange interaction in solid ^3He for molar vols. along the melting curve. The ^4He melting curve measured between 12×10^{-3}°K. and 300×10^{-3}°K. has a slope of 0 ± 0.007 atm./°K. RCPJ

1968

XI-568

C.A. 1968. 69. ~~16~~ 14

(+1)

He^3 (P_m) " XI 568 1968.

Zeisse C. R.,

Dissert. Abstr., 1968, B 28 (9), 3851

The melting ~~point~~ curve of helium-3.

Б φ CA 1968, 69, N6, 22240e

$^3He/^4He$ 1969

34011k Specific heat of liquid helium-3/helium-4 mixtures near the junction of the lambda and phase-separation curves. Alvesalo, T.; Berglund, P.; Islander, S.; Pickett, G. R.; Zimmermann, William, Jr. (Tech. Univ. Helsinki, Otaniemi, Finland). *Phys. Rev. Lett.* 1969, 22(24), 1281–3 (Eng). The sp. heat of liq. $^3He/^4He$ mixts. has been measured at satd. vapor pressure for 3 values of the ^3He mole fraction x near the junction of the lambda and phase-sepn. curves. The sp. heat at the lambda peak appears to be finite, continuous, and cusped. Both the lambda peak and the anomaly in the sp. heat as the system goes from the 2-liq.-phase region to the 1-liq.-phase region tend to disappear as the junction of phase boundaries is approached. RCZV

C_p

C. A. 1969 · 71 · 8

^3He - ^4He (p-p) 1969

P, ΔH_{mix}, ΔH_v

92285e Singularities of thermodynamic properties of helium-3-helium-4 solutions at helium I-helium II transition. Grigor'ev, V. N.; Esel'son, B. N.; Masimov, E. A.; Mikhailov, G. A.; Novikov, P. S. (Phys.-Tech. Inst. Low Temp., Kharkov, USSR). *Proc. Int. Conf. Low Temp. Phys., 11th* 1968 (Pub. 1969), 1, 371–4 (Eng). Edited by Allen, J. F. Organising Comm. of the Conf.: St. Andrews, Scot. Singularities in the concn. and temp. dependence of thermodynamic values of ^3He-^4He solns., such as satd. vapor pressure, distribution coeff., heat of mixing, heat of evapn. etc. obsd. at the λ-transition are discussed. S. K. Mukherjee

C.A. 1970. 73. 18

N-2055 1969

3 He

(Cp)

32151m Heat capacity of pure liquid helium-3. Mota, A. C.; Platzeck, R. P.; Rapp, R.; Wheatley, John C. (Centro At. Bariloche, Com. Nac. Energ. At., San Carlos de Bariloche, Argent.). *Phys. Rev.* 1969, 177(1), 266–71 (Eng). The heat capacity was detd. of pure ^{3}He at 0.24 atm. and 0.020–0.150°K. by a differencing method. The temp. scale T^* used is that valid for powd. Ce Mg nitrate in the form of a right circular cylinder with diam. equal to height. There is excellent agreement between the present and earlier measurements. Considering all low-pressure difference data, at 0.006–0.125°K. the ratio of heat capacity to magnetic temp. decreases linearly with increasing temp. The relation of the measurements to the temp. scale and to theories of spin fluctuations in ^{3}He is also discussed. RCPJ

C.A. 1969 . 70 . 8

He³

He⁴

ΔG

1969

43023t Thermodynamic interaction functions in quantum liquids helium-4 and helium-3. Rudakov, E. S. (Inst. Katal., Novosibirsk, USSR). *Teor. Eksp. Khim.* 1969, 5(2), 216–25 (Russ). The Helmholtz free energies of liq. ^{3}He and ^{4}He at 0°K. were found by using a calcd. correction factor: 10.98 and 14.26 cal./mole, resp. At the crit. point these values were found by integration of the virial equation with a correction factor: ^{3}He (3.33°K.) 6.64 and ^{4}He (5.20°K.) 7.87 cal./mole. The thermodynamics of the satd. vapor at 0°K. and the behavior of ^{4}He at the λ-point are discussed. J. L. Stiff

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C.A. 1969 · 71 · 10

He[3]

XI-468

1969

{59912p} **Melting curve and related thermodynamic properties of helium-3 below 1°K.** Scribner, R. A.; Panczyk, M. F.; Adams, E. D. (Phys. Dep., Univ. of Florida, Gainesville, Fla.). *J. Low Temp. Phys.* 1969, 1(4), 313–40 (Eng). Measurements of the melting curve of ^3He have been made at 16.6°mK–0.7°K. The liq. and solid molar vols. at the m.p. have been extended from 0.33°K to <0.03°K, and the molar vol. change on melting ΔV_m obtained. An increase in ΔV_m from 1.20 cm^3/mole at 0.33°K to 1.28 cm^3/mole at 0.06°K is found, with an extrapolation to 1.27 cm^3/mole at $T = 0$. Examn. of the thermodynamic consistency of the data indicates that the melting curve slopes are accurate, within exptl. error, down to 0.04°K. The demagnetization app. is described, with considerable attention devoted to thermometry, thermal equil. and exptl. techniques. Construction details of the high-sensitivity capacitive strain gage are given. RCMY

кривая плавления; термод. св-ва

C. A. 1970. 72. 12

3 He

1969

Cp

103858t Heat capacity of sub-monolayer helium-3 and helium-4. Stewart, Glenn Alexander (Univ. Washington, Seattle, Wash.). 1969, 140 pp. (Eng). Avail. Univ. Microfilms, Ann Arbor, Mich., Order No. 70-14,790. From *Diss. Abstr. Int. B* 1970, 31(2), 878. SNDC

+1

C.A. 1971. 74.20.

He^3

1969

кривая плавления; термод. св-ва

104636q Melting curve and related thermodynamic properties of helium-3 below 1°K. Scribner, Richard A. (Univ. of Florida, Gainesville, Fla.). 1968, 212 pp. (Eng). Avail. Univ. Microfilms, Ann Arbor, Mich., Order No. 69-10,962. From *Diss. Abstr. Int. B* 1969, 30(1), 351–2. SNDC

C.A. 1970.72.20

He³

1969

(Cp)

5 E804. **Аномальная теплоемкость ОЦК-He³.** Wette F. W. de, Werthamer N. R. Anomalous specific heat of bcc He³. «Phys. Rev.», 1969, 184, № 1, 209—214 (англ.)

Теоретически анализируются эксперим. данные о теплоемкости твердого He^3 с ОЦК-структурой. На основе полученной авторами ранее температурной зависимости приведенной дебаевской т-ры выделяется часть теплоемкости, вызванная фононными возбуждениями. Остальная, аномальная часть выражается ф-лой

$$c_x(T) = AR(\varphi/T)^2 \exp(-\varphi/T)\,[1-\exp(\varphi/T)]^{-2},$$

где A — константа, близкая к единице; R — газовая постоянная, φ — характеристич. т-ра, зависящая от мол. объема ($k\varphi$ — энергия возбуждения процесса, ответственного за аномальную теплоемкость). Библ. 16.

А. К. Кикоин

ЭФ. 1970. 5Б

³He

1969

⁴He

[Cp]

80729q Helium and ultralow temperatures. Wheatley, John C. (Univ. of California, Berkeley, Calif.). *Sciences (Paris)* 1969, No. 61, 4–11 (Fr). A discussion of the properties of ^{3}He and ^{4}He especially with reference to heat capacity-temp. relations. A method of using the properties of these 2 isotopes to provide temps. within 0.002°K of absolute zero is given. Diagrams and photographs of the equipment are included. S. Goldwasser

(+1) 1.

C. A. 1970. 73. 16

He^3 (P, S)

XI - 4021 1970

Dash J.G., Peierls R.E., Stewart G.A.,

Phys. Rev. A, 1970, 2, N3, 932-935

Б, Ю

есть ф.к

He 3

XV-707

1970

125751p Specific heat anomaly in solid helium-3. Guyer, Robert A. (Dep. of Phys. and Astron., Univ. of Massachusetts, Amherst, Mass.). *Phys. Rev. Lett.* 1970, 24(15), 810–11 (Eng). A careful look at the data on the sp. heat anomaly in bcc. solid ^3He reveals that it disagrees in temp. dependence and concn. dependence with the theory recently proposed by Varma.
RCZV

Cp

C. A. 1970 · 72 · 24

^4He, ^3He (термод. св-ва) " XI 1050 1970

Hansen J. P.,

J. Phys. (Paris) Colloq 1970, (3), C3-67-

-C3-78 (англ.)

Ground state of solid helium: theoretical aspects.

6 лит.

Б / Ф

CA 1971, 74 (20), 103078 o

^3He

1970

25496c Helium-3: its properties and applications in cryogenics. Peshkov, V. P. (Inst. Phys. Probl., Moscow, USSR). *Proc. Int. Cryog. Eng. Conf., 3rd* 1970, 70–82 (Eng). Iliffe Sci. Technol. Publ.: Guildford, Engl. A review with 80 refs.
W. J. Ristey

св-ва

С.Ж. 1971, 7Б4.

XI - 1155 1970

^3He, ^4He (Cp)

Steward G. A.,

Dissert. Abstr. Int. B., 1970, 31 (2), 878

Б

3 He

4 He

Cp

1970

113614d Heat capacities of submonolayer helium-3 and helium-4 adsorbed on argon-plated copper. Stewart, G. Alec; Dash, J. Gregory (Dep. of Phys., Univ. of Washington, Seattle, Wash.). *Phys. Rev. A* 1970, [3] 2(3), 918–32 (Eng). Extending the earlier study by Goodstein, McCormick, and Dash, the heat capacities (c) were measured of ^{3}He and ^{4}He films absorbed in Ar-plated Cu, at coverages x ranging from 0.1 to 0.8 monolayer at 0.5–4.2°K. The broad features of the results include the following: $C(T)$ for ^{4}He resembles the temp. dependence of 2-dimensional Debye solids, but with characteristic temps. Θ_D which decrease as T falls; Θ_D at high coverage agrees with the value 28°K obtained by Goodstein, *et al.*; Θ_D decreases at lower x, but is surprisingly large (16°K) at $x = 0.1$; ^{3}He heat capacities at high coverage are quite similar to ^{4}He films at the same d.; at intermediate and lower coverages, $C(x,T)$ of ^{3}He is significantly different from that of ^{4}He and displays a small peak or offset at $T \simeq 2$°K. The data are compared with several microscopic models: localized adsorption, 2-dimensional gases, noninteracting particles in a 2-dimensional tunneling band and 2-dimensional solids. Each is shown to be inadequate to account for the obsd. variations with T, x, and isotopic mass

C.A. 1970 73·22

(+1) !

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The data are then compared with the behavior of a 2-phase film and this agrees with the data on ^{4}He over a substantial range of $\bar{x}$, but it fails at low x. Surface inhomogeneity is invoked to resolve the paradox, and an ad hoc model (due to Peierls) is examd. of a substrate consisting of 2 distinct regions, on which the He is clustered into dense monolayer patches. The 2-patch model is quite successful for ^{4}He, yielding 2-dimensional characteristic temps. $\Theta_1 = 16°K$, $\Theta_2 = 28°K$ for the 2 species, the Θ_D values and the areas belonging to each fraction of the substrate being practically independent of T. Agreement with the 2-patch model implies that much of the substrate is substantially bare of adatoms, and hence that adatoms are strongly bound in the dense surface phases. The latent heat for 2-dimensional vaporization is estd. to be at least 15°. This value is about 8° greater than the heat of vaporization of bulk liq. ^{4}He, implying a large enhancement due to interactions with the substrate. A possible mechanism is proposed for the enhancement; namely, a local depression of the surface by the adatoms: a "mattress effect." The 2-patch model is successful in describing $C(T)$ for ^{3}He at high coverage, but $C(T)$ at low coverage and the x dependence over the entire range shows that ^{3}He is significantly different from ^{4}He; no explanation is given for the difference. RCPJ

^3He

XI – 266

1970

7557c Low temperature melting curve of helium-3. Johnson, Richard Torsten; Lounasmaa, Olli V.; Rosenbaum, Ralph L.; Symko, Orest G.; Wheatley, John C. (Dep. of Phys., Univ. of California, La Jolla, Calif.). *J. Low Temp. Phys.* 1970, 2 (3–4), 403–21 (Eng). Measurements of the melting curve of ^3He have been made at 0.003–0.040 °K, after cooling the liq.-solid ^3He mixt. by the adiabatic solidification method. The slope of the melting curve shows that at the lowest temp. there is a substantial departure of the solid ^3He entropy from R ln 2. This effect is due to nuclear spin ordering. Temps. < 0.003 °K were obtained during compression. By theoretically estg. the melting curve below 0.003 °K, it is possible to est. temps. from pressure measurements. By such means, it is estd. that Kelvin temps. of 0.0015–0.002 m°K were actually achieved. RCMY

Tm

C.A. 1970. 73. 2

He^3 (ш.)

XI — 2815

1971

38172q Metastable thermodynamic states near the critical point of helium-3. Dahl, David; Moldover, M. R. (Sch. Phys. Astron., Univ. Minnesota, Minneapolis, Minn.). *Phys. Rev. Lett.* 1971, 27(21), 1421–4 (Eng). The first measurements of the sp. heat of a metastable, superheated, pure liq. He^3 are reported. The sp. heat shows no evidence of any singularity near the onset of metastability. Also the lifetimes of metastable states are obsd. as the He^3 is cooled at const. d. For ds. near the crit. d., lifetimes decrease abruptly in an extremely narrow, reproducible temp. interval. This may indicate the onset of an "intrinsic" instability.

Cp

C. A. 1972. 76. 8

He^3—
—He^4
смесь

(C_{vx})

1972

7 Б792. **Исследование теплоемкости смесей He^3—He^4 вблизи их критической точки газ — жидкость.** Brown G. Raymond, Meyer Horst. Study of the specific heat of a He^3—He^4 mixture near its gas—liquid critical point. «Phys. Rev. A: Gen. Phys.», 1972, 6, № 4, 1578—1587 (англ.)

Измерена теплоемкость C_{vx} жидк. смесей He^3 и He^4 с конц-ней He^3 $X=0,80$ вблизи крит. точки газ — жидкость. Получено 9 изохор для смесей с плотностью $0,52<\rho/\rho_c<1,20$ в т-рной области $-0,1\leqslant t\leqslant 0,1$, где $t=(T-T_c)/T_c$, а ρ_c и T_c плотность и т-ра крит. смеси. Т-ра измерялась термометром сопротивления, откалиброванным по давл. паров He^4 в области т-р 3,4—4,0° К. Точность т-рной шкалы 0,5° мК. Построены фазовые диаграммы смесей He^3—He^4 в плоскостях ρ—P и P—T для данного X. Максим. величина т-ры перехода, определенная по излому на кривой зависимости ρC_v от T, в т-рном интервале 3,62—3,73° К приходится на изо-

X. 1973. № 7

хоры смесей с плотностью меньшей, чем критическая. Изменение C_{vx} вдоль крит. изохоры для смесей аналогично изменению C_{vx} чистого He^3 в области $10^{-4} \leqslant t \leqslant 10^{-2}$. В однофазной области кривые зависимости ρC_{vx} от ρ/ρ_c дают максимум в области $\rho/\rho_c = 1{,}0$ при т-рах 3,725° К ($X = 0{,}805$) и 3,318° К ($X = 1{,}00$) и плавно поднимаются с увеличением ρ/ρ_c от 0,5 до 1,2 при т-рах 3,900° К ($X = 0{,}805$) и 3,500° К ($X = 1{,}00$). В двухфазной области зависимость ρC_{vx} от ρ/ρ_c практически прямолинейна. Время установления термич. равновесия в двухфазной области в смесях значительно больше, чем в чистом He^3. Термодиффузия в двухфазной области имеет максимум при плотности на ~20% меньшей, чем ρ_c.

Б. Г. Пожарский

He^3-He^4 1972

3 Е156. **Измерение теплоемкости смеси He^3—He^4 вблизи критической точки газ — жидкость.** Brown G. Raymond, Meyer Horst. Study of the specific heat of a He^3—He^4 mixture near its gas-liquid critical point. «Phys. Rev. A: Gen. Phys.», 1972, 6, № 4, 1578—1587 (англ.)

(C_p)

В калориметре высотой 0,5 мм измерена теплоемкость $C_{v,x}$ смеси He^3—He^4 с конц-ией He^3, равной 80%, на 9 изохорах, лежащих в интервале $0{,}52 < \rho/\rho_c < 1{,}20$, в области т-р $-0{,}1 \leqslant (T-T_c)/T_c \leqslant 0{,}1$. Оказалось, что для данного ρ/ρ_c теплоемкость смеси ведет себя подобно чистому He^3, в частности на критич. изохоре в интервале $10^{-2} \leqslant (T-T_c)/T_k \leqslant 10^{-4}$ $C_{v,x}$ слабо расходится

ф. 1973 N3

с критич. индексом $\alpha \sim 0{,}1$. Возможно, что не достигнута та близость к критич. т-ре, где теплоемкость должна стать конечной величиной. Времена установления теплового равновесия малы (<5 мин) в однофазной области и велики (до 3—4 час.) — в двухфазной, причем в данном эксперименте $C_{v,x}$ в двухфазной области измерено на не вполне равновесной системе. Максимум времен установления равновесия наблюдается при плотности, на 20% меньше критической. М. Г.

^{3}He

XI – 3173

1972

(ΔH_{tr})

52973d **Measurement of the heat of transition of helium-3 from one liquid phase of the helium-3-helium-4 solution to another.** Gladun, A.; Peshkov, V. P. (Inst. Fiz. Probl., Moscow, USSR). *Zh. Eksp. Teor. Fiz.* 1972, 62(5), 1853–7 (Russ). The heat of transition q of He^3 from a He^3-rich to a He^4-rich phase mixt. was measured at 0.02–0.70°K. At T <0.050°K, $q = (80 \pm 3)T^2$ J/mole. At $T = 0.54$°K, $q =$ 4.5 J/mole and is max. The heat of transition data are in good agreement with the sp. heat values available for He^3, He^4, and He^3–He^4 solns., and with the shape of the soln. stratification curve. A. G. Streng

C.A. 1972, 77, 8

^3He

XI – 2830

1972

77358z Specific heat of solid helium-3. Guyer, R. A. (Inst. Festkoerperforsch., Kernforschungsanlage, Juelich, Ger.). *J. Low Temp. Phys.* 1972, 6(3–4), 251–6 (Eng). A brief review is given of the exptl. evidence for anomalous behavior of the sp. heat in bcc. ^3He. 9 refs. W. J. James

C_p

C.A. 1972 · 76 · 14

^3He, ^4He (C_p) XI 3058 1972

Hickernell D.C., McLean E.O., Vilches O.E.

Phys. Rev. Lett., 1972, 28, N13, 789-92 (англ.)

Very low-temperature specific heat of submonolayer helium films.

6 (Р)

CA, 1972, 76, N22, 132366c

^{3}He

1972.

Ttz

170537n Neel temperature of bcc. helium-3. Zane, L. I. (Dep. Phys., Colorado State Univ., Fort Collins, Colo.). *Phys. Lett A* 1972, 41(5), 421-2 (Eng). The Neel temp. (0.0025–0.0029°K) for the antiferromagnetic ordering of solid bcc. ^{3}He near the melting curve was calcd. by using the 2-particle cluster approxn. of B. Strieb, et al. (1963), with inclusion of the effect of triple exchange (Z., 1972).

C. A. 1972. 77. N 26

^{3}He XI-3493 1972

63167r Role of paramagnons in the anomalous specific heat of Fermi liquids. Van der Merwe, P. du T. (At. Energy Board, Pretoria, S. Afr.). *Lett. Nuovo Cimento Soc. Ital. Fis.* **1972**, [2]5(15), 1016–18 (Eng). The deviations of the sp. heat (C_v) from the linear temp. (T) dependence of a Fermi liq., obsd. for ^{3}He, are a consequence of the singular behavior of the fermion self-energy due to the emission and reabsorption of soft bosons. The strength of the singularity that dets. the crit. behavior is detd. by the quasiparticle–boson vertex at small wavenos. and by the excitation energies of the collective excitations. The predominant role of the persistent spin fluctuations (paramagnons) in the anomalous C_v originates from their low excitation energies. Thus, the intrinsic temp. properties of paramagnons, as reflected by the excitation energies, are a detg. factor in the anomalous C_v. Equations were derived for the enhancement of the intrinsic temp. properties of paramagnons and for the paramagnon contribution to the free energy in a nearly ferromagnetic liq. Due to the intrinsic temp. dependence of the collective states, the decrease in C_v/T is less rapid in nearly ferromagnetic systems than in paramagnetic systems.

(C_v)

C. A. 1973. 78. N 10

^3He XI-3388 1972

169505u Jump in the specific heat of liquid helium-3 at 2.65 × 10^{-3}°K. Vvedenskii, V. L. (Inst. Fiz. Probl., Moscow, USSR). *Pis'ma Zh. Eksp. Teor. Fiz.* 1972, 16(6), 358–60 (Russ). The conclusion [D. D. Osheroff, R. C. Richardson, and D. M. Lee, 1972] that the jump in the pressure–time curve for cooling ^3He is due to the appearance of a new solid phase is questioned. A similar jump in the temp.–time curve corresponds to the jump in the heat capacity of the liq. is masked by the short relaxation time (0.3 sec at 0.003°K).

(C_p)

C. A. 1972. 77 N26

^{3}He–^{4}He

XI–3617

1972

(p)

164204f **Vapor pressure of helium-3-helium-4 mixtures in the 0.7–1.3°K range.** Vvedenskii, V. L.; Peshkov, V. P. (Inst. Fiz. Probl., Moscow, USSR). *Zh. Eksp. Teor. Fiz.* 1972, 63(4), 1363–70 (Russ). The vapor pressure of the ^{3}He-^{4}He mixts. was measured at 0.7 to 1.3°K. Investigated were the mixts. contg. up to 5% of ^{3}He in the liq. phase and the mixts. with full range of ^{3}He concns. in the gaseous phase. The app. used and method of investigation are described. The dependence of the Henry's law const. on temp. is $4.75\ (1/T - 0.17)$. Numerical data showing the dependence of the vapor pressure on temp. and gas phase concns. are presented. A. G. Streng

C. A. 1973, 78 N 26

^3He (тв)

XI-3502

1973

23714f **Possible Neel temperature of solid helium-3.** Adams, E. D.; Nosanow, L. H. (Phys. Dep., Univ. Florida, Gainesville, Fla.). *J. Low Temp. Phys.* 1973, 11(1-2), 11-14 (Eng). A calcn. of the effect of the conjectured 3-body exchange on the possible Neel temp. of solid ^3He is made. A value of 2.24×10^{-3}°K is obtained from $P_v(T)$ data, whereas susceptibility data indicate 2.9×10^{-3}°K. These calcns. indicate that 3-body exchange may lead to the occurrence of the transition above 2.0×10^{-3}°K, the previously expected value.

(T_{tr})

C.A. 1973. 79 N 4

^3He

XI – 3405

1973

(T_{t2})

76017s Properties of a possible superfluid state of helium-3. Anderson, P. W.; Varma, C. M. (Bell Lab., Murray Hill, N.J.). *Nature (London)* 1973, 241(5386), 187–9 (Eng). The exptl. obsd. (D. D. Osherhoff, et al., 1972) anomalies at ~0.003 and ~0.002°K, resp., in the pressure vs. temp. relation and the NMR line of ^3He along the melting curve are interpreted as the possible occurrence of an anisotropic superfluid condensation of liq. ^3He (e.g., A. and P. Morel, 1961). The anomaly at ~0.003°K can be interpreted in terms of a 2nd-order phase transition in the liq., and the anomaly at ~0.002°K as a 1st-order transition.

C. A. 1973. 78, N 12

1973

^{3}He (ж)

XI - 3506

(Cp)

141091c **Heat capacity of liquid helium-3 along the melting curve between 0.0018 and 0.0042°K.** Anufriev, Yu. D.; Alvesalo, T. A.; Collan, H. K.; Opheim, N. T.; Wennerstrom, P. (Dep. Tech. Phys., Helsinki Univ. Technology, Otaniemi, Finland). *Phys. Lett. A* 1973, 43(2), 175–6 (Eng). Measurements of the heat capacity of ^{3}He by using adiabatic compressional cooling revealed a 2nd-order phase transition at 0.0026°K, which might be a superfluid transition with Bardeem-Cooper-Schrieffer-type pairing.

C.A. 1973, 78, N 22

^{3}He

XI - 3527

1973

(Cp)

10552b Low-temperature specific-heat anomaly of bcc. helium-3. Castles, S. H.; Adams, E. D. (Phys. Dep., Univ. Florida, Gainesville, Fla.). *Phys. Rev. Lett.* **1973**, 30(22), 1125–8 (Eng). The sp. heat of bcc. ^{3}He was measured from T = 25 m°K to near the melting curve, with particular attention given to the region of the low-temp. anomaly, $T \lesssim 500$ m°K. The sp. heat has a term linear in T, in addn. to the Debye T^3 term. From the sp. heat at the lowest temps., for the larger-molar-volume samples, values of the exchange energy J are calcd. in agreement with previous results.

Ж-5-907

C. A. 1973. 79 N2

^3He XI-3527 1973

11 Е958. **Низкотемпературная аномалия теплоемкости в ОЦК He^3.** Castles S. H., Adams E. D. Low-temperature specific-heat anomal of bcc ^3He. «Phys. Rev. Lett.», 1973, 30, № 22, 1125—1128 (англ.)

Измерена теплоемкость ОЦК He^3 в интервале т-р от $25 \cdot 10^{-3}$° К до кривой плавления. Установлено значительное отклонение температурной зависимости теплоемкости твердого ^3He от кубич. закона. В случае интерпретации данных на основе ф-лы Дебая дебаевская т-ра θ как ф-ция т-ры T имеет максимум при $T \approx 0{,}02\ \theta_{макс}$. Показано, что теплоемкость ОЦК ^3He может быть описана суммой кубического и линейного по т-ре членов. Для сравнения выполнены измерения теплоемкости ГПУ ^4He, где упомянутого отклонения от кубич. закона не обнаружено. Обсуждаются возможные причины низкотемпературной аномалии твердого ^3He.

П. С. Кондратенко

Ср

*5-907

Ф. 1973 N 11

^3He

1973

83700h **Measurement of P-V-T relations and critical indexes of helium-3.** Chase, C. E.; Zimmerman, George O. (Francis Bitter Natl. Magnet Lab., Massachusetts Inst. Technol., Cambridge, Mass.). *J. Low Temp. Phys.* **1973**, 11(5-6), 551-79 (Eng). By measuring the capacitance of a parallel-plate capacitor filled with ^3He as a function of temp. and pressure, the dielec. constant of ^3He was detd. along 28 isotherms between 3.00 and 3.45°K at pressures $\leq 10^3$ Torr, and along the coexistence curve between 3.20°K and the crit. temp. for both satd. liq. and vapor. The d. along these same trajectories can then be calcd. assuming the Clausius-Mossotti relation holds. The critical temperature T_c, pressure P_c, and d. ρ_c, as well as the crit. indices β, γ, γ', and δ, were evaluated.

T_{cr}; P_{cr}; V_{cr};

C. A. 1973, 79 N 14

$^3He-^4He$ (mix)

XI – 3683

1973

46365g Vapor pressure of helium-3–helium-4 mixtures near the tricritical point. Goellner, Gregory J. (Duke Univ., Durham, N.C.). 1973, 184 pp. (Eng). Avail. Univ. Microfilms, Ann Arbor, Mich., Order No. 73-11,623. From *Diss. Abstr. Int. B* 1973, 33(11), 5433–4.

(p)

C.A. 1973. 79 N 8

$^3He - ^4He$ XIS-2797 XI-3990/1973

64070g Thermodynamic properties of liquid helium-3-helium-4 mixtures near the tricritical point. I. Vapor pressure measurements and their thermodynamic analysis. Goellner, G.; Behringer, R.; Meyer, H. (Duke Univ., Durham, N.C.). *J. Low Temp. Phys.* 1973, 13(1-2), 113-47 (Eng).- Sensitive vapor-pressure (P_{sat}) measurements of $^3He-^4He$ mixts. by a low-temp. strain gauge are described at 0.5-1.5°K and $0.4 < X < 0.85$, where X is the ^3He mole fraction in the liq. phase. The vapor-pressure cell is flat, with a height of only 2 mm, to reduce concn. gradients near the tricrit. point. The pressure-sensitive device, which resolves changes of $\sim 5 \times 10^{-6}$ atm, is described, and its advantages over a conventional manometer system are discussed. Data taken successively on mixts. of small mole fraction difference are used to locate the phase-sepn. boundary in the $T-X$ plane and also the λ-line from a change in $(\partial P_{sat}/\partial T)_x$

(P, термод. св-ва)

С. А. 1974. 80. N 12

at these transitions. The limiting slopes $(dT/dX)_e$ and $(dT/dX)_\lambda$ of the phase-sepn. curve and the λ-line in the vicinity of their intersection, the tricrit. point, are presented and compared with previous work. From the vapor-pressure data, the concn. susceptibility $(\partial X/\partial\Delta)_{T,P}$ was obtained. Here $\Delta = \mu_3 - \mu_4$ is the chem. potential difference of the respective isotopic components ^3He and ^4He. $(\partial X/\partial\Delta)_T$ diverges as the tricrit. point is approached along various paths in the T–X plane, and the relevant tricrit. exponents are given. The slight divergence of $(\partial X/\partial\Delta)_T$ along the λ-line predicted from the postulates of Griffiths and Wheeler could not be detected, and such divergence must occur in a temp. interval that is far too small to be resolved with present-day techniques. Further, gravity effects might well prevent observation of the slight divergence. The λ-transition is a distinct shoulder in a plot of $((\partial X/\partial\Delta)_T$ at const. X as a function of T. This shoulder becomes smaller and is gradually masked by a peak as X decreases from the tricrit. mole fraction X_t. From a combination of vapor-pressure and calorimetric data, the chem. potential difference $[\Delta(X,T) - \Delta_t]$ is calcd. between 0.78 and 1.22°K. Here Δ_t is the value at the tricrit. point. The crit. line and its slope $(d\Delta/dT)_\lambda$ are obtained and compared with previous values based on calorimetric expts. alone, and with calcns. based on the excess chem. potentials μ_3^E and μ_4^E derived from satd. vapor-pressure data.

^3He XI-3488 1973

89282z **Measurements along the melting curve of helium-3 at millikelvin temperatures.** Johnson, R. T.; Paulson, D. N.; Pierce, C. B.; Wheatley, J. C. (Dep. Phys., Univ. California, La Jolla, Calif.). *Phys. Rev. Lett.* **1973**, 30(6), 207–10 (Eng). The melting curve of pure He^3 was measured in the region of the "*A*" and "*B*" phenomena [D. D. Osheroff et al. (1972)]. Within a 2% precision there is no effect of the "*A*" phenomenon on the slope of the equil. melting curve. This indicates that "*A*" is not related to the properties of solid He^3. Also, a new effect is described on thermal relaxation of a powdered Ce Mg nitrate thermometer immersed in He^3.

T_m

C. A. 1973. 78 N 14

30418.1252 Ph,TE,MGU	^3He 42531	29-218

Lawson D.T., Gully W.J., Goldstein S., Richardson R.C., Lee D.M. Attenuation of zero sound and the low-temperature transitions in liquid ^3He.
"Phys. Rev. Lett.", 1973, 30, N 12, 541-544 (англ.) 0855 ПИК

840 844 0848 ВИНИТИ

^3He

XI-4083

1973

(Tcrit).

112805z. Superfluidity in liquid helium-3. Condensation in the L = 2 or L = 3 state. Oestgaard, E. (Norway). *Ark. Fys. Semin. Trondheim* 1973, No. 14, 1–15 (Eng). The possibility of superfluidity in liq. ^3He was investigated, and the corresponding crit. temp. was calcd. or estd. In the calcns. were used reaction-matrix elements calcd. by means of the Brueckner theory. There is no superfluidity corresponding to *S*-state or *P*-state pairing in liq. ^3He. There is probably superfluidity corresponding to *D*-state or *F*-state pairing. The largest transition temp. was obtained for $L = 3$, i.e., anisotropic superfluidity corresponding to the triplet *F*-state is more likely than the singlet *D*-state pairing. The estd. crit. temps. for $L = 3$ are ~0.0026–0.0176°K, whereas expt. indicates a value of 0.0026°K. For $L = 2$, the estd. crit. temps. are ~0.0004–0.0022°K.

C.A. 1974. 80. N20

^3He XI-3487 1973

63164n Specific heat of a normal Fermi liquid. I. Landau-theory approach. Pethick, C. J.; Carneiro, G. M. (Dep. Phys., Univ. Illinois, Urbana, Ill.). *Phys. Rev. A* 1973, 7(1), 304–18 (Eng). The contribution of small-momentum-transfer processes to the $T^3 \ln T$ term in the sp. heat of a normal Fermi liq. is considered using Landau theory, and is evaluated exactly in terms of Landau parameters. This contribution is due to a term in the quasiparticle interaction. The phys. process responsible for this behavior is the repeated scattering of quasiparticle-quasihole pairs. The results for the 2-body problem are applied to a quasiparticle-quasihole pair. The results are applied to the liquid ^3He at low pressure.

(C_p)

C. A. 1973, 78, N 10

^{3}He

XI – 3499

1973

89352x Observation of a second-order phase transition and its associated P-T* phase diagram in liquid helium-3. Webb, R. A.; Greytak, T. J.; Johnson, R. T.; Wheatley, J. C. (Dep. Phys., Univ. California, La Jolla, Calif.). *Phys. Rev. Lett.* 1973, 30(6), 210–13 (Eng). A sp. heat "discontinuity" is obsd. in liq. ^{3}He from 241 lb/inch^2 to the melting pressure at 2–3 m°K.

(C_p)

C. A. 1973. 78 N 14

^{3}He (C_p). XI 4318 1973.

Winter J.M.,

J. Phys. (Paris), Colloq., 1973, (10), 53-7.

Phase changes in liquid helium-3 at very low temperature.

Б

C.A. 1974. 81 N16. 96499z.

5

^3He XI – 4238 1974

(T_{tr})

68832a **Semiphenomenological theory of superfluid liquid helium-3.** Amritkar, R. E.; Kumar, N. (Dep. Phys., Indian Inst. Sci., Bangalore, India). *Curr. Sci.* 1974, 43(12), 366-7 (Eng). The 1st order and 2nd order transitions in liq. ^3He [14762-55-1] at <3 m°K are interpreted semiquant. in terms of an effective spin Hamiltonian incorporating an intrapair and an interpair spin dependent interactions. The results are in agreement with the exptl. data.

C.A 1974 81 N 12

^3He

XI – 4045

1974

(p)

124968t **Thermomolecular corrections to vapor pressure measurements of helium-3.** Bernat, T. P.; Cohen, H. D. (Dep. Phys. Astron., Louisiana State Univ., Baton Rouge, La.). *J. Low Temp. Phys.* 1974, 14(5–6), 597–605 (Eng). Accurate measurements were made of the thermomol. correction to ^3He vapor pressures in long, stainless steel tubes, by using an abs. method (B. and C., 1973). The results are consistent with the Weber–Schmidt equation (1936), and indicate that this equation is more generally valid than those suggested by G.T. McConville, et al., (1966–7) and R.A. Watkins, et al., (1967). This result is discussed in terms of the phenomenol. gas-wall interactions. The 2-tube differential pressure method suggested by W., et al., lacks sufficient reliability for high-precision ^3He vapor-pressure thermometry at the lowest temperatures.

C.A. 1974. 80. N 22

^3He XI-5259 1974

(Cp)

130036v Specific heat of solid helium-3. Castles, S. H.; Kirk, W. P.; Adams, E. D. (Phys. Dep., Univ. Florida, Gainesville, Fla.). *Low Temp. Phys.-LT 13, Proc. Int. Conf. Low Temp. Phys., 13th* 1972 (Pub. 1974). 2, 43-7 (Eng). Edited by Timmerhaus, Klaus D; O'Sullivan, William John; Hammel, E. F. Plenum: New York, N. Y. The sp. heat of bcc. ^3He [14762-55-1] was studied from 25 m°K to near the melting

C. A. 1975. 82. N20

curve. There are 2 regions of interest. At the lowest temps. the major contribution to the sp. heat is due to the onset of nuclear spin ordering and the exchange energy J can be obtained. At higher temps. the interest is in the behavior of the lattice sp. heat, which can be characterized by the Debye temp. θ_D. The low temp. θ_D anomaly cannot be resolved by present theories.

XI-5259 1974

^3He

9 Е302. **Теплоемкость твердого ^{3}He.** Castles S. H., Kirk W. P., Adams E. D. Specific heat of solid ^{3}He. «Low Temp. Phys.—LT 13. Vol. 2.» New York—London, 1974, 43—47 (англ.)

С помощью импульсного метода проведено измерение теплоемкости твердого ^{3}He от $25 \cdot 10^{-3}$° K до точки пл. Теплоемкость описывается выражением $C_p = aT^{-2} + bT + cT^3$, причем, первый член, связанный с упорядочением ядерных спинов, наблюдался ниже $200 \cdot 10^{-3}$° K лишь для образца с молярным объемом 24,13 см^3/моль, для которого теплоемкость имеет минимум вблизи $100 \cdot 10^{-3}$° K. Для образца с молекулярным объемом 21,67 см^3/моль теплоемкость монотонно растет. Т-ра Дебая θ растет при уменьшении молекулярного объема, а ее температурная зависимость θ характеризуется пологим максимумом.

В. Е. Зиновьев

(Ф)

Ф. 1975. N9

^3He XI–4430 1974.

(Tm)

103321c Melting curve of helium-3 between 2.6 and 10°mK. Collan, H. K. (Low Temp. Lab., Helsinki Univ. Technol., Otaniemi, Finland). *Phys. Lett. A* 1974, 50A(4), 305–6 (Eng). The melting curve of ^3He was detd. at 2.6–10 m°K with the viscosity of liq. ^3He as the thermometric parameter. The A-transition occurs at 2.57 m°K and the melting curve slope is −39 bar/°K at $T = T_A$. The ratio J_{nnn}/J_{nn} is > 0 where J_{nnn} and J_{nn} are next nearest and nearest neighbor interactions, resp.

C.A. 1975 – 82 № 16

$^3He_{(TE)}$ (C_p). XI 4262 1974.

Dundon J.M., Goodkind J.M.,
Phys. Rev. Lett., 1974, 32 (24),
1343-6.

Specific heat of solid helium-
-3 below 25 mk.

Б

C.A. 1974. 81 N 12. 69356 k.

$He^3 + He^4$ 1974

21 Б737. Теплоемкость смесей He^3+He^4 в стекле Викор. Eggington M. A., Moore M. A. Specific heat of $^3He-^4He$ mixtures in vycor glass. «J. Low Temp. Phys.», 1974, 15, № 1—2, 99—110 (англ.)

Рассчитана теплоемкость смеси He^3+He^4, заполняющей узкие капиллярные поры в интервале т-р 0,5—1,0° К. В расчетах учтены силы Ван-дер-Ваальса, действующие на атомы He^3 и He^4 со стороны стенок измерительного сосуда, выполненного из стекла Викор. Полученные значения сравнимы с измерениями теплоемкости в сосудах из стекла Викор, полученными для больших объемов жидкости. При рассмотрении Ван-дер-Ваальсовских сил взаимодействия смеси со стенкой учитывалось, что при взаимодействии атомов He^3 преобладают силы отталкивания, однако получение точной поправки затруднено из-за отсутствия сведений о распределении He^3 вдоль длины поры. А. В. Салов

(C_p)

ж. 1974. №21

^3He 1974

(Cp)

130037w Thermodynamic functions for helium-4 submonolayers. Elgin, R. L.; Goodstein, D. L. (California Inst. Technol., Pasadena, Calif.). *Low Temp. Phys.-LT 13, Proc. Int. Conf. Low Temp. Phys., 13th* 1972 (Pub. 1974). 2, 175-9 (Eng). Edited by Timmerhaus, Klaus D; O'Sullivan, William John; Hammel, E. F. Plenum: New York, N. Y. The thermodn. functions were calcd. for ^4He [7440-59-7] submonolayers on *Grafoil* [7782-42-5] by measuring concurrently pressure isotherms, heat capacity isosters, and heats of adsorption. The app. used was similar to that used by H. A. Kierstead (1971) to measure pressures near the crit. point. The isosteric heat of adsorption was derived from pressure isotherms near 12.4°K. The heat capacity was measured at 5-14°K and 0.01 to 1.5 layers. The entropy isotherms for bulk ^4He and areal entropy for adsorbed ^4He are given.

C.A. 1975. 82. N20

^3He

1974

давление плавл.

1 Е445. **Давление плавления ^3He при очень низких температурах.** Goldstein Louis. The melting pressure of helium-3 at very low temperatures. «J. Low Temp. Phys.», 1974, 15, № 5—6, 583—599 (англ.)

Очень подробно обсуждаются термодинамич. аспекты задачи о вычислении давления плавления ^3He при сверхнизких т-рах. Рассмотрены: область, где твердый ^3He является парамагнетиком; вопросы, связанные со спиновым упорядочением; плавление спин-упорядоченной фазы. Эффективное обменное взаимодействие между атомами ^3He считается изотропным. Результаты термодинамич. анализа сравниваются с эксперим. данными. Рассмотренные вопросы важны для установления термодинамич. шкалы т-р. Библ. 25. Ю. М. Б.

ф. 1975. №1

^{3}He (тв) отпечатан 2287 1974

(Cp)

ф. 1974 N 12

12 Е905. **Теплоемкость твердого ^{3}He ниже $25 \cdot 10^{-3}$ °К.** Dundon Jeffrey M., Goodkind John M. Specific heat of solid ^{3}He below 25 mK. «Phys. Rev. Lett.», 1974, 32, № 24, 1343—1346 (англ.)

Импульсным методом измерена теплоемкость твердого ^{3}He в области теоретич. предсказываемого перехода в упорядоченное состояние в интервале т-р $(1—25) \cdot 10^{-3}$ °К. Обнаружено, что переход к упорядоченному состоянию происходит в области т-р $\sim 10^{-3}$ °К. Низкое значение т-ры перехода ^{3}He в антиферромагн. состояние подтверждается термодинамич. расчетами и может быть объяснено обменным взаимодействием соседей, следующих за ближайшими. Предполагается, что при т-ре ниже $4 \cdot 10^{-3}$ °К в ^{3}He возможны переходы и другой природы.

Б. Д. Корешков

^3He (36) оптика 2287 1974

(Cp)

69356k Specific heat of solid helium-3 below 25 mK. Dundon, Jeffrey M.; Goodkind, John M. (Dep. Phys., Univ. California, La Jolla, Calif.). *Phys. Rev. Lett.* 1974, 32(24), 1343–6 (Eng). The sp. heat of solid ^3He was measured at 0.001–0.025°K. The results indicate that the ordering of the nuclear spins takes place at a lower temp. than was anticipated theor., and with an unexpected temp. dependence.

CA 1974 81 N12

1974

^3He

(Ttr)

96502m **Superfluidity and phase transitions in liquid helium-3.** Khalatnikov, I. M.; Fomin, I. A. (Inst. Teor. Fiz. im. Landau, Moscow, USSR). *Priroda (Moscow)* 1974, (6), 15–21 (Russ). A review on superfluidity, phase transition, and magnetic properties of liq. He-3 without refs.

C.A.-1974. 81. N 16

^3He

XI-4133

1974

(ΔH)

74956q Enthalpy-pressure (H-p) diagram of helium-3 in the range 1.0° K ≤ T ≤ 4.17°K and 0 ≤ p ≤ 6.5 atm and inversion curve for T ≤ 4.17°K. Kraus, J.; Uhlig, E.; Wiedemann, W. (Leybold-Heraeus G.m.b.H., Cologne, Ger.). *Cryogenics* 1974, 14(1), 29-35 (Eng). The enthalpy of ^3He was detd. as a function of pressure between 1 and 4.17°K. The inversion curve for ^3He at $T \leq 4.17$°K, detd. from the enthalpy-pressure diagram, is in agreement with the data above 4°K. Applications of the results to a ^3He refrigerator working on the Joule-Thompson principle are given.

C.A.1974.80.N14

^3He, ^4He (тв) 1974

(T_{tr}; p).

100350j Solid helium. Ground-state energy, pressure, and phase transition at high densities. Ostgaard, E. (Fys. Inst., Univ. Trondheim, Trondheim, Norway). *Phys. Lett. A* 1974, 46(6), 417-19 (Eng). The ground-state energy and the pressure of solid ^3He and ^4He are calcd. by using a modified Brueckner theory. The possibility of a phase transition into a metallic state at very high ds. is considered. A phase transition occurs at a pressure of approx. 2×10^7 atm.

(+1) ☒

C.A. 1974. 80. N18

He-3

1974

Cp

(t) 137940q Heat capacity problem in solid helium-3. Kreisman, Peter J. (Univ. Minnesota, Minneapolis, Minn.). 1974. 120 pp. (Eng). Avail. Xerox Univ. Microfilms, Ann Arbor, Mich., Order No. 75-12,101. From *Diss. Abstr. Int. B* 1975, 35(12, Pt. 1), 6041.

C. A. 1975. 83 N16

^3He 1974

XI − 4350

(C_p)

95507s **Low-temperature phases of liquid helium-3.** Richardson, R. C.; Lee, D. M. (Lab. At. Solid State Phys., Cornell Univ., Ithaca, N. Y.). *Collect. Prop. Phys. Syst., Proc. Nobel Symp., 24th* 1973 (Pub. 1974), 84-90 (Eng). Edited by Lundqvist, Bengt. Nobel Found.: Stockholm, Swed. A review with 21 refs. is given on NMR-shift, heat-capacity, viscosity, magnetization, and sound-attenuation expts. on liq. ^3He at very low temps.

C.A. 1974. 81. N/6

1974

^3He

(C_p)

96499r Phase changes in liquid helium-3 at very low temperature. Winter, J. M. (Serv. Phys. Solide Resonance Magn., C.E.N. Saclay, Gif-sur-Yvette, Fr.). *J. Phys. (Paris), Colloq.* 1973, (10), 53-7 (Fr). The topics reviewed with 21 refs. include: properties of liq. and solid ^3He [14762-55-1] at 0.01-0.1°K, cryogenic techniques, exptl. results (sp. heat, viscosity, NMR), and theor. interpretations. F. R. Morral

C.A. 1974. 81. N16

³He

⁴He

1975

4 E257. Аномальная теплоемкость твердого гелия при низких температурах. Amritkar R. E., Kumar N. Anomalous low temperature specific heat of solid helium. «Proc. Nucl. Phys. and Solid State Phys. Symp., Calcutta, 1975. Vol. 18C.» S. l., s. a., 329—331 (англ.)

Обсуждаются причины существования линейного по т-ре члена в теплоемкости твердых ^3He и ^4He. Показано, что появление такого члена может быть обусловлено ролью точечных дефектов с конц-ией $\sim 10^{16}$ см$^{-3}$. Этот вывод согласуется и с характером зависимости рассматриваемого коэф. от давления.

Cp

(+1)

Ф. 1978 № 4

^3He

^4He

(C_v)

1975

87: 91726b **Anomalous low temperature specific heat of solid helium.** Amritkar, R. E.; Kumar, N. (Dep. Phys., Indian Inst. Sci., Bangalore, India). *Proc. Nucl. Phys. Solid State Phys. Symp.* 1975, 18C, 329-31 (Eng). The coeff. *A* in the heat capacity equation of bcc. ^3He and hcp. ^4He, $C_v = AT + BT^3$, decreases with increasing pressure (S. H. Castles and E. D. Adams (1973). This is explained by assuming the presence of zero point vacancies or defectons. The no. of defectons is estd. to be $\sim 10^{16}$/c.c.

(+1) 18

C.A. 1977. 87 N 12

^3He 1975

(C_p)

85: 10976s Specific heat of helium-3 superfluids in several magnetic fields. Archie, C. N.; Halperin, W. P.; Rasmussen, F. B.; Gould, C. M.; Alvesalo, T. A.; Richardson, R. C. (Phys. Dep., Cornell Univ., Ithaca, N. Y.). *Proc. Int. Conf. Low Temp. Phys., 14th* 1975, 1, 96-9 (Eng). Edited by Krusius, Matti; Vuorio, Matti. North-Holland: Amsterdam, Neth. The sp. heat measurements were made in the A, A_1, and B phases of ^3He along the melting curve in magnetic fields. The suppression of the B transition by magnetic field extended the available temp. range of the A phase to $T/T_c = 0.49$. The jumps in sp. heat at different transition temps. were detd.

C. A. 1976 85 N2

^3He

XI-4425

1975

Критич. пост.

145176q **Further tests of universality assumption for liquid-gas critical points.** Bauer, H. C.; Brown, G. R. (Phys. Dep., Tech. Univ. Muenchen, Garching/Munich, Ger.). *Phys. Lett. A* 1975, 51A(2), 68–70 (Eng). Evaluation of data for the liq.-gas crit. points of ^3He, ^4He, CO_2, SF_6, and $CClF_3$ lends further support to the universality assumption for crit. amplitude.

(+4)

☒

C.A. 1975. 82. N22

^3He ж-ц-9247 XI-4519 1975

66549f **Specific heat of solid helium.** Castles, S. H.; Adams, E. D. (Dep. Phys., Univ. Florida, Gainesville, Fla.). *J. Low Temp. Phys.* 1975, 19(5-6), 397-431 (Eng). The specific heat of bcc ^3He [14762-55-1] was measured from 25 m°K to near the melting curve, with particular attention given to the region of the low-temp. anomaly, $T \leq 500$ m°K. The data were analyzed in various ways to show the temp. and molar vol. dependence of the specific heat. In the region of the anomaly, the specific heat has a term linear in T, in addn. to a T^3 term. The data at the lowest temps. for 2 large-molar-vol. bcc ^3He samples were used to det. the nuclear exchange energy J. The values of J found are in agreement with previous results.

(C_p)

С. А. 1975. 83, N8

xis -9247 XI-4519 1975

^{3}He

(Cp)

10 Е295. **Теплоемкость твердого гелия.** Castles S. H., Adams E. D. Specific heat of solid helium. «J. Low Temp. Phys.», 1975, 19, № 5-6, 397—431 (англ.)

В диапазоне т-р от $25 \cdot 10^{-3}$° К почти до т. пл. с помощью импульсного метода исследована теплоемкость ^{3}He. Подробно описана измерит. аппаратура и калориметр. Вблизи $130 \cdot 10^{-3}$° К для образцов с объемом больше 24 см^3/моль получен минимум теплоемкости, который не наблюдается для образца с объемом 21,67 см^3/моль. Теплоемкость описывается выражением вида $C = AT^{-2} + BT + CT^3$, где $A = 3R\ (J/K)^2$, а J — энергия ядерного обменного взаимодействия. Для образцов с объемами 24,40 и 24,13 см^3/моль (J/K) равна 0,89 и $0{,}67 \cdot 10^{-3}$° К соответственно. Для образца с меньшим объемом ядерный вклад отсутствует и становится заметным наличие линейного члена в теплоемкости. Приведены зависимости т-ры Дебая от т-ры и объема. Библ. 36. В. Е. Зиновьев

Ф. 1975 N 10

XI-4945 1975

^{3}He

(Tm)

J ...157j Measurements of the melting curve of helium-3 ...5 mK. Dundon, J. M.; Goodkind, J. M. (Dep. Phys., ...California, La Jolla, Calif.). *J. Low Temp. Phys.* 1975, ...315-19 (Eng). Measurements of the pressure vs. temp. ...the melting curve of ^{3}He are presented. Cooling is ...by adiabatic demagnetization of Cu nuclei and these ...rements extend below 1 m°K. The results support ...usioins about the entropy of solid ^{3}He drawn from ...rements on the heat capacity of the solid, and confirm the ...scale inferred from measurements in Pomeranchuk cells.

C. A. 1975. 82. N26

^3He 1975

(Cp)

85: 10979v The thermal properties of bcc helium-3. Franck, J. P.; Calder, I. D. (Dep. Phys., Univ. Alberta, Edmonton, Alberta). *Proc. Int. Conf. Low Temp. Phys., 14th* 1975, 1, 495-8 (Eng). Edited by Krusius, Matti; Vuorio, Matti. North-Holland: Amsterdam, Neth. The unusual behavior of the thermal properties of bcc. ^3He is explained on the basis of the large zero point motion in solid He. Theor. equations are given for the heat capacity and the bulk modulus. The calcd. data are in agreement with the literature exptl. data.

C.A. 1976 85 № 2

^3He (C_p). XI-4746 1975

Goldstein L.,

J. Low Temp. Phys., 1975, 21 (3-4), 321-45.

Very low temperature properties of liquid helium-3

C. A. 1975, 83 N 22. 183664a. БФ

XI-4679 1975

^3He (ж)

(C_p)

33277n **Thermal behavior of ordered liquid helium-3.** Goldstein, Louis (Los Alamos Sci. Lab., Univ. California, Los Alamos, N. Mex.). *J. Low Temp. Phys.* 1975, 18(5-6), 543-7 (Eng). Heat capacity and phase-boundary line data on very low-temp. liq. ^3He predict the thermally anomalous higher temp. liq. to become of normal thermal behavior over a limited pressure and temp. range of its ordered *B* phase. Well below the phase boundary temps., this ordered phase may become thermally anomalous again. If confirmed exptl., this alternation in thermal behavior may point toward the resp. dominance of 2 groups of thermal excitations over the indicated temp. ranges, a situation realized in liq. ^4He II.

C.A. 1975. 83 N4

^{3}He

XI – 2687

1975

66582m **Low-temperature specific-heat anomaly of bcc. helium-3. Comments.** Greywall, D. S. (Bell Lab., Murray Hill, N. J.). *Phys. Rev. B* **1975**, 11(11), 4717–20 (Eng). The low-temp. sp.-heat data for bcc. ^{3}He [14762-55-1] reported by Castles and Adams (1973) was reanalyzed to ext. an excess sp. heat under the constraint that the lattice contribution be consistent with a recent elastic detn. of Θ_D. The excess sp. heat of 24.40 cm^{3}/mole is fitted well by the sp. heat of a collection of identical 2-level systems with a level sepn. of 0.35°K and with a conc. of 1 system per 300 He atoms.

(C_p)

C. A. 1975. P3. N8

^3He XI-4681 1975

11 Е285. **Низкотемпературная аномалия теплоемкости ОЦК ^3He.** Greywall D. S. Low-temperature specificheat anomaly of bcc ^3He. «Phys. Rev. B: Solid State», 1975, **11**, № 11, 4717—4720 (англ.)

Обсуждаются результаты исследований теплоемкости ^3He ниже 0,5° К. Указывается, что добавочный по сравнению с дебаевским вклад в теплоемкость может быть обусловлен аномалией Шоттки. Рассматривается двухуровневая схема с расстоянием между уровнями в 0,35° К. Рассчитанная температурная зависимость теплоемкости хорошо описывает эксперим. данные.

В. Е. Зиновьев

(C_p)

Ф. 1975 № 11

^3He

XI-4388 1975

19391p **Elastic constants and Debye temperature of bcc. helium-3.** Greywall, D. S. (Bell Lab., Murray Hill, N. J.). *Phys. Rev. B* 1975, 11(3), 1070–85 (Eng). Measurements of the longitudinal, the fast-transverse, and the slow-transverse sound velocities were made in single crystals of bcc. ^3He at 24.45 cm^3/mole and at 0.4°K. The quality and orientation of the crystals were detd. by x-rays. The reduced elastic consts. in units of 10^9 cm^2/sec^2, are $C_{11}/\rho = 1.634 \pm 0.020$, $C_{12}/\rho = 1.356 \pm 0.033$, and $C_{44}/\rho = 0.753 \pm 0.010$ from a least-squares fit. These consts. yield both a compressibility which agrees with the thermodn. measurements and a Debye temp. which is consistent with T_D, the max. value of the temp.-dependent calorimetric Debye temp. Sound-velocity data at 21.66 cm^3/mole were reanalyzed with the results: $C_{11}/\pi = 2.727 \pm 0.033$, $C_{12}/\rho = 2.477 \pm 0.058$, and $C_{44}/\rho = 1.422 \pm 0.021$. These consts. also yield a compressibility in agreement with thermodn. measurements. Only C_{12} is significantly different (4%) from the consts. previously reported. $(C_{11}-C_{12})/2\rho$, The modulus corresponding to the slow-transverse velocity in the ⟨110⟩ direction, is considerably larger. The Debye temp. from these consts. is not inconsistent with T_D. This disagrees with previous results. At neither d. is there evidence to suggest that any of the anomalous sp. heat is due to an anomalous phonon dispersion.

Θ_D

C.A. 1975
83 N2

^3He (C_p, ΔS_m, T_m, ΔH_m) 1975

XI-4741

Halperin W. P.,

Diss. Abstr. Int. B, 1975, 36 (2) 800.

Melting properties of ^3He. Specific heat, entropy, latent heat and temperature.

C.A. 1975, 83 N22. 184511 k.

Б

^3He

1975

(ΔHm)

87: 157961h A thermodynamic temperature scale derived from measurement of helium-3 latent heat. Halperin, W. P.; Archie, C. N.; Rasmussen, F. B.; Richardson, R. C. (Mater. Sci. Cent., Cornell Univ., Ithaca, N. Y.). *Liq. Solid Helium, Proc. Eur. Phys. Soc. Top. Conf.* 1974 (Pub. 1975), 227–31 (Eng). Edited by Kuper, Charles G.; Lipson, Stephen G.; Revzen, M. Wiley: New York, N. Y. The latent heat of ^3He was measured along the melting curve from 20 mK to 1 mK. This establishes a thermodn. temp. scale in units of the A-transition temp. The T_A is 2.75 ± 0.14 mK using liq. specific heat data.

C.A. 1977, 87, N 20

^3He

(ΔH_m)

1975

- 8916

XI - 4742

33166a **Thermodynamic temperature scale derived from measurements of helium-3 latent heat.** Halperin, W. P.; Archie, C. N.; Rasmussen, F. B.; Richardson, R. C. (Mater. Sci. Cent., Cornell Univ., Ithaca, N. Y.). *Phys. Rev. Lett.* 1975, 34(12), 718–21 (Eng). The latent heat of ^3He was measured along the melting curve from 23 to 1 m°K. With these results, an abs. temp. scale is established which depends only on measurements of heat, vol., and pressure and the assumption that the entropy of solid ^3He approaches $R \ln 2$ at high temps.

C. A. 1975. 83 N4

(P-V-T)

$^3He + ^4He$

1975

84: 65498x P-V-T ratios of helium isotope mixtures in the 14-60°K and 4-110 atm. ranges. Karnus, A. I.; Rudenko, N. S.; Vinokurov, E. I. (Inst. Mat., Kiev, USSR). *Ukr. Fiz. Zh. (Russ. Ed.)* 1975, 20(10), 1729-30 (Russ). The mol. vols. of mixts. ^4He + ^3He contg. ^3He 85.1, 63.7, 40.2, 15.4, and 7.0 mole % were detd. at 4-110 atm and 14.20, 16.93, 23.55, 32.91, 37.64, and 48.15°K. The error of the detn. of the compn. of the mixts. wes 0.05-0.25%. Isotherms are given in a P-V coordinates system. In all cases the mol. vols. were linear additive.

J. Kramarz

C. A. 1976. 84 N 10

^3He

1975

— 25532t Magnetic field dependence of the helium-3 melting curve and of the superfluid B transition. Kummer, R. B.; Mueller, R. M.; Adams, E. D.; Kirk, W. P.; Greenberg, A. S.; Lee, D. M. (Phys. Dep., Univ. Florida, Gainesville, Fla.). *Proc. Int. Conf. Low Temp. Phys., 14th* 1975, 1, 509-12 (Eng). Edited by Krusius; Matti; Vuorio, Matti. North-Holland: Amsterdam, Neth. Melting pressures are reported for ^3He for magnetic fields $B < 1.2$ tesla for temps. <1 mk where ordering in solid occurs. The superfluid transitions into the *A* and *B* phases of ^3He liq. were obsd. The *B* transition was obsd. to fields < .45 tesla.

(Ttr)

C. A. 1976. 85 N 4

^3He (тв)

1975

фазовое превращ.

11 Б753. Влияние квантовых флуктуаций на фазовые переходы первого рода. Meissner Günther. Effects of quantum fluctuations on first order phase transitions. «Fluctuat., Instabil., and Phase Transit.» New York—London, 1975, 117—126 (англ.)

Представлено рассмотрение явлений нуклеации при фазовых превращениях в системах, к-рые испытывают переход при сравнительно низких т-рах. С помощью метода Монте-Карло и теории ср. поля проведен анализ фазовых превращений в тв. He^3. Показана возможность определения равновесного давл. перехода 1-го рода при нулевой абс. т-ре. Найдена т-ра, при к-рой доминирующее влияние квантовых флуктуаций на фазовое превращение сменяется термич. флуктуациями. Показано, что предложенный квантокинетич. метод применим для случая метастабильных состояний при малых эффективных массах частиц. С этой точки зрения наиболее перспективно изучение влияния квантовых флуктуаций на явления нуклеации в гелии, водороде, электронно-дырочных каплях и др. Г. Л. Апарников

X.1977. № 11

^3He

XI–4546

1975

(T_{cr})

168656f Phase diagram and magnetic susceptibility of superfluid helium-3. Oestgaard, E. (Fys. Inst., Univ. Trondheim, Trondheim, Norway). *Phys. Lett. A* 1975, 54A(1), 39–41 (Eng). The crit. temp. for superfluidity in liq. ^3He is calcd. or estd. as function of Fermi momentum, giving a corresponding phase diagram. In the calcns. are used reaction-matrix elements obtained by a modified Brueckner theory, giving superfluidity corresponding to F-state pairing in the A phase. The zero-temp. limit for the susceptibility ratio χ_B/χ_F in the B phase is also estd. from the Landau Fermi-liq. parameters Z_0 and Z_2.

C.A. 1975. 83 N 20

^3He

1975

85: 10980p Entropy of solid helium-3 between 1 and 23 mK. Rasmussen, F. B.; Halperin, W. P.; Archie, C. N.; Richardson, R. C. (Phys. Lab. I, H. C. Oersted Inst., Copenhagen, Den.). *Proc. Int. Conf. Low Temp. Phys., 14th* 1975, 1, 513-16 (Eng). Edited by Krusius, Matti; Vuorio, Matti. North-Holland: Amsterdam, Neth. The entropy of solid ^3He was detd. on the melting curve (H. et al., 1974, 1975). The sp. heat was calcd. The entropy decreases smoothly from $R\ln 2$ until a sharp decrease at T_s = 1.10 m°K which is interpreted as evidence for the onset of magnetic order. The sp. heat increases smoothly with decreasing temp. >4 m°K. Around T_s, the sp. heat rises more than an order of magnitude within 0.09 m°K.

(S°, C_p)

C.A. 1976 85 N2

^3He 1975

(C_p)

84: 140813b **Free energy and spin waves in superfluid helium-3.** Tewordt, Ludwig (Abt. Theor. Festkoerperphys., Univ. Hamburg, Hamburg, Ger.). *Festkoerperprobleme* 1975, 15, 411-26 (Eng). The topics reviewed with 21 refs. include: exptl. results for the *A* and *B* phases of superfluid ^3He (phase diagram, sp. heat); anisotropic BCS states; spin fluctuations (paramagnons) and free energy; conservation laws and coupling of paramagnons and fluctuations of the superfluid condensate; and the role of dipole interactions and order-parameter fluctuations in generating spin waves (magnons) with a finite energy gap that give rise to longitudinal NMR.

C.A. 1976 84 N20

^3He

1976

84: 185018n **On the properties of liquid helium-3.** Dyugaev, A. M. (Inst. Teor. Fiz. im. Landau, Moscow, USSR). *Pis'ma Zh. Eksp. Teor. Fiz.* 1976, 23(3), 156-61 (Russ). At <1°K, a change of pressure on liq. ^3He from 0 to 27 atm results in an increase of Landau-theory parameters Φ_0 and Φ_1 (which are related with sound velocity and effective mass, resp.). Since the theory cannot accomodate such increase, this phenomenon is related to an exciton interaction between quasiparticles of ^3He. The excitons are virtual paramagnons with wave vector $k \neq 0$, indicating that ^3He is near an antiferromagnetic transition. At 0.03-0.20°K, the heat capacity is a linear function of $T^{1/2}$. Relations between parameters of the Landau Fermi-liq. theory are derived.

(C_p)

C.A. 1976 84 N26

^{3}He

1976

(C_p, T_{tr})

C.A. 1976 85

N 14

85: 99446q **Theory of liquid helium-3.** Dyugaev, A. M. (Inst. Teor. Fiz. im. Landau, Moscow, USSR). *Zh. Eksp. Teor. Fiz.* 1976, 70(6), 2390-407 (Russ). The anomalous properties of liq. ^{3}He can be explained by assuming that its spin d. fluctuation spectrum has a deep roton min. This means that ^{3}He is close to the phase transition to the [illegible] state. A comparison of the theory and expts. confirms this assumption. The spin roton parameters (roton vector (k), effective roton mass, and roton gap) are found. The temp. dependence of the specific heat is detd. up to $T \approx 1.5°K$. For $0.05°K < T < 0.5°K$ the dominant specific heat term is $\approx T^{0.5}$. The temp. $T \approx 0.5°K$ has the meaning of the degeneracy temp. of the spin roton gas. The quasiparticle spectrum and parameters of the Landau theory of a Fermi fluid are found. The dependence of the magnetic susceptibility χ on wave vector is detd. For $k = k_0$ ($k_0 \approx k$ extrapolated to 0°), χ exceeds 50 times the susceptibility of a perfect Fermi gas of the same d.

^3He Ж 15-14130 1976

11 Е307. Отсутствие аномалии теплоемкости ОЦК ^{3}Не при низких температурах. Greywall D. S. Absence of the low-temperature specific-heat anomaly in bcc ^{3}He. «Phys. Rev. Lett.», 1976, 37, № 2, 105—107 (англ.)

Приведены результаты измерений теплоемкости ^{3}Не вдоль трех изохор (24,454; 23,786 и 23,081 см^3) в интервале т-р от $50 \cdot 10^{-3}$° К до т-ры плавления. Для т-р ниже 0,3° К результаты описываются ф-лой $C_V = \alpha T^{-2} + \gamma T^3$. Аномалии теплоемкости, найденной в ряде предыдущих работ, не обнаружено.

(C_p)

Ф. 1976. N18.

^3He

1976

№5-14130

85: 167591k Absence of the low-temperature specific-heat anomaly in bcc helium-3. Greywall, D. S. (Bell Lab., Murray Hill, N. J.). *Phys. Rev. Lett.* 1976, 37(2), 105-7 (Eng). The sp. heat of bcc ^3He was measured along 3 isochores for temps. T between 50 mK and the melting curve. The data for T <0.3 K can be described well by the function $C_v = \alpha T^2 + \gamma T^3$ and are inconsistent with the existence of the low-temp. specific-heat anomaly reported previously by others.

(C_p)

C.A. 1976 85 N 22

^3He

1976

$\Delta H_{tr}, T_{tr}$

86: 111276q **Helium-3 melting pressure temperature scale.** Halperin, W. P.; Archie, C. N.; Richardson, R. C.; Rasmussen, F. B. (Mater. Sci. Cent., Cornell Univ., Ithaca, N. Y.). *Proc. Int. Cryog. Eng. Conf.* 1976, 6, 194-7 (Eng). The latent heat of solidification of ^3He was measured along the ^3He melting curve at 1-23 mK. A temp. scale is established which depends only on measurement of heat, pressure, and vol. and on the condition that the entropy of ^3He approaches R ln 2 at high temps., where R is the gas const. The detd. temp. of transition from normal Fermi liq. to superfluid phase A, T_A, as a fixed point on the scale is $T_A = 2.75 \pm 0.11$ mK. The agreement of this value and independent measurements of T_A, based on nuclear or electronic paramagnetism, Johnson noise thermometry, or on properties of liq. ^3He is discussed.

C.A. 1977, 86 N16

1976

^3He (ne)

(Cp)

84: 185698j Specific heat of normal and superfluid helium on the melting curve. Halperin, W. P.; Archie, C. N.; Rasmussen, F. B.; Alvesalo, T. A.; Richardson, R. C. (Lab. Solid State Phys., Cornell Univ., Ithaca, N. Y.). Phys. Rev. 1976, 13(5), 2124-31 (Eng). A method was developed for d... the specific heat of liq. ^3He on the melting curve as a function temp. and magnetic field. This approach depends on th... accurate measurement of pressure and vol. responses to h... pulses applied to the ^3He in a Pomeranchuk cell. Anal. of a n... of different expts. at a particular melting pressure yields b... the specific heat of the liq. and its temp. Measurements were performed between 1.1 and 23°mK in magnetic fields up to 8.8 kOe. From the normal-fluid specific-heat data the low-temp. value of the effective mass at the melting curve is $m^*/m = 5.5 \pm 0.2$. This is substantially smaller than that reported by J. C. Wheatley (1973). Specific-heat discontinuities at the A, A_1, A...

C. A. 1976, №5, 84

and B superfluid transitions were measured. These give values for certain combinations of the coeffs. of the 4th-order invariants in a Ginzburg-Landau expansion. Comparison was made with the predictions of spin-fluctuation theories. These alone cannot account for the behavior of ^3He at melting pressures. The entropy difference between the A and B phases was calcd. from the specific-heat data and compared with that calcd. from (i) measurement of the latent heat at the $B \rightarrow A$ transition, and (ii) measurement of the suppression of the B transition by magnetic field, B phase susceptibility data, and a magnetic Clausius-Clapeyron equation. The different methods give a consistent picture in which the thermal differences between A and B phases are quite small. The A-phase specific heat at $T/T_c \sim 0.5$ appears to have a weaker dependence on temp. than that expected for the limiting low-temp. behavior of the Anderson-Brinkman-Morel state.

^3He

1976

85: 37430w The paramagnon model and some properties of superfluid helium-3. Kuroda, Yoshihiro; Nagi, A. D. S. (Dep. Phys., Univ. Waterloo, Waterloo, Ont.). *J. Low Temp. Phys.* 1976, 23(5-6), 751-70 (Eng). The paramagnon model for the Bardeen-Cooper-Schrieffer-type state of superfluid ^3He was applied to calc. the following properties in the Anderson-Brinkman-Morel and Balian-Werthamer (BW) states: the pressure dependence of the initial slope of the normalized superfluid mass d. vs. $1-T/T_c$; the pressure dependence of the normalized specific heat jump at T_c; and the temp. dependence of the superfluid mass d. at P = 20.7 and 27.6 bar. The temp. dependence of the normalized nuclear spin susceptibility in the BW state was also calcd. The results are compared with the exptl. data on the A and B phases of superfluid ^3He.

(C_p)

C.A. 1976 85 N6

^3He

^4He

1976

86: 22062z **Virial coefficients and some thermodynamic quantities of helium isotopes at low temperatures.** Karnus, A. I. (Fiz.-Tekh. Inst., Kharkov, USSR). *Ukr. Fiz. Zh. (Russ. Ed.)* 1976, 21(7), 1183-90 (Russ). Previously obtained *PVT* measurements at 14-60°K were used to calc. the second (B_{33} and B_{44}) and third (C_{33} and C_{44}) virial coeffs. for ^3He and ^4He by the graphical extrapolation method. The calcd. dependence of B_{44} on T is in good agreement with that calcd. theor. using the Lennard-Jones (6-12) potential, but with B_{33} the agreement is much less good. The plot of (B_{33}-B_{44}) against T diverges from the theor. graph as T increases. The temp. variation of C_{44} is in good agreement with the theor. curve using the Lennard-Jones (6-9) potential for ^4He; the values for C_{33} are close to but slightly higher than those for C_{44} at corresponding T. The entropy and enthalpy values for ^3He and ^4He at 14-60°K and 0.01-0.16 g. cm^{-3} are calcd. from the same *PVT* data and are tabulated.

C. D. Kopkin

ΔH, ΔS

2ой вир. коэф.

(+1) P. P.

☒

C.A. 1977 86 N4

^3He 1976

8 И160. **Гелий три.** Wheatley John C. Helium three. «Phys. Today», 1976, 29, № 2, 32—33, 35—36, 39—42 (англ.)

Сокращенный вариант лекции, прочитанной автором на открытии 14 Международной конференции по физике низких т-р по случаю присуждения ему премии им. Ф. Лондона. Лекция знакомит с ходом эксперим. исследований низкотемпературных свойств жидкого ^3He и недавно открытых анизотропных сверхтекучих магн. фаз этой жидкости. А. С.

Низкотемперат. св-ва

Ф. 1976 № 8

3 He

1977

86: 178490y Specific heat of bcc helium-3. Greywall, D. S. (Bell Lab., Murray Hill, N. J.). *Phys. Rev. B* 1977, 15(5), 2604-23 (Eng). The sp. heat of bcc ^3He was measured at 5 molar vols. between 21.5 and 24.5 cm^3 and for temps. between 50 mK and the melting curve. The data below 0.5 K show no evidence of the large anomalous contribution to the sp. heat which has been obsd. in all previous measurements, indicating that this anomaly is not due to an intrinsic property of this quantum solid. Values of the nuclear exchange energy derived from the low-temp. data are in good agreement with values detd. by others from various types of measurements. The sp.-heat data above approx. 0.5 K are in agreement with previous results and show the large contribution which is generally attributed to thermally activated vacancies. Because of the absence in the present work of the low-temp. anomaly, however, the temp. dependence of the vacancy contribution could be detd. more accurately than was previously possible. The measured vacancy contribution shows significant deviations from the expected behavior.

(C_p)

C.A. 1977 86 N 24

³He

1977

4 Е256. **Измерения теплоемкости твердого ^{3}He.** Greywall D. S. Specific-heat measurements on solid ^{3}He. «Quantum fluids and solids». New York—London, 1977, 323—332 (англ.)

В интервале т-р от 0,05° K до точки плавления измерена теплоемкость при постоянном объеме C_v твердого ^{3}He, имеющего ОЦК-структуру. Исследования проводились на образцах с молярным объемом от 21,5 до 24,5 см^3. Большой объем калориметра (9 см^3) и медленная кристаллизация позволили получить кристаллы ^{3}He высокого качества. При т-рах $T \leqslant 0{,}1°$ K величина C_v обусловлена в основном вкладом ядерных спинов и пропорциональна T^{-2}; при более высоких т-рах доминирует фононный вклад и $C_v \sim T^3$. Не обнаружена описанная в литературе аномалия температурной зависимости C_v при $T < 0{,}5°$ K. Предполагается, что эта аномалия вызвана структурными дефектами кристалла ^{3}He. Библ. 24.

А. И. Коломийцев

(Cp)

7.1978 № 4

^3He

1977

7 Е353. Теплоемкость ОЦК ^{3}He. Greywall D. S. Specific heat of bcc ^{3}He. «Phys. Rev. B: Solid State», 1977, 15, № 5, 2604—2623 (англ.)

Теплоемкость 5 образцов ^{3}He с молярными объемами от 21,5 до 24,5 см^3 измерена от 0,05° К до т-р плавления. Подробно описана аппаратура и методика измерений. При т-рах ниже 0,5° К аномалии теплоемкости, найденной ранее, не обнаружено. При т-рах выше 0,5° К результаты согласуются с литературными и обнаруживают большой вклад термически активированных вакансий, которые не описываются простой ф-лой Шоттки. Составлены таблицы теплоемкости и термодинамич. ф-ций. Библ. 63.

(Cp)

Ф, 1977, N 7

^{3}He (Тв)

1977

(Cp)

89: 49739z Specific heat measurements on solid helium-3. Greywall, D. S. (Bell Lab., Murray Hill, N. J.). *Quantum Fluids Sol., [Proc. Int. Symp.], 2nd* 1977, 323-32 (Eng). Edited by Trickey, Samuel B.; Adams, Earnest Dwight; Dufty, James W. Plenum: New York, N. Y. The sp. heat of bcc ^{3}He was measured at five molar volumes between 21.5 and 24.5 cm^3 and for temps. between 50 mK and the melting curve. The data below 0.5K show no evidence of the large anomalous contribution to the sp. heat which has been obsd. in all of the previous sp. heat measurements on ^{3}He, and thus indicate that this long-standing anomaly is not due to an intrinsic property of this quantum solid.

С. А. 1978. 89 N 6

оттиск 5106

^3He Rosenfeld V, et al. 1977

Phys. Rev., 1977, A15

(Tm) (3), 1269–73

(см. Ar; I)

^3He

1977

(Cp)

86: 178482x Measurement of fountain pressure and other thermal properties in superfluid helium-3. Shields, Steven E.; Goodkind, John M. (Univ. California, La Jolla, Calif.). *J. Low Temp. Phys.* 1977, 27(1-2), 259-79 (Eng). The fountain pressure, heat capacity, and thermal cond. of superfluid ^3He were measured simultaneously at pressures of 29, 23.2, 10, and 2.5 atm and at the satd. vapor pressure. If the fountain equation, based on the 2-fluid model, is used to compute the entropy from the obsd. fountain pressure, it is consistent with the entropy obtained by integrating the specific heat. The measured thermal conductivities are dominated by a diffusive cond. which is inversely proportional to the temp. T_c.

C. A. 1977. 86 № 24

³He

1978

тепло-
проводность

7 Е474. «Дебаевское поведение» теплопроводности ОЦК ^{3}He при очень низких температурах. Armstrong G., Greenberg A. S. Debye behavior of the thermal conductivity of bcc ^{3}He at very low temperatures. «J. phys.» (France), 1978, 39, № 8, colloq. № 6/1, 135—137 (англ.; рез. франц.)

Приведены результаты измерений теплопроводности ^{3}He от 0,03 до 0,4° К. При т-рах меньших т-ры максимума теплопроводность пропорциональна кубу абс. температуры. Резюме

Ф. 1979, № 7

1978

^3He (Cp)

Андреев А.Ф.,

Письма ж. эксп. теор. физ. 1978, 28 (9), 603-6.

(см. ^4He; I)

3 He

1978

(Tm)

89: 12402h **Measurement of helium-3 melting curve using lanthanum-CMN thermometer.** Fujii, Genshiro; Oda, Yasukage; Kosuge, Kazuo; Nagano, Hiroshi (Inst. Solid State Phys., Univ. Tokyo, Tokyo, Japan). *Phys. Ultralow Temp., Proc. Int. Symp.* 1977 (Pub. 1978), 315 17 (Eng). Edited by Sugawara, Tadashi. Phys. Soc. Japan: Tokyo, Japan. A ^{3}He melting curve was precisely measured by Peomeranchuk method using a high sensitivity capacitance meter and both a cerium mangesium nitrate (CMN) thermometer and an improved CMN thermometer dild. with nonmagnetic La ions.

C. A, 1978, 89, N2

3He – 4He (смесь)

1978

88: 178050w Universality of the specific heat of helium-3/helium-4 mixtures at the λ transition. Gasparini, F. M.; Gaeta, A. A. (Dep. Phys. Astron., State Univ. New York, Buffalo, N. Y.). *Phys. Rev. B* 1978, 17(3), 1466-71 (Eng). An anal. of sp.-heat data of ^{3}He-^{4}He mixts. at the λ transition is presented in which a trial function with a correction term to the leading singularity is used. For mixts. up to 0.39 mol fraction of ^{3}He in ^{4}He, a universal leading exponent $\alpha = \alpha' = -0.022$ and a universal leading amplitude ratio of $A/A' = 1.088$ are found. These results are in agreement with theor. expectations and other exptl. results along the λ line as a function of pressure. The data at pure ^{4}He and satd. vapor pressure appear to show a small deviation from universal behavior.

(Cp)

C.A., 1978, 88, N24

^3He

1978

C_p, S, ΔH

23 Б780. Характеристики плавления ^3He: теплоемкость, энтропия, скрытая теплота и температура. Halperin W. P., Rasmussen F. B., Archie C. N., Richardson R. C. Properties of melting ^3He: specific heat, entropy, latent heat, and temperature. «J. Low Temp. Phys.», 1978, 31, № 5-6, 617—698 (англ.)

Изучены и обобщены термич. св-ва жидк. и тв. ^3He в интервале т-р 1—25 мК при плотностях, соотв-щих кривой плавления. Двухфазная смесь образца ^3He самозахолаживалась методом Померанчука. Измерения методом тепловых импульсов в сочетании с измерениями объема и давл. позволили провести раздельные определения след. св-в жидк. и тв. фаз: теплоемкость жидк. ^3He в фазах жидкости Ферми и суперфлюида; энтропия ^3He выше и в области ядерного магнитного перехода при 1,10 мК; установление абс. термодинамич. т-рной шкалы по измерениям скрытой теплоты превращения жидк. фазы в твердую.

Резюме

Э-1978, №23

3
He

1978

89: 95980u **Properties of melting helium-3: specific heat, entropy, latent heat, and temperature.** Halperin, W. P.; Rasmussen, F. B.; Archie, C. N.; Richardson, R. C. (Mater. Sci. Cent., Cornell Univ., Ithaca, N. Y.). *J. Low Temp. Phys.* 1978, 31(5-6), 617-98 (Eng). Thermal properties of liq. and solid ^3He were measured at 1-25 *m*K and melting curve ds. A 2-phase mixt. was self-cooled by the Pomeranchuk method. A heat-pulse technique was used, combined with measurements of pressure and vol., to yield sep. detns. of liq. and solid properties: the sp. heat of liq. ^3He in the normal liq. and superfluid phases; the entropy of solid ^3He above and through a nuclear magnetic transition at 1.10 mK; and an abs. thermodn. temp. scale based on measurement of the latent heat of solidification. Complete description of exptl. work with special emphasis on exptl. details is given.

(C_p, S^0)

CA, 1978, 89, N 12

^3He 1978

6 E334. **Вклад магнитных поляронов вакансий в теплоемкость твердого ОЦК-^{3}He.** Héritier M., Lederer P. Contribution of vacancy magnetic polarons to the specific heat of solid bcc ^{3}He. «J. phys.» (France), 1978, 39, № 8, colloq. № 6/1, 130—132 (англ.; рез. франц.)

С целью определения вклада магн. поляронов вакансий в суммарную теплоемкость измерена теплоемкость твердого ^{3}He в интервале т-р 0,05—0,001° К. Измеренная теплоемкость имеет аномалию при т-ре ~0,02° К. Полученные данные позволили определить число вакансий в образце 23,8 см^3/моль, равное $\sim 7 \cdot 10^{-4}$. Однако механизмы, приводящие к столь большой конц-ии вакансий, не выяснены.

А. С. Андреенко

(C_p)

ф. 1979, № 6

^3He 1978

4 Е302. **Ширина зоны вакансий в объемноцентрированном кубическом кристалле ^3He по данным о теплоемкости.** Hetherington J. H. Vacancy bandwidth in BCC ^3He as determined by specific heat. «J. Low Temp. Phys.», 1978, 32, № 1-2, 173—183 (англ.)

Полученные недавно данные по теплоемкости ОЦК-кристалла ^3He анализируются с помощью представления о конечной ширине зоны вакансий. При этом теоретич. выражение для добавочной теплоемкости имеет один лишний параметр и гораздо лучше согласуется с экспериментом, чем теплоемкость Шоттки, вычисленная для бесконечно узкой зоны. Получены оценки для ширины зоны и плотности состояний вакансий.

В. Оскотский

(C_p) вакансии

РЖФиз, 1979, №4

^3He

1978

89: 152875q **Vacancy bandwidth in bcc helium-3 as determined by specific heat.** Hetherington, J. H. (Phys. Dep., Michigan State Univ., East Lansing, Mich.). *J. Low Temp. Phys.* 1978, 32(1-2), 173-83 (Eng). The sp. heat data obtained by Greywall (*Phys. Rev., B* 1977, 15, 2604) were analyzed and shown to imply a vacancy band of nonzero width. Certain limits on the d. of the vacancy states are derived and a fit for the data is given. The existing theor. ideas on the vacancy bandshape in bcc. ^3He are reviewed.

(C_p)

C.A., 1978, 89, N18

^{3}He 1978

Kim K. S

Haksul Yonguchi - chungnam
(Cp) Taehakkyo, ekayon Kwahak
Yonguso, 1976, 3(1), 57-62

(ец. ^{4}He ; I)

^3He

1978

92: 186717a Heat capacity of submonolayers of helium-3 adsorbed on solid neon. Wennerstroem, P.; Toerne, A.; Lindqvist, T. (Inst. Technol., Univ. Uppsala, Uppsala, Swed.). *Report* 1978, UPTEC-78-31-R; Order No. 80-11267, 17 pp. (Eng). Avail. NTIS. From *Gov. Rep. Announce. Index (U. S.)* 1980, 80(5), 768. The heat capacity of ^3He adsorbed on solid Ne was measured for coverages from 1% of monolayer capacity to a complete monolayer with high resoln. The desorption heat capacity has a max. at 7 K. At predesorption temps., the heat capacity is linear and depends on the coverage. The heat capacity of the lowest coverages has anomalous behavior <0.7 K.

(C_p)

CA 1980 92 N 22

^3He

Спонтанн 9123 1979

91: 217912n **Observation of anomalous heat capacity in liquid helium-3 near the superfluid transition.** Alvesalo, T. A.; Haavasoja, T.; Main, P. C.; Manninen, M. T.; Ray, J.; Rehn, Leila M. M. (Low Temp. Lab., Helsinki Univ. Technol., SF-02150 Espoo, 15 Finland). *Phys. Rev. Lett.* 1979, 43(20), 1509–12 (Eng). The sp. heat c of liq. ^3He at 0.8–20 mK and zero pressure was measured. Above ~3 mK the sp. heat is linear in temp. and C/nRT = 2.11 K^{-1}, which is 30% less than the currently accepted value. Below 3 mK, C deviates increasingly from this relationship reaching, at the superfluid transition T_c = 1.04 mK, a value 9% in excess of the extrapolated linear sp. heat. The anomalous behavior and its consequences with regard to the interpretation of the data are discussed.

(C_p)

C.A. 1979, 91, N26

3 He

1979

12 Е258. Измерения удельной теплоемкости твердого ^{3}He. Грейволл Д. С. «Новости фундаментальн. физ.» (Москва), 1979, № 10, 266—277

Измерена уд. теплоемкость ОЦК-фазы ^{3}He при 5 молярных объемах в интервале 21,5—24,5 см^3 и при т-рах от 0,05° К до кривой плавления. Ниже 0,5° К не было обнаружено аномалии теплоемкости, которая наблюдалась другими авторами. Это указывает на то, что аномалия теплоемкости не является внутренним свойством твердого ^{3}He как квантового кристалла. Библ. 24.

Резюме

(Cp)

Ф. 1979 N12

1979

^3He (k)

92: 100405d **Measurements of the specific heat capacity of solid helium-3.** Greywall, Dennis S. (USSR). *Novosti Fundamental'n. Fiz., Moskva* 1979, (10), 266–77 (Russ). From *Ref. Zh., Fiz., E* 1979, Abstr. No. 12E258. Title only translated.

(C_p)

C.A. 1980. 92 N 12

^3He

1979

2 Е327. **Теплопроводность ОЦК ^3He при низких температурах.** Low-temperature thermal conductivity of bcc ^3He. Greenberg A. S., Armstrong G. «Phys. Rev.», 1979, **B 20**, № 3, 1050—1060 (англ.)

Измерения проведены от 0,03 до 0,6° К для интервала молярных объемов 22,4—24,3 см³/моль. Результаты измерений для тщательно выращенных образцов свидетельствуют о диффузном рассеянии фононов на границах и независимости средней длины пробега от т-ры. Величина фононной теплоемкости соответствует результатам калориметрич. исследований. Для некоторых образцов зависимость от т-ры оказывается более слабой, чем кубическая, что объясняется существованием добавочного рассеяния фононов на дислокациях. Библ. 23.

Л. П. Ф.

тепло-проводность

Ф-1980-№2

3 He

оттиск 8390

1979

91: 113317f On the use of CMN thermometry in specific heat measurements below 10 mK. Halperin, W. P. (Dep. Phy., Northwestern Univ., Evanston, IL 60201 USA). *J. Phys., Lett.* (*Orsay, Fr.*) 1979, 40(15), 373-5 (Eng). It is pointed out that small deviations of the cerium magnesium nitrate (CMN) temp. scale from the thermodn. one, may give rise to significant errors in interpretation of heat capacity measurements performed with CMN-based thermometry. On reassessing the conclusions reached by B. Hebral et al. (1976) concerning the anomalous low temp. dependence of the heat capacity of solid ^3He it is found that all presently available data are in qual. agreement.

(C_p)

C.A. 1979, 91, N14

^{3}He оттиск 7777 1979

^{4}He

Накаока Исоукэ

фазов. диагр. P-T.

Bussei Kenkyu (Study of Property of Matter), 1979, 31 (4), 229-240. Quantum solid...

(статья на японском языке)

^{3}He

(Cp)

7 Е466. Измерения теплоемкости ОЦК ^{3}Не от 0,003 до 0,3° К. Hebral B., Frossati G., Godfrin H., Schumacher G., Thoulouze D. Specific heat measurements on bcc ^{3}He from 3 to 300° mK. «J. Phys. Lett.» (France), 1979, 40, № 3, 41—44 (англ.; рез. франц.)

1979

Проведены измерения теплоемкости ОЦК-фазы твердого ^{3}Не с молярным объемом 23,8 см^3/моль. Исследуемый ^{3}Не располагался в ячейке с порошком церий-магниевого нитрата (ЦМН), играющим роль хладагента и термометра. Теплоемкость калориметра и ЦМН определялась в калибровочном эксперименте с жидким ^{3}Не. Показано, что в исследованной области т-р теплоемкость имеет немонотонную температурную зависимость, связанную с вкладами как дебаевского, так и обменного слагаемых. Ниже 0,05° К теплоемкость пропорциональна T^{-2}, что соответствует простой гейзенберговской модели с обменной энергией $0{,}56 \pm 0{,}01 \cdot 10^{-3}$ К. В этой области не обнаружено никаких аномалий в температурном ходе теплоемкости. В интервале 0,05—0,15° К эксперимент дает избыточную теплоемкость по сравнению с расчетной, что, вероятно, связано с влиянием ограниченной геометрии. Сообщается также об измерении сопротивления Капицы между твердым гелием и ЦМН, которое ниже 0,02° К не зависит от т-ры и равно $0{,}35 \cdot 10^{-3}$ сек·град/эрг. Библ. 28.

Э. Р.

Ф. 1979 № 7

Отттисск 7338

³He

Ammиси 7338

1979

(Cp)

(90) 128462e Specific heat measurements on bcc helium-3 from 3 to 300 mK. Hebral, B.; Frossati, G.; Godfrin, H.; Schumacher, G.; Thoulouze, D. (Cent. Rech. Tres. Basses Temp., CNRS, Grenoble, Fr.). *J. Phys., Lett. (Orsay, Fr.)* 1979, 40(3), L41–L44 (Eng). The sp. heat of bcc. ^3He (23.8 cm^3/mol) was detd. at 3–300 mK. A const. value, 0.56 mK, is obtained for the exchange integral, in very good agreement with higher temp. bulk results. No contribution due to magnetic polarons appears below 50 mK. An excess in the sp. heat is obsd. around 100 mK.

C.A. 1979, 90, N16

^3He оттиск 7246 1978.

Hetherington J.H.;

(Cp)

J. physique. Cologue C6
Suppl. N8, <u>39</u>, 1978, 126-127.

^3He (ж)

1979

90: 192663w **Low-temperature properties of liquid helium-3.** Woelfle, Peter (Inst. Theor. Phys., Tech. Univ. Muenchen, Garching, Ger.). *Rep. Prog. Phys.* 1979, 42(2), 269-346 (Eng). A review with many refs. is given on theories describing the properties (including thermodn., magnetic susceptibility, viscosity, thermal cond., spin diffusion, sp. heat, flow, textures, NMR, and sound propagation) of the normal-liq. phases and the superfluid *A*- and *B*-phases of ^3He.

C_p; терм.нод. св-ва

C.A. 1979. 90 № 24

^{3}He

^{3}He ^{4}He

Tcritical, ур. сост.

1979

✓92: 32611m Equation of state and critical exponents of helium-3 and a helium-3-helium-4 mixture near their liquid-vapor critical point. Pittman, Charles; Doiron, Theordore; Meyer, Horst (Dep. Phys., Duke Univ., Durham, NC 27706 USA). *Phys. Rev. B: Condens. Matter* 1979, 20(9), 3678-86 (Eng). For ^{3}He near the liq.-vapor crit. point (T_c), the effective crit. exponents β and γ were detd., where β and γ characterize the singular behavior, resp., of the densities of the coexisting phases ($T < T_c$), and of the compressibility along the crit. isochore for $T > T_c$. The densities were detd. with the dielec.-const. method at $2 \times 10^{-1} > |t| > 3 \times 10^{-5}$, where $t = (T - T_c)/T_c$. Far away from T_c, $\beta = 0.36$; β decreased toward 0.32 as T_c was approached. For $2 \times 10^{-2} > t > 5 \times 10^{-4}$, $\gamma = 1.13 \pm 0.01$. Both the coexistence curve and the compressibility were fitted to power-law series. The slope of the rectilinear diam. is -0.022. For the mixt. ^{3}He 80 + ^{4}He 20% above T_c, $\gamma = 1.18 \pm 0.02$, and the singular d. gradient in the earth gravitational field diverged strongly as T_c was approached.

(+1)

CA 1980 92 N 10

отпечатки 7610 1979

^3He

90: 174872j **Comment on the specific heat of superfluid helium-3.** Serene, J. W.; Rainer, D. (Dep Phys., State Univ. New York, Stony Brook, N. Y.). *J. Low Temp. Phys.* 1979, 34(5-6), 589-94 (Eng). The heat capacities of the ^3He B-phase in the weak coupling-plus model are given. Temp. dependence of the heat capacity is accurately detd. by the jump at T_c, which provides a test of the T_c/T_F expansion scheme for calcg. strong coupling effects in superfluid ^3He.

(C_p)

C.A. 1979, 90, N22

$^3He-^4He$ 1979

13 Б690. **Термодинамическая устойчивость и λ-точка в растворах $^3He-^4He$.** Семенченко В. К., Иващенко З. Г. «Ж. физ. химии», 1979, 53, № 2, 521—523

Для растворов $^3He-^4He$ изучены т-рные зависимости термич. и мех. коэф. устойчивости [T/C_p и $-(d_p/dv)_s$ соотв.] и вычисляемого из них термомех. минора $D_{T,p}$, характеризующего устойчивоость системы относительно термич. и мех. воздействий. В области конц-ий 0—57,5% ^3He указанные зависимости имеют экстремумы, причем т-ры, отвечающие минимумам на этих кривых, соответствуют т-рам λ-перехода. Отсюда сделан вывод о закрит. характере перехода, в к-ром основную роль играют флуктуации, никогда не доходящие до образования макроскопич. зародышей др. фазы с отличным от нуля поверхн. натяжением. Условно за границу перехода принята линия минимумов $D_{T,p}$, причем миним. значения $D_{T,p}$ для указанных составов мало отклоня-

термодин. устойчив.

Х: 1979, N13

ются от средн. значения 1,89·10[4]. Поэтому в точках минимума $D_{T,p}=(T/C_p)(-dp/dv)_s=(T/C_v)(-dp/dv)_T=$ $=(dT/dv)_s(dT/dv)_p=\text{const}$. Это чисто термостатич. ур-ние позволяет вычислять один коэф. устойчивости из другого, а также определяет положение λ-точки в р-рах. Оно показывает, что исчезновение вязкости является побочным эффектом, связанным с термодинамич. устойчивостью раствора. А. Б. Кисилевский.

етр.
дк

^3He

1980

92: 204438h Pressure dependence of the specific-heat jump at the superfluid transition and the effective mass of helium-3. Alvesalo, T. A.; Haavasoja, T.; Manninen, M. T.; Soinne, A. T. (Low Temp. Lab., Helsinki Univ. Technol., SF-02150 Espoo, 15 Finland). *Phys. Rev. Lett.* 1980, 44(16), 1076-9 (Eng). The sp. heat of liq. ^3He was measured at 1-10 mK and 0-32.5 bars. The values implied that the effective mass are considerably smaller than the currently accepted ones. Near zero pressure, the specific-heat jump is close to 1.43, and at 32.5 bars it has reached 1.90 in the *B* phase and 2.04 in the *A* phase. The temp. dependence of the sp. heat in the *B* phase agrees with a model of J. W. Serene and D. Rainer (1979). The latent heat at the *A*-*B* transition was measured.

(C_p)

CA 1980 92 N24

^3He

1980

(Tm)

92: 186071b **Shifts in the helium-3 melting curve due to pore condensation.** Eckstein, Y.; Lahav, Y.; Landau, J.; Olami, Z. (Dep. Phys., Technion-Israel Inst. Technol., Haifa, Israel). *Phys. Lett. A* 1980, 76A(1), 77-9 (Eng). Two different procedures were used to det. the melting curve. In the 1st a cell with an open geometry was used. In the 2nd the same cell was filled with MgO powder. Below 200 mK there is a difference between the 2 melting lines.

CA 1980 92 n 22

^{3}He 1980

93: 174121a **Phase diagram of helium-3 at melting pressures and high magnetic fields.** Godfrin, H.; Frossati, G.; Greenberg, A. S.; Hebral, B.; Thoulouze, D. (Cent. Rech. Tres Basses Temp., CNRS, 38042 Grenoble, Fr.). *J. Phys., Colloq. (Orsay, Fr.)* 1980, (C7), 125–7 (Eng). Pressure measurements on melting ^{3}He in a Pomeranchuk cell precooled to ~ 3 mK are reported in magnetic fields up to 7.2 T. The equil. pressures of the A_1 and A_2 phase transitions of superfluid ^{3}He were measured. A neg. deviation from the linear P_{A2}–P_{A1} vs. H splitting was found due to the magnetic ordering of solid ^{3}He. The magnetic P(H) phase diagram of solid ^{3}He was obtained. The H(T) phase diagram in high fields can be deduced by using a thermometry based on the A_1–A_2 splitting. These results are in agreement with the multiple spin exchange model of solid ^{3}He.

фазов. диагр.

C. A. 1980. 93 N 18

оттиск 9871 1980

³He

(Ttt)

Р. 1981 № 1

1 Е385. Давление плавления и энтропия спин-упорядоченного твердого ^3He. The melting pressure and entropy of spin ordered solid ^3He. Osheroff D. D., Yu C. «Phys. Lett.», 1980, A77, № 6, 458—460 (англ.)

Проведены измерения давлений плавления $P_{пл}$ (T) твердого ^3He в интервале т-р T от 1,2 до $0{,}36 \cdot 10^{-3}$ °K. Для достижения столь низких т-р применен комбинированный метод ядерного размагничивания и померанчуковской камеры. Точность определения $P_{пл}$ оценивается равной 3 мкбар, а ошибка в определении т-ры $\Delta T \pm 5 \cdot 10^{-6}$ °K. Для антиферромагн. перехода в твердом ^3He, определявшегося по положению излома на кривой плавления, получено значение $T_N = 1{,}030 \cdot 10^{-3}$ °K. Само наличие излома свидетельствует при этом о том, что данный фазовый переход является переходом первого рода со скачком энтропии $\Delta S = 0{,}443\ R \ln 2$ и скрытой теплотой $L = 2{,}62$ мдж/моль. Ниже T_N зависимость $P_{пл}$ от T в согласии с теоретич. предсказаниями описывается законом $P_{пл}(T) - P_{пл}(0) \sim T^4$. При этом из величины коэф. пропорциональности для скорости спиновых волн получено значение $v_s = 8{,}4 \pm 0{,}4$ см/сек. А. С.

3 He

оттиск 9871

1980

93: 80369k The melting pressure and entropy of spin ordered solid helium-3. Osheroff, D. D.; ''u, C. (Bell Lab., Murray Hill, NJ 07974 USA). *Phys. Lett. A* 1980, 77A(6), 458-60 (Eng). The melting pressure of solid ^{3}He was measured at T = 0.00036-0.0012 K. At 0.001030 ± 0.000005 K, a 1st-order phase transition in the solid was obsd., the entropy of which was detd. At <0.0006 K, the melting pressure varied as T^4, in agreement with antiferromagnetic spin-wave theory.

T_{tr}; ΔS_{tr}

CA 1980 93 N8

^3He

1980

фазов. диагр.

93: 54500b **Phase diagram of superfluid helium-3.** Sokolov, A. I. (Leningr. Elektrotekh. Inst., Leningrad, USSR). *Zh. Eksp. Teor. Fiz.* 1980, 78(5), 1985-97 (Russ). The thermodn. of fluid ^3He was studied near the phase transition line to the superfluid state. The renormalization group equations for the evolution of the effective coupling const. in the crit. region are derived by

CA 1980 93 N6

$^3He-^4He$
(смесь)

[оттиск 10794] 1980.

Takada T., Watanabe T.

(Cp)

J. Low Temp. Phys.,
1980, <u>41</u> (3/4), 221-24.

(след. ^4He-I)

3 He(ж).

1981

96: 41924o Specific heat of normal and superfluid helium-3. Alvesalo, T. A.; Haavasoja, T.; Manninen, M. T. (Low Temp. Lab., Helsinki Univ. Technol., Espoo, Finland). *J. Low Temp. Phys.* 1981, 45(3-4), 373-405 (Eng). Measurements of the heat capacity of liq. ^3He in the normal and superfluid phases at 0.8-10 mK and 0-32.5 bar in zero magnetic field are reported. The phase diagram of ^3He is presented. In the normal liq. at low pressures and near the superfluid transition an excess sp. heat is found. The effective mass m^* of ^3He is ~30% smaller than the values reported earlier. The latent heat at the superfluid transition is 1.14 ± 0.02 μJ/mol at 32.5 bar and decreases quickly as the polycrit. point is approached; at 23.0 bar, it is = 0.03 ± 0.02 μJ/mol.

C_p^0, ΔH_{tr};

C.A. 1982, 96, N6

^3He 1981

96: 249788h Zero sound and the melting curve of helium-3. Armbruster, H.; Kirk, W. P.; VerWest, B. J. (Phys. Dep., Texas A and M Univ., College Station, TX 77843 USA). *Physica B+C (Amsterdam)* 1981, 108(1-3), 1207-8 (Eng). Data from existing accurate pressure and molar vol. measurements of ^3He along the melting curve were analyzed to det. explicit entropy contributions of the liq. and solid phases. Below 300 mK there is a significant discrepancy between the melting curve data of E. R. Grilly (1971) and W. P. Halperin, et al., (1977). The resoln. of this problem is the subject of this paper. Zero sound makes an important contribution to the liq. entropy and the superfluid ^3He A-transition temp. must be shifted upward.

кривая плавления

C.A. 1982, 96, № 4

^{3}He, ^{4}He

1981

λ

7 Е273. Теплопроводность кристаллов ^{3}He и ^{4}He, содержащих примесь неона. Thermal conductivity of ^{3}He and ^{4}He crystals containing neon impurities. Berman R., Livesley D. M. «J. Phys. C: Solid State Phys.», 1981, 14, № 31, L945—L949 (англ.)

Методом стационарного продольного теплового потока в интервале т-р 1÷7 К исследована теплопроводность кристаллов ^{3}He и ^{4}He различных молярных объемов, содержащих примесь Ne. Максим. конц-ия Ne в кристаллах достигала $7 \cdot 10^{-2}$ ат.% при содержании в газовой фазе в процессе кристаллизации до $1,2 \cdot 10^{-1}$ ат.%. Коэф. теплопроводности λ для ^{4}He с малым молярным объемом монотонно уменьшается с ростом конц-ии Ne в исходном газе. Однако при больших молярных объемах величина λ кристаллов, выращенных из газа с примесью $2,35 \cdot 10^{-2}$ и $1,17 \cdot 10^{-1}$ ат.% Ne одинакова. Это указывает на то, что

Ф. 1982, 18, N7.

максимальная равновесная конц-ия Ne в твердой фазе Не больше, чем в газовой фазе. Результаты измерения λ интерпретируются в рамках механизмов рассеяния фононов путем норм. процессов и процессов переброса, а также резонансного рассеяния на дефектах, включая примесь Ne.

А. И. Коломийцев

3 He

1981

Кривая плавления

5 Е494. **Эксперимент по давлению плавления спин-поляризованного** ^{3}He. Experiment on the melting pressure of spin polarized ^{3}He. Chapellier M., Olsen M., Rasmussen F. B.— Proceedings of the 16th International Conference on Low Temperature Physics, Los Angeles, Calif., 19—25 Aug., 1981. Part 1. Contributed Papers.— «Physica», 1981, **BC 107**, № 1—3, 31—32 (англ.)

Исследована кривая плавления ^{3}He в ячейке Померанчука. Установлено, что давление плавления снижается в случае сильной локальной спиновой поляризации. Это снижение давления в интервале т-р 30—50 мК составляет 60—80 кПа. Приближенная оценка дает значение степени локальной спиновой поляризации ^{3}He от 25 до 40%. А. И. К.

Ф. 1982, 18, N5.

He^3 (ж)

(Оттиск 12080)

1981

95: 193270f Specific heat of liquid helium-3 at 29.4 bar. Hebral, B.; Frossati, G.; Godfrin, H.; Thoulouze, D. (CNRS, 38042 Grenoble, Fr.). *Phys. Lett. A* 1981, 85A(5), 290-2 (Eng). The heat capacity of liq. He-3 was measured at 4-300 mK and 29.4 bar. The values do not follow the γT behavior. The effective mass ($5.8m_3$) agrees with 1 set of earlier results and differs from another.

C_p^0

C. A. 1981, 95, N22.

^3He 1981

Lhota E., et al.

Physica B+C (Amsterdam)

Cp 1981, 107 (1-3), 337-338.

(см. Температ. шкала...; I)

^3He

Оттиск 13046

1981

Cp, Tc

Lhota E., Manninen M.T., et al.,

Phys. Rev. Lett., 1981, 47, N8, 589–592.

^3He

1981

95: 49769h **Anomalous specific heat of liquid helium-3 above the superfluid transition temperature.** Pal, A.; Bhattacharyya, P. (Tata Inst. Fundam. Res., Bombay, India). *J. Low Temp. Phys.* 1981, 43(1-2), 17-24 (Eng). The contribution to the sp. heat due to order-parameter fluctuations in liq. ^3He just above the superfluid transition temp. T_c was calcd. exactly within a Landau theory approach. The effect is unobservably small, and thus cannot explain the large (~9%) rise in sp. heat above the normal state value at the satd. vapor pressure obsd. exptl. (T. A. Alvesalo, et al., 1979). The divergence of the sp. heat at T_c was not found, in contrast to the findings of D. J. Thouless (1960) in a microscopic calcn.

(C_p)

C.A.-1981, 95, N6

^3He (ж) Оттиск 13221 1981

96: 41916d New data on the heat capacity of liquid helium-3. Roach, Pat R.; Eckstein, Yakov; Meisel, Mark W. (Solid State Sci. Div., Argonne Natl. Lab., Argonne, IL 60439 USA). *Physica B+C (Amsterdam)* 1981, 108(1–3), 1211–12 (Eng). Recent heat capacity measurements on liq. ^3He by T. Haavasoja (1980) have shown much smaller values than previous measurements by J. C. Wheatley (1975). The pressure of the liq. at const. vol. was measured as function of temp., $P_v(T)$, from which were derived the values for $\delta C_v/\delta_v$. The values obtained from the heat capacity measurements agree with the heat capacities of Wheatley but disagree with those from Haavasoja.

Cp;

C.A. 1982, 96, N6.

$^3He-^4He$
(смесь ж.)

оттиск 12422 1981

Takada T., et al.

(C_p, p)
C_v/T

Cryogenics, 1981, 601–606.

^3He(ж)

1981

Оттиск 13224

96: 41917e **Specific heat of normal and superfluid helium-3.** Zeise, E. K.; Saunders, J.; Ahonen, A. I.; Archie, C. N.; Richardson, R. C. (Lab. At. Solid State Phys., Cornell Univ., Ithaca, NY 14853 USA). *Physica B+C (Amsterdam)* 1981, 108(1-3), 1213-14 (Eng). The sp. heat of liq. 3-He in the normal and superfluid phases was measured by using a calorimeter of novel design. The results with data recently reported by the group in Helsinki (Aevesalo et al., Phys. Rev. Lett. *1980*).

Cp,

C. A. 1982, 96, N6.

^3He, ^4He ~~Оттиск 14256~~ 1982

Оттиск 14302

Castaing B.,
Greenberg A.S., et al.,

T_{tr}, фа-
зовая
диаграм-
ма.

J. Low Temp. Phys., 1982,
47, N 3-4, 191-206

3 He (ж)

1982

Оттиск 14419

96: 168880t **Single-particle spectrum and specific heat of liquid helium-3.** Fantoni, S.; Pandharipande, V. R.; Schmidt, K. E. (Dep. Phys., Univ. Illinois Urbana-Champaign, Urbana, IL 61801 USA). *Phys. Rev. Lett.* 1982, 48(13), 878–81 (Eng). The behavior of the sp. heat of liq. ^3He, over a wide range of temp., indicates a wiggle in the single-(quasi)particle spectrum $e(k)$ at k_F. This wiggle corresponds to the enhancement of the effective mass $m^*(k)$ at k_F of current interest in nuclear physics. It can be quant. understood from the microscopic Hamiltonian within correlated-basis perturbation theory.

Cp;

C. A. 1982, 96, N20

^3He Оттиск 15241 1982

97: 61984y High-precision specific-heat measurements on normal liquid helium-3. Greywall, Dennis S.; Busch, Paul A. (Bell Lab., Murray Hill, NJ 07974 USA). *Phys. Rev. Lett.* 1982, 49(2), 146-9 (Eng). High-precision measurements were made of the sp. heat of pure liq. ^{3}He for $8 < T < 500$ mK and for $0 < P < 32.5$ bar. The specific-heat results for $T \lesssim 100$ mK differ significantly from all of the previous measurements on ^{3}He. Only the new data, however, satisfy several important thermodn. checks.

C_p^0;

C. A. 1982, 97, N 8.

^3He ОМ. 15041 1982

(Cp)

97: 170005a **Heat capacity of normal and superfluid helium-3.** Haavasoja, T. (Low Temp. Lab., Helsinki Univ. Technol., SF-02150 Espoo, 15 Finland). *Physica B+C (Amsterdam)* 1982, 109-110, 1606-14 (Eng). The latest measurements of ^3He heat capacity as a normal Fermi liq. and below the superfluid transition temp. are reviewed with >36 refs.

C.A. 1982, 97, N 20.

^3He, ^4He

1982

97: 61948q **Thermodynamic functions of helium isotopes in the 1.5–14 K range.** Konareva, V. G.; Karnatsevich, L. V.; Bogoyavlenskii, I. V. (Fiz.-Tekh. Inst., Kharkov, USSR). *Ukr. Fiz. Zh. (Russ. Ed.)* 1982, 27(5), 675–82 (Russ). On the basis of previously obtained *P–V–T* data for pure helium isotopes (^4He and ^3He) at 1.5–14 K and pressures to 100 atm, the basic thermodn. functions of these substances were calcd. Compressibility factors, isothermal compressibilities, free energies, Gibbs' potentials, entropies, and enthalpies were detd. Data on ^3He were obtained for the first time. Literature data on ^4He are compiled and specified.

P-V-T данные

C. A. 1982, 97, N8.

^3He (Оттиск 13671) 1982

96: 92756j **Discrepancy in the heat capacity of liquid helium-3.** Roach, Pat R.; Meisel, Mark W.; Eckstein, Yakov (Solid State Sci. Div., Argonne Natl. Lab., Argonne, IL 60439 USA). *Phys. Rev. Lett.* 1982, 48(5), 330–3 (Eng). High-precision *PVT* measurements were made on liq. ^3He at low temps.; the results yield values for the deriv. of the heat capacity, $\partial C_v/\partial v$, which compared well with those from actual heat-capacity measurements. The comparison shows agreement between the present data and those of J. C. Wheatley (1975) but disagreement with $\partial C_v/\partial v$ from heat capacities of T. Haavasoja (1980).

p-V-T;

C.A. 1982, 96, N 12

^3He 1982

7 Е635. Фазовый переход ГПУ—ГЦК в ^{3}Не от тройной точки до $P=6$ кбар. The hcp-fcc phase transition in ^{3}He from the triple point to 6 kbar. Ryschewitsch M. G., Franck J. P., Duch B. J., Daniels W. B. «J. phys.» (Fr.), 1982, 43, № 12, suppl.; «ICOMAT—82: Int. Conf. Martensitic Transform., Leuven, Aug. 8—12, 1982», 413—414 (англ.)

фазовый переход

Оптическим методом исследована фазовая диаграмма ^{3}Не от тройной точки (T=17,65 К, P=1560 бар) до давления P=6 кбар. Показано, что фазовый переход ГПУ—ГЦК происходит примерно так же, как и в ^{4}Не. Фазовая граница является прямой линией, dP/dT = =555±22 бар/К при нагреве и dP/dT=731±46 бар/К при охлаждении. Е. С. Алексеев

Ф. 1983, 18, N 7.

3He

1982

4 Е633. **Изучение превращения ГПУ—ГЦК в ^{3}He.** Observation of the hcp-fcc phase transition in ^{3}He. Ryschkewitsch M. G., Franck J. P., Duch Barbara J., Daniels W. B. «Phys. Rev. B: Condens. Matter», 1982, 26, № 9, 5276—5278 (англ.)

Оптическим методом (в аппарате высокого давления с сапфировыми окнами) изучено превращение ГПУ—ГЦК в ^{3}He от тройной точки при 17,65 К и 1560 бар до 6,3 кбар. При давлении выше 2,5 кбар линия превращения линейна, ее наклон 617 бар/К. Кинетика превращения, его гистерезис и интервал превращения аналогичны таковым при превращении в ^{4}He. Библ. 28.

Резюме

90. 1983, 18, N4

^{3}He (ж) Оттиск 14038 1982

96: 130799k **Specific heat of liquid helium-3 under pressure.** Sakai, Akira; Suzuki, Hideji (Fac. Sci., Univ. Tokyo, Tokyo, Japan 113). *J. Phys. Soc. Jpn.* 1982, 51(2), 397–403 (Eng). The sp. heat of liq. ^{3}He was measured at 0.5 1.4 K and pressures to 27.6 atm. For each pressure, the specific-heat data >0.6 K are well represented by the formula $C_p/R = A + BT + CT^3$. The coeff. B has a strong pressure dependence and becomes neg. at high pressures. The results are compared with previous investigations and with the data obtained from the entropy of compression.

(C_p)

C.A. 1982, 96, N16

^3He 1982

96: 150107m The specific heat of normal and superfluid B-phase helium-3. Zeise, Eric Karl (Cornell Univ., Ithaca, NY USA). 1981. 174 pp. (Eng). Avail. Univ. Microfilms Int., Order No. 8129663. From *Diss. Abstr. Int. B* 1982, 42(8), 3325.

Cp;

C. A. 1982, 96, N18

Оттиск 14642 1982

^3He

Wennerström, Törne A., et al.,

Cp

Phys. scr., 1982, 25, N6/2, 939-942

^3He, ^4He

1983

/ 103: 27640r **Helium vapor pressure equations on the EPT-76.** Durieux, M.; Rusby, R. L. (Kamerlingh Onnes Lab., Univ. Leiden, Leiden, Neth.). *Metrologia* 1983, 19(2), 67–72 (Eng). Equations are presented relating the vapor pressures of ^{3}He and ^{4}He with temp. using the EPT-76 scale. Values of vapor pressure, and its deriv., dP/dT_{76}, are tabulated at 0.01 K intervals, and the differences with respect to the 1958 ^{4}He scale and the 1962 ^{3}He scale are given.

(p)

C. A. 1985, 103, N 4.

^3He (ж)

1983

98: 133179k **Specific heat of normal liquid helium-3.** Greywall, Dennis S. (Bell Lab., Murray Hill, NJ 07974 USA). *Phys. Rev. B: Condens. Matter* 1983, 27(5), 2747–66 (Eng). High-precision, const.-vol. specific-heat measurements were made on pure liq. ^3He in the normal phase at 7 mK to 2.5 K and 0–32.5 bar. Below 30 mK, the results are about 25% greater than those from 2 other recent expts. and about 10% less than the earliest values. Between 30 and 500 mK, the data agree with all previous measurements to within about ±5%. Above 500 mK, the present measurements are the first to be reported at other than satd. vapor pressure. Checks indicate that only the present very-low-temp. data are thermodynamically consistent. Consequently, adjustments must be made in all of the previously detd. Landau parameters. In agreement with the theory, the low-temp. specific-heat data at all densities can be described well by a function which includes terms only in T and in $T^3 \ln T$. This form seems to apply to higher temps. than expected. From the coeff. of the $T^3 \ln T$ term, values of the Landau parameter are extd. which are consistent with other detns.

C_V;

C. A. 1983, 98, N16.

^3He (K) от. 16334 1983

98: 132653y Thermal properties of paramagnetic solid helium-3. Goldstein, Louis (Los Alamos Natl. Lab., Univ. California, Los Alamos, NM USA). *J. Low Temp. Phys.* 1983, 50(3-4), 267-99 (Eng). The thermal properties were calcd. of magnetized solid He-3. The entropy, heat capacity, and magnetization were calcd. in the presence of magnetic fields of various (increasing) strengths.

C_p, S^o

C.A. 1983, 98, N16.

^3He, ^4He 1983

) **11 Е261. Рассеяние фононов и равновесие фаз в кристаллах ^3He и ^4He, содержащих примеси неона.** Phonon scattering and phase equilibrium in ^3He and ^4He crystals containing neon impurities. Livesley D. M. «J. Phys. C: Solid State Phys.», 1983, 16, № 15, 2881—2888 (англ.)

Обсуждаются результаты измерений теплопроводности кристаллов ^3He и ^4He, содержащих до 0,1% Ne (Berman R. et al. «J. Phys. C.», 1981, 14, L945). Анализируется процесс рассеяния фононов на примесях Ne. Сделан вывод, что наблюдаемая величина рассеяния объясняется частичной компенсацией эффектов изменения масс и силовых констант. Сделано заключение, что силовая константа Ne—He больше силовой константы He—He. С увеличением плотности кристалла это различие уменьшается из-за большей жесткости атомов Ne. Предложена фазовая диаграмма исследованных кри-

λ;

Ф. 1983, 18, N 11

сталлов. В осях т-ра — конц-ия Ne она содержит области жидкого состояния, твердого He с примесью Ne и твердого Ne с примесью He. Эти области разделяются областью энергетически нестабильных состояний. Остаются неясности относительно поведения Ne в тех случаях, когда его конц-ия превышает предел растворимости в твердом He. В. С. Виноградов

^3He

1983

99: 164844y **Specific heat of helium-3 in the Fermi liquid region.** Mayberry, M. C.; Fogle, William E.; Phillips, Norman E. (Lawrence Berkeley Lab., Univ. California, Berkeley, CA 94720 USA). *AIP Conf. Proc.* 1983, 103(Quantum Fluids Solids), 161-70 (Eng). A CMN thermometer was calibrated by nuclear orientation thermometry at low temps. and by He vapor pressure thermometry at high temps. The calibration agrees well with the NBS temp. scale between 100 and 200 mK. Sp. heat data on ^3He in the Fermi liq. region, obtained with this thermometer, agree with recent measurements at Bell Labs. It is argued that discrepancies with other data arise from differences in the underlying temp. scales.

(C_p)

C.A. 1983, 99, N20

$^3He - ^4He$

1983

фазов. диаграм.

98: 60691j **Phase diagram of spin-polarized helium-3/helium-4 solutions.** Meierovich, A. E. (Inst. Fiz. Probl., Moscow, USSR). *Pis'ma Zh. Eksp. Teor. Fiz.* 1983, 37(1), 28-30 (Russ). The possible existence and properties of unusual phases of solid and liq. ^3He-^4He solns. in equil. with spin-polarized ^3He are analyzed.

C. A. 1983, 98, N 8.

^3He 1983

99: 110949t **The effective mass and the specific heat of normal liquid helium-3.** Mishra, V. K.; Brown, G. E.; Pethick, C. J. (Dep. Phys., State Univ. New York, Stony Brook, NY USA). *J. Low Temp. Phys.* 1983, 52(5-6), 379-96 (Eng). The behavior of the sp. heat of liq. ^3He as a function of temp. implies a rapid variation of effective mass with energy. Recently a model has been developed for understanding this (B. et al., 1982). This model is extended to explain the low-temp. ($T \lesssim 100$ mK) sp. heat measurements of normal liq. ^3He by D. S. Greywall, (1983). The model gives a reasonably accurate description of the data in this temp. range.

(C_p)

C. A. 1983, 99, N 14

^3He 1983

фаз. состав

99: 59042n The low-temperature phases of helium-3. Richardson, Robert C. (Mater. Sci. Cent., Cornell Univ., Ithaca, NY 14853 USA). *Mater. Res. Soc. Symp. Proc.* 1983, 19(Alloy Phase Diagrams), 361–4 (Eng). At 1–3 mK and in magnetic fields 0–1 T, there are 4 distinct phases of liq. ^3He and 3 distinct phases of solid ^3He. The liq. becomes a triplet superfluid and the solid becomes a nuclear antiferromagnet. Despite the great differences which exist between a superfluid and an antiferromagnet, there are remarkable similarities between phase diagrams of the 2 systems.

C.A. 1983, 99, N 8

He

Ст. [illegible]
17948

1983

Wells B.H., Wilson S.,

расчет
Ван-дер-Ваальсов.
потенциалов
взаимодейств.

Chem. Phys. Lett,
1983, 101, N4-5,
429 – 434.

^3He

1983

99: 147121t Heat capacity (Cv) change of quantum crystals near the melting point. Udovidchenko, B. G. (Fiz.-Tekh. Inst. Nizk. Temp., Kharkov, USSR). *Fiz. Nizk. Temp. (Kiev)* 1983, 9(7), 749-52 (Russ). The nature of the temp.-dependence of the isochoric heat capacity, C_v, near the melting line was explained from the point of view of crystal lattice dynamics. Calcd. and exptl. C_v data for ^3He, ^4He, and p-H_2 were compared.

(Cv)

C.A. 1983, 99, N 18,

3 He

1984

101: 235765w **Phase diagram of superfluid helium-3-A_1.** Israelsson, U. E.; Crooker, B. C.; Bozler, H. M.; Gould, C. M. (Dep. Phys., Univ. South. California, Los Angeles, CA 90089 USA). *Phys. Rev. Lett.* 1984, 53(20), 1943-6 (Eng). The A_1 and A_2 transitions, which delineate the A_1 phase of superfluid ^3He, are measured in magnetic fields up to 3 T over a wide range of pressures. At zero pressure the A_1–A_2 splitting is found to be smaller than at melting pressure by a factor of 5. Strong-coupling effects are similarly smaller by an order of magnitude.

фазовая диаграмма

C. A. 1984, 101, N 26.

³He
⁴He

1984

2 Б3018. **Смеси $^3He/^4He$ при очень низких температурах: теплоемкость и спиновые волны.** $^3He/^4He$ — Mischungen bei sehr tiefen Temperaturen: Spezifische Wärme und Spinwellen. Chocholacs H. «Ber. Kernforschungsanlage Jülich», 1984, № 1901, 138 S., ill. (нем.; рез. англ.)

В специально сконструированном калориметре исследована теплоемкость разб. р-ров ^3He в ^4He при очень низких т-рах в зависимости от давл., т-ры и конц-ии. Экспериментально подтверждено, что до самых низких достигнутых т-р ^3He в ^4He ведет себя как нормальная жидкость Ферми, т. е. теплоемкость пропорциональна т-ре. Методом ЯМР исследованы магнитные св-ва ядер ^3He в смеси, и впервые получены прямые доказательства существования спиновых волн в гелиевой смеси. Также впервые определена величина параметра Ландау Ферми-жидкости $F_l^a = 0,34 \pm 0,10$ (при 5% ^3He и давл. 0 бар). Вплоть до 220 мкК не обнаружено каких-либо данных о возможном фазовом переходе ^3He-компонента в сверхтекучее состояние.

В. Ф. Байбуз

теплоемкость

Х, 1985, 19, N2.

^3He (ж)

1984

101: 236418x **Specific heat, entropy and magnetic susceptibility of liquid helium-3.** Dyugaev, A. M. (Inst. Teor. Fiz. im. Landau, Chernogolovka, USSR). *Zh. Eksp. Teor. Fiz.* 1984, 87(4), 1232–43 (Russ). The spin contribution to the sp. heat and entropy of liq. ^3He was ascertained by analyzing the exptl. data. At high temps. the spin entropy per particle approaches $S_0 \approx 0.972$ which differs from ln2. The const. S_0 does not depend on the d. of the liq. The nonspin contribution to the entropy is linear with respect to temp. For a fixed liq. d., the spin contribution, which depends on the temp. and pressure, is quite distinct and is proportional to the logarithm of the temp.

C_p, S^0;

C. A. 1984, 101, N 26.

^3He

1984

10 Е323. Теплоемкость и давление при постоянном объеме твердого ОЦК-^{3}He. Specific heat and isochoric pressure measurements in BCC solid ^{3}He. Fukuyama Hiroshi, Miwa Yoshiyuki, Sawada Anju, Masuda Yoshika. «J. Phys. Soc. Jap.», 1984, 53, № 3, 916—919 (англ.)

Теплоемкость C_V и давление p при постоянном объеме в твердом ОЦК-^{3}He измерены в интервале т-р от 2 до 60 мК. Результаты анализируются с помощью разложения по обратной т-ре $\beta=1/T$. Особенности $C_V(T)$ и p_V в области т-р $\geqslant$10 мК анализируются в рамках обменной 4-спиновой модели ядерного магнетизма.

В. Оскотский

C_p;

ф. 1984, 18, N10

^3He 1984

100: 181083f **Specific heat and isochoric pressure measurements in bcc. solid helium-3.** Fukuyama, Hiroshi; Miwa, Yoshiyuki; Sawada, Anju; Masuda, Yoshika (Dep. Phys., Nagoya Univ., Nagoya, Japan). *J. Phys. Soc. Jpn.* **1984,** 53(3), 916-19 (Eng). The sp. heat and isochoric pressure of bcc. solid ^3He were measured from 2 to 60 mK at densities near the melting curve. The thermodn. consistency was obtained between both measurements. The second order coeff. e_3, in the high temp. series expansion of the sp. heat was detd. with satisfactory precision. The results were analyzed by using the current 4-spin exchange model.

C_p, p;

C.A. 1984, 100, N 22

3 He

1984

104: 40850z Low-temperature calorimeter for small amounts of a substance. Kosov, V. I.; Malyshev, V. M.; Mil'ner, G. A.; Shibakin, V. F. (VNII Fiz.-Tekh. Radiotekh. Izmer., Mendeleevo, USSR). *Probl. Kalorim. Khim. Termodin., Dokl. Vses. Konf., 10th* 1984, 2, 560–2 (Russ). Edited by Emanuel, I. M. Akad. Nauk SSSR, Inst. Khim. Fiz.: Chernogolovka, USSR. The installation, which contains a cryostat operating at 0.5–7 K is described. For tests, heat capacities of samples of 2 cm^3 of He–3 were detd.

(Cp)

C.A: 1986, 104, N6

$^3He - ^4He$
смесь

1984

102: 33769k **Preliminary results from high resolution heat capacity measurements near the lambda-line of helium-3-helium-4 mixtures.** Lipa, J. A.; Chui, T. C. P. (Dep. Phys., Stanford Univ., Stanford, CA 94305 USA). *Physica B+C (Amsterdam)* 1984, 126(1-3), 481-2 (Eng). The first heat capacity measurements are reported for a $^3He-^4He$ mixt., which resolve the gravitational rounding at the λ-transition. The sample height was 0.38 mm, giving a 2-phase region width $\Delta T/T_\lambda$ of $\sim 3 \times 10^{-8}$. The data are compared with similar measurements on a sample of pure He of the same vertical height. The initial results from an anal. aimed at performing an improved test of the universality hypothesis for co-operative phase transitions are also reported.

(Cp)

C. A. 1985, 102, N4.

³He

1984

101: 44318t **Specific heat of helium-3 in the Fermi liquid region.** Mayberry, M. C. (Lawrence Berkeley Lab., Berkeley, CA USA). *Report* 1983, LBL-17131; Order No. DE84005713, 101 pp. (Eng). Avail. NTIS. From *Energy Res. Abstr.* 1984, 9(7), Abstr. No. 12890. The powd. cerium magnesium nitrate (CMN) temp. scale was used in measurements of the sp. heat of ^{3}He at zero pressure between 6.5 and 190 mK. The results agree with other recent measurements.

(C_p)

C.A. 1984, 101, N6

^3He 1984

101: 98022k **Inverted forms of the new helium vapor pressure equations.** Rusby, R. L.; Durieux, M. (Div. Quantum Metrol., Natl. Phys. Lab., Teddington/Middlesex, UK). *Cryogenics* 1984, 24(7), 363-6 (Eng). Equations relating the vapor pressures of He^3 and He^4 to temp. on the 1976 temp. scale were approved by the International Committee of Wts. and Measures. By using these equations, temps. can only be calcd. from pressures by iteration. The equations are not amenable for use at less than full precision. Alternative equations expressing temp. as a function of pressure over somewhat reduced ranges are presented in forms which are more easily solved for temp. and are capable of further simplification if reduced accuracy is acceptable.

(p)

C. A. 1984, 101, N 12

^3He (ж)

1984

От. 19013

100: 92307q **Specific-heat measurements of normal liquid helium-3 in an 8-Tesla magnetic field.** Sen, Bidyut; Archie, C. N. (Dep. Phys., State Univ. New York, Stony Brook, NY 11794 USA). *Phys. Rev. B: Condens. Matter* 1984, 29(3), 1490-2 (Eng). Within a precision of 2%, the sp. heat of liq. ^3He remains unchanged >20 mK from 0 to 8-T magnetic field. These results agree well with the zero-field sp.-heat measurement of Busch and Greywall (1982).

(C_p)

C.A. 1984, 100, N 12

^3He 1985

103: 183741c **Boundary layer (of the order of correlation lengths) in superfluid helium-3 B.** Fal'ko, V. I. (Inst. Fiz. Tverd. Tela, Chernogolovka, USSR). *Pis'ma Zh. Eksp. Teor. Fiz.* 1985, 42(5), 213–15 (Russ). The states of the near-boundary layer in ^3He-*B* are classified with respect to their symmetry. The 1st-order phase transition obsd. in the gyroscopic expt. (J. P. Pekola and J. T. Simola, 1985) can be explained by the reorientation of the near-boundary layer. A model for the dynamics of the B → A phase transition is proposed.

(фаз. перех.)

C.A. 1985, 103, N 22

3 He

1985

102: 121055c **Helium-3 melting-curve thermometry at millikelvin temperatures.** Greywall, Dennis S. (AT and T Bell Lab., Murray Hill, NJ 07974 USA). *Phys. Rev. B: Condens. Matter* 1985, 31(5), 2675-83 (Eng). A pressure-vs.-temp. calibration of the ^{3}He melting curve is given for $1 < T < 250$ mK. The calibration is based on the data of Halperin et al (1978) and Greywall and Busch (1982) and is consistent with the revised National Bureau of Stds. temp. scale. On the new scale, $T_A = 2.708$ mK. With the use of the transition line between normal and superfluid ^{3}He [i.e., , $T_c(P)$] as a basis for intercomparison, the melting-curve scale is found to be proportional to the magnetic temp. scales of D. N. Paulson et al. (1979) and T. Haavasoja et al. (1980). Included is a description of the $PrNi_5$ nuclear demagnetization refrigerator, which was used to cool the ^{3}He samples to less than 0.3 mK.

Кривая плавления

C. A. 1985, 102, N 14.

^3He

1985

105: 13175x **Thermodynamics and zero sound properties of superfluid helium-3-A_1.** Israelsson, Ulf Egil (Univ. Southern California, Los Angeles, CA USA). 1985. No pp. Given (Eng). Avail. USC. From *Diss. Abstr. Int. B* 1986, 46(11), 3901.

термодин. св-ва

C. A. 1986, 105, N 2

$^3He - ^4He$

смесь

1985

103: 110938q **Thermodynamic properties of liquid helium-3 - helium-4 mixtures at zero pressure for temperatures below 250 mK and helium-3 concentrations below 8%.** Kuerten, J. G. M.; Castelijns, C. A. M.; De Waele, A. T. A. M.; Gijsman, H. M. (Eindhoven Univ. Technol., Eindhoven, Neth.). *Cryogenics* 1985, 25(8), 419-43 (Eng). The thermodn. quantities were calcd. of dil. liq. ^3He-^4He mixts., from exptl. values of the sp. heat and the osmotic pressure. The calcns. are confined to temp. <250 mK and ^3He concns. <8% at zero pressure. Some results are esp. useful for diln. refrigeration. The results agree with exptl. data for both the osmotic pressure and osmotic enthalpy.

(Ф)

C.A. 1985, 103, N 14.

^3He - ^4He От. 21013 1985

Kuerten J.G.M., Castelijns C.A.M., et al.,

расчет термодин.- св-в

Physica, 1985, BC 128, N2, 197-200.

3 He

1985

102: 192297w **The specific heat of helium-3 in the Fermi liquid region.** Mayberry, Michael Charles (Univ. California, Berkeley, CA USA). 1984. 99 pp. (Eng). Avail. Univ. Microfilms Int., Order No. DA8427039. From *Diss. Abstr. Int. B* 1985, 45(9), 2974.

Cp;

C.A. 1985, 102, N 22

^3He (ж) OM. 22140 1985

102: 121039c **Fluctuation theory of the specific heat of normal liquid helium-3.** Mishra, Suresh G.; Ramakrishnan, T. V. (Inst. Phys., Bhubaneswar, 751005 India). *Phys. Rev. B: Condens. Matter* 1985, 31(5), 2825–30 (Eng). The measured sp. heat of normal liq. ^3He shows a plateau for $0.15 < T < 1$ K; at <0.15 K and >1 K, it rises linearly with temp. However, the slope on the high-temp. side is very much reduced compared with the free-Fermi-gas value. These features are explained through a microscopic, thermal spin- and d.-fluctuation model. The plateau is due to spin fluctuations which have a low characteristic energy in ^3He. Because of the low compressibility, the d. fluctuations are highly suppressed, which leads to a reduced slope for $C_v(T)$ for high T.

Cp;

C. A. 1985, 102, N 14.

^3He 1985

102: 138683f **On the specific heat of Fermi liquids.** Pamyatnykh, E. A.; Poltavets, A. V. (Ural State Univ., Sverdlovsk, USSR). *Phys. Lett. A* 1985, 108A(2), 108–10 (Eng). The contributions of long-wavelength spin fluctuations to the sp. heat of Fermi liqs. was calcd. on the basis of the Landau theory of Fermi liqs. More satisfactory estns. of the Landau parameter F_1^a for liq. ^3He are obtained.

(Cp)

C. A. 1985, 102, N 16.

^3He От 24424 1986

11 И117. Теплоемкость ^3He и термометрия при милликельвиновых температурах. ^3He specific heat and thermometry at millikelvin temperatures. Greywall D. S. «Phys. Rev. B: Condens. Matter», 1986, 33, № 11, 7520—7538 (англ.)

Проведены прецезионные измерения теплоемкости чистого жидкого ^3He в нормальной и сверхтекучих фазах при т-рах от 5 до 0,6 мК и давлениях от 0 до 34 бар. Термометр калибровался по шкале НБС (Национального бюро стандартов) при т-ре около 15 мК, а при более низких т-рах — по линейной температурной зависимости теплоемкости ^3He в норм. фазе. Приведена новая, уточненная фазовая диаграмма ^3He. Наиболее заметно изменилась т-ра перехода в *A*-фазу (2,49 мК вместо прежнего значения 2,7 мК). Обсуждается соответствие полученной температурной шкалы со шкалами других авторов. Заново определенное здесь значение эффективной массы квазичастиц в норм. фазе хорошо

C_p;

Ф. 1986, 18, N 11

согласуется с полученным ранее значением. Данные хельсинской группы по эффективной массе приводятся в хорошее соответствие с данными, полученными авторами при учете необходимой перенормировки хельсинской температурной шкалы. Делается вывод, что имеющееся расхождение эксперим. данных по теплоемкости связано исключительно с различием температурных шкал. Не обнаружено никакой аномалии в теплоемкости фазы при низких давлениях, а измеренный скачок теплоемкости при сверхтекучем переходе всего на несколько процентов больше вычисленного, согласно теории слабой связи. При высоком давлении температурная зависимость теплоемкости ниже T_c также лишь незначительно отличается от теоретич. предсказаний. Библ. 43.

А. Э. Мейерович

$)/T_c$

OM 24424 1986

^3He (ж)

OM 24424

(C_p)

C.A. 1986, 105, N4.

105: 30973y **Helium-3 specific heat and thermometry at milli=kelvin temperatures.** Greywall, Dennis S. (AT and T Bell Lab., Murray Hill, NJ 07974 USA). *Phys. Rev. B: Condens. Matter* **1986**, 33(11), 7520–38 (Eng). High-precision specific-heat measurements were made on pure liq. ^3He in normal and superfluid phases for temps. between 0.6 and 5 mK and for pressures between 0 and 34 bars by using a magnetic susceptibility thermometer. The ^3He phase diagram is presented. T_A = 2.49 MK differs from the currently accepted value of ~2.7 mK. Multiplying the Pt NMR temps. detd. by Haavasoja and co-workers by a factor of 0.89 or subtracing 0.13 mK from the magnetic temps. of Paulson et al. brings both of these scales into excellent agreement with the new scale. The ^3He quasiparticle effective mass, $m_3^*(P)$, extd. from the normal-phase data agrees well with previously reported results based on higher-temp. specific-heat data. The values of $m_3^*(P)$ from Haavasoja and co-workers are ~20% smaller. However, if their specific-heat data are reanalyzed by using the new temp. scale, the 2 sets of values are brought into good agreement. The large discrepancies between previous specific-heat measurements are probably due almost entirely to differences in temp. scales. The new normal-phase specific-heat data at low pressures show no evidence of the anomalous behavior obsd. by Hhaavasoja and co-workers. Consequently, the size of the specific-heat jump at T_c could be detd. with little ambiguity over the entire pressure range. $\Delta C/C$ Is only a few % larger than the weak-coupling value at $P = 0$ and increases linearly with sample d. At high d. the temp. dependence of the sp. heat below T_c shows small deviations from theory.

^3He 1987

108: 119283h **Helium-3 melting curve below 15 mK.** Fukuyama Hiroshi; Ishimoto, Hidehiko; Tazaki, Tetsurou; Ogawa, Shinji (Inst. Solid State Phys., Univ. Tokyo, Tokyo, Japan 106). *Phys. Rev. B: Condens. Matter* 1987, 36(16), 8921-4 (Eng). Measurements were made of *P-T* relation along the ^3He melting curve for temps. between 0.4 and 15 mK in zero magnetic field. Three distinct points on the melting curve (the 2 superfluid transitions and the nuclear-spin ordering in the solid phase) are obsd. at temps. lower than the currently accepted values by ~10%. These results agree with the *P-T* relation recently proposed by D. Greywall (1986) using a La-Ce Mg nitrate thermometer, but differ seriously from the thermodn. measurements by W. Halperin et al. (1978). From the measured melting curve, the ground-state energy was detd. of a nuclear spin in solid ^3He to be −1.24 mK at the melting d. This value can be quant. explained by the current 4-spin exchange theory.

Кривая плавления

C.A. 1988, 108, N14

^3He

1987

9 Е590. Кривая плавления ^3He ниже 15 мК. ^3He melting curve below 15 mK. Fukuyama Hiroshi, Ishimoto Hidehiko, Tazaki Tetsurou, Ogawa Shinji. «Phys. Rev. B: Condens. Matter», 1987, **36**, № 16, 8921—8924 (англ.)

Проведены новые *P*—*T*-измерения вдоль кривой плавления ^3He в области т-р 0,4—15 мК при нулевом магн. поле. Использовался платиновый ЯМР-термометр, прокалиброванный выше 15 мК по реперным сверхпроводящим точкам. Предложено ур-ние с десятью коэф., хорошо описывающее наблюдаемую зависимость *P* от *T*. Полученные результаты согласуются с данными Грейволла (Greywall D. S. «Phys. Rev.», 1986, **B33**, 7520), который использовал термометрию, на основе восприимчивости лантан-церий-магниевого нитрата, и сильно отличаются от термодинамич. измерений Гальперина и др. (Halperin W. P. et al. «J. Low Temp. Phys.», 1978, 31, 617). Сообщаются значения т-р фазовых переходов на кривой плавления: $T_A = 2{,}477 \pm 0{,}026$ мК; $T_B = 1{,}933 \pm 0{,}021$ мК; $T_s = 0{,}914 \pm 0{,}012$ мК, где T_A и T_B — т-ры перехода в сверхтекучие *A*- и *B*-фазы, T_s — т-ра ядерного спинового упорядочения в твердом ^3He. Э. Р.

Кривая плавления

ф.1988, 18, N 9

^3He (K)

1987

108: 83190j **Specific heat of magnetically ordered bcc. helium-3.** Greywall, Dennis S. (AT and T Bell Lab., Murray Hill, NJ 07974 USA). *Jpn. J. Appl. Phys., Part 1* 1987, 26(Suppl. 26-3, Proc. Int. Conf. Low Temp. Phys., 18th, 1987, Pt. 1), 413-14 (Eng). Precise specific-heat measurements were made on low-d. samples of bcc. ^3He at 0.6-10 mK and for magnetic fields of 0, 6, and 10 kOe. When plotted as functions of T/T_c, the high-field data lie on a universal curve which exhibits a peak characteristics of a λ-type transition. It is also obsd. that T_c (10 kOe) $\propto V^{8.7}$, that $V_{spin} \propto T_c(H)$, and that the field-induced in the paramagnetic phase sp. heat is proportional H^2/T^2 near T_c.

(Cp)

C. A. 1988, 108, N 10.

^3He 1987

108: 193796u **Proposed major revision in the millikelvin temperature scale.** Greywall, Dennis S. (AT and T Lab., Murray Hill, NJ 07974 USA). *Can. J. Phys.* 1987, 65(11), 1328-9 (Eng). A new millikelvin temp. scale is presented that is based, in part, on the constraint that the normal-phase sp. heat of liq. ^3He be linear in temp. with a proportionality const. taken from higher temp. specific-heat measurements. The new scale differs considerably from all of the commonly used scales but provides an explanation for the long-standing ^3He specific-heat controversy.

(G)

C. A. 1988, 108, N 22

^{3}He | от. 28561 | 1987

Карнацевич Л.В., Богоявленский И.В. и др.,

Физ. низ. температур, 1987, 13, № 12, 1261–1264.

Диаграмма энтропия — температура для ^{3}He.

^3He 1987

107: 183813n Phase transitions in partially spin-polarized helium-3. Barranco, M.; Polls, A.; Stringari, S.; Nacher, P. J.; Laloe, F. (Fac. Fis., Univ. Barcelona, Diagonal, Spain 647). *J. Phys., Colloq.* 1987, (C2), C2-101/C2-106 (Eng). Liq.-gas equil. phase diagrams are given for partially spin-polarized ^3He. At low temps., interesting phenomena such as liq. metamagnetism and liq. overpolarization were found.

фазовый переход

C.A. 1987, 107, N20

^3He 1987

107: 183811k Theory of the phase transition of helium-3 to the superfluid state. Marchenko, V. I. (Inst. Fiz. Tverd. Tela, Chernogolvka, USSR). *Zh. Eksp. Teor. Fiz.* 1987, 93(1), 141–50 (Russ). All extrema of the Landau energy in the phase transition of He-3 to the superfluid state are found.

фазовий перехід

C.A. 1987, 107, N 20

^3He

1987

109: 80779t **The heat capacity of liquid helium-3 beyond T·log T.** Schakel, A. M. J.; Calkoen, C. J.; Van Weert, C. G. (Inst. Theor. Phys., Univ. Amsterdam, 1018 XE Amsterdam, Neth.). *Can. J. Phys.* 1987, 65(11), 1549–51 (Eng). The heat capacity of liq. ^3He up to 2.5 K was calcd. on the basis of a spin-fluctuation model in the context of the Landau theory of Fermi liqs. A good fit of the data was achieved by including the temp. dependence of the magnetic susceptibility, and by using a different, smaller, quasiparticle mass. The magnetic susceptibility and the compressibility are analytic functions of the temp.

(C_p)

C. A. 1988, 109, N 10

^4He и ^3He

1988

4 И55. Вириальные коэффициенты изотопов гелия при низких температурах. Карнацевич Л. В., Богоявленский И. В., Титарь Л. П. «Физ. низ. температур», 1988, 14, № 1, 3—14 (рез. англ.)

На основании эксперим. $P—V—T$ данных в области давлений 0,2—8 атм, плотностей 0,001—0,03 моль/см³ и т-р 3—14 К определены значения второго (B) и третьего (C) вириальных коэф. изотопов гелия (^4He и ^3He). Для полученных результатов совместно с литер. данными в интервале т-р 2—60 К подобраны аппроксимирующие аналитич. выражения. Эксперим. значения B и C для ^4He и ^3He проанализированы с точки зрения квантового закона соответственных состояний и имеющихся теоретич. расчетов при различном выборе формы парного потенциала взаимодействия атомов гелия.

Резюме

вириальные коэффициенты

ф. 1988, 18, N 4

He

1988

110: 29322g Determination of the parameters of the BWR equation of state for gases. Malijevska, Ivona; Fenclova, Dana; Labik, Stanislav; Malijevsky, Anatol; Novak, Josef P. (VSCHT, Prague, Czech.). *Sb. Vys. Sk. Chem.-Technol. Praze, Fys. Chem.* 1988, 9, 207-17 (Czech). The methods of detn. and estn. of the consts. of the equation of state from the different data sources are discussed. A specific treatment of the data processing is demonstrated on the examples of air and He.

Ур-ие состоян.

C.A. 1989, 110, N 4

He (к)

1988

2 Б3065. **Фазовая диаграмма при высоких давлениях до 23,3 ГПа и уравнение состояния твердого гелия, полученные из рентгенографии монокристаллов.** High-pressure phase diagram and equation of state of solid helium from single-crystal X-ray diffraction to 23.3 GPa. / Mao H. K., Hemley R. J., Wu Y., Jephcoat A. P., Finger L. W., Zha C. S., Bassett W. A. // Phys. Rev. Lett.— 1988.— **60**, № 25.— С. 2649—2652.— Англ.

Методом рентгенографии монокристалла с синхротронным излучением изучены фазовые соотношения тв. ^4He при давл. 15,6—23,3 ГПа и т-ре 300 К. Чистота ^4He составляла 99,999%. Представлена фазовая диаграмма ^4He. Структура тв. ^4He — гексагон. плотноупакованная в широком интервале давл. Параметры решетки и мол. объем тв. ^4He уменьшаются с ростом давл. Сжимаемость тв. ^4He значительно больше, чем рассчитанная методом парных Пт.

Л. Г. Титов

фазовая диаграмма

Х. 1989, N2

^3He (om. 29 241) 1988

Masuda Y., Iwahashi K., et al.,

C_p;

Can. J. Phys., 1988, N 65, N 11, 1346 – 1350.

Calorimetric studies of body - centered cubic solid ^3He

$^3He + ^4He$ (смесь) (Om 30 098) 1988

Cp,

109: 136178r **Heat capacity of helium-3/helium-4 mixtures.** Owers-Bradley, J. R.; Main, P. C.; Bowley, R. M.; Batey, G. J.; Church, R. J. (Dep. Phys., Univ. Nottingham, Nottingham, UK). *J. Low Temp. Phys.* 1988, 72(3-4), 201-12 (Eng). The sp. heat capacities were measured of three dil. mixts. (2.6, 1.07, and 0.44%) of ^3He in ^4He and of pure ^4He. The ^4He contribution to the sp. heat of the mixt. is subtracted, leaving only the ^3He part. This is fitted to a theor. expression over the whole temp. range from 10 to 700 mK. By assuming a dispersion relation of the form $\epsilon = \hbar^2k^2(l + \gamma k)^2)/2m^*$, the fits yield the value of γ and the effective mass m^* of each mixt. The av. value of γ is -0.076 ± 0.01 A^2 and the effective mass in the limit of zero concn. is (2.23 ± 0.02) m_3. These are compared to values deduced from other measurements.

C. A. 1988, 109, N 16.

3He (ж) (Эл. 29240) 1988

Schakel A.M.J., Calkoen Ch.J. et al.,

Ср; Can. J. Phys., 1988, N65, N11, 1549-1551.

^3He 1989

Barrat Jean Louis,
Loubeyre Paul, et al.

Кривые плавлен.

J. Chem. Phys. 1989,
90 (10), 5644–50.

(см. ^4He; I)

He[3]

1989

112: 43707j Nuclear spin heat capacity of helium-3 adsorbed on graphite. Greywall, Dennis S. (AT and T Bell Lab., Murray Hill, NJ 07974 USA). *AIP Conf. Proc.* 1989, 194(Quantum Fluids Solids), 213-16 (Eng). The heat capacities of ^3He films absorbed on graphite were measured for films between one and five at. layers and for temps. between 2 and 200 mK. The results are compared with recent magnetization data which also show several anomalies in this coverage regime. Prior to third layer promotion, the second layer is found to solidify into a registered structure with unusual properties. This contradicts the model proposed to explain the NMR measurements.

(C_p)

C.A. 1990, 112, N 6

He^3 (Оm. 32582) 1989

Greywall D. S., Bush P. A.,

(G) Phys. Rev. Lett., 1989, 62, N 16, 1868-1871.

3 He

1989

(Пт)

110: 180441r Crystallization thermometer with a generator based on a tunnel diode for measuring ultralow temperatures. Mikheev, V. A.; Movsesyan, G. D.; Babayan, K. Z.; Mina, R. T.; Maidanov, V. A.; Mikhin, N. P.; Chagovets, V. K.; Sheshin, G. A. (USSR). *Prib. Tekh. Eksp.* 1989, (1), 226–7 (Russ). The construction of the crystn. thermometer is based on the dependence of the m.p. of He-3 on pressure. The temp. interval for the measurement is 1–600 mK.

C.A. 1989, 110, N 20

³He

1990

7 И10. **Аппроксимирующая формула для давления насыщенных паров ³He.** Fit function for the vapour pressure of ³He / Elsner Albrecht // Phys. Lett. A.— 1990.— 149, № 4.— С. 184—190.— Англ.

Рассмотрены аппроксимирующие ф-ции (АФ) для давления насыщенных паров ³He вида:

$$\ln P = \alpha_1 \ln T + \sum_{\nu=2}^{n} \alpha_\nu T^{\nu-3}$$

(P — давление паров, T — т-ра), используемые в температурных шкалах 1962 ³He и EPT-76 (³He). Утверждается, что попытка построения фазовых диаграмм на основе этих АФ приводит к несоответствию между различными термодинамич. величинами в области низких т-р и выше 3 К. В частности, не выполняется условие на производную уд. теплоты парообразования ε по т-ре,

(p)

Ф. 1991, N 7

$$\lim_{T \to 0} \frac{\partial \varepsilon}{\partial T} = 0,$$

и неравенство

$$\frac{d^2 \ln (P/T)}{d (\ln T)^2} \geqslant 0,$$

следующее из ф-лы Клапейрона — Клаузиуса. Требование выполнения этих условий приводит к ряду соотношений между коэф. α_1, α_2, α_3, α_4 аппроксимирующей функции. А. П.

$^3He - ^4He$ 1992

11 Б3013. **Теплофизические свойства сверхтекучих растворов** $^3He - ^4He$ /Адаменко И. Н., Немченко К. Э., Цыганок В. И. //9 Теплофиз. конф. СНГ, Махачкала, 24—28 июня, 1992 :Тез. докл .—Махачкала ,1992 .—С. 43 .—Рус.

теплофиз. св-ва

Х. 1993, N 11

$^3He-^4He$ 1992

121: 19477z **Specific heat and transport properties of dilute $^3He-^4He$ mixtures based on polaron model.** Wittes, Johan (Univ. Instelling Antwerpen, Belg.). 1992. 93 pp. (Eng). Avail. Univ. Microfilms Int., Order No. DA9223315. From *Diss. Abstr. Int. B* 1992, 53(3), 1448.

(C_p)

C.A. 1994, 121, N2

Hc

1993

17 Б3020. Автоматизированная изохорная аппаратура для измерения плотности смесей флюидов при температурах от 298,15 К до 773,15 К и давлениях до 40 МПа: результаты для гелия и азота. Automated isochoric apparatus for the measurement of density of fluid mixtures at temperatures from 298,15 K to 773.15 K and pressures up to 40 MPa: results for helium and for nitrogen /Fenghour A., Wakeham W. A. //J. Chem. Thermodyn. .— 1993 .— **25** ,№ 7 .— С. 831—845 .— Англ.

Описана новая полностью автоматизир. эксперим. установка, предназначенная для измерения плотности смесей флюидов при т-рах 298,15—773,15 К и давл. до 40 МПа с точностью ±0,05% и основанная на принципе почти изохорных измерений с использованием сферич. сосуда давл. На описанной установке измерены плотности гелия вдоль трех изохор при т-рах 321—670 К и давл. до 21 МПа и азота вдоль пяти изохор при т-рах 321—680 К для давл. до 37 МПа. Результаты измерений подтвердили надежность работы новой установки и ожидаемую точность эксперим. результатов.

В. Ф. Байбуз

(PVT-данные)

(Н)

Х. 1994, №17.

№2

^3He 1993

120: 16775p **Heat capacity of low temperature solid helium-3.** Sun, Z.; Hetherington, J. H. (Dep. Phys. Astron., Michigan State Univ., East Lansing, MI 48824-1116 USA). *J. Low Temp. Phys.* 1993, 91(5-6), 299-313 (Eng). The authors have calcd. the spin wave spectra and from these the sp. heats of CNAF and UUDD solid ^3He at low temps. The values are compared with exptl. data and are in good agreement even though the authors also find major deviations from simple T^3 behavior. The calcn. included the six-spin exchange terms now recognized to be important for quant. calcns. The inclusion of these terms was made more tractable by application of an algebraic technique from nuclear theory (RPA) for execution of the spin wave calcn., which nevertheless involved lengthy anal.

(C_p)

C. A. 1994, 120, N2

He

1994

121: 142875c Measurement of the heat capacity of helium under superfluid flow conditions near the lambda transition. Chui, T. C. P.; Israelsson, U. E.; Lysek, M. J. (Jet Propul. Lab., Calif. Inst. Technol., Pasadena, CA 91109 USA). *Physica B (Amsterdam)* 1994, 194–196, 491–2 (Eng). A proposed expt. to measure the heat capacity of He under superfluid flow condition near the lambda transition is discussed. This expt. would clarify the role of the superfluid d. depression vs. the role of the intrinsic crit. velocity, in the description of the property of He.

Ср вблизи
λ перехода

C.A. 1994, 121, N 12

$^3He-^4He$ 1994

121: 309539n Refrigeration and thermometry of liquid $^3He-^4He$ mixtures in the ballistic regime. Konig, R.; Betat, A.; Pobell, F. (Univ. Bayreuth, D-95440 Bayreuth, Germany). *J. Low Temp. Phys.* 1994, 97(34), 311-33 (Eng). The ballistic regime of liq. $^3He-^4He$ mixts. is characterized by a large mean free path λ of the thermal excitations compared to the characteristic dimension of the expt. Investigations are reported of the transport properties of mixts. as well as superfluid ^3He in the ballistic regime by means of the vibrating wire technique. In order to avoid possible sources of heat leaks into the liq., the exptl. setup was built as far as possible of pure materials only. The contribution of a Ag sinter to the heat leak as well as its influence on the attainable min. temp. of the mixts. were investigated by performing measurements in two similar setups which differed in the size of the heat exchanger by about one order of magnitude. Moreover, the vibrating wire were used partly immersed in the superfluid ^3He-B phase of a phase-sepd. mixt. as a very sensitive, continuously monitoring thermometer for liq. mixts. in their ballistic regime. The achieved min. temp. of a 6.8%-mixt. at p = 0.35 bar and of a 9.5%-mixt. at p = 9.8 bar was 130 μK. This value can be considered as an upper limit for the temp. of the mixts. as the damping of the vibrating wire thermometer sats. at this temp. due to its intrinsic properties.

C.A. 1994, 121, N 26

He

1994

121: 165011j Heat capacity and thermal relaxation of bulk helium very near the lambda point. Lipa, J. A.; Swanson, D. R.; Nissen, J. A.; Chui, T. C. P. (Department Physics, Stanford University, Stanford, CA 94305 USA). *Physica B (Amsterdam)* 1994, 197(1–4), 239–48 (Eng). In Oct. 1992 a low temp. expt. was flown on the Space Shuttle in a low earth orbit. The objective of the mission was to measure the heat capacity and thermal cond. of helium very close to the lambda point with the smearing effect of gravity removed. The authors report preliminary results from the expt., and compare them with related measurements performed on the ground. The sample was a sphere of helium 3.5 cm in diam. contained within a copper calorimeter of very high thermal cond. The calorimeter was attached to a pair of high-resoln. paramagnetic salt thermometers with noise levels in the 10^{-10} K range and suspended from a high-stability thermal isolation system. During the mission the authors found that the resoln. of the thermometers was degraded somewhat due to the impact of charged particles. This effect limited the useful resoln. of the measurements to about two nanokelvins from the lambda point. The results reported here are limited to about ten nanokelvins from the transition.

(C_p)

C. A. 1994, 121, N 14

^3He 1994

121: 142884g Thermodynamic properties of bcc solid ^3He near the ordering transitions. Ni, W.; Xia, J. S.; Adams, E. D. (Cent. Ultralow Temp. Res., Univ. Fla., Gainesville, FL 32611 USA). *Physica B (Amsterdam)* 1994, 194–196, 941–2 (Eng). The melting pressure of magnetically ordered solid ^3He near the LFP–PP, HFP–PP and LFP–HFP transitions was measured in various fields. The entropy in each phase and the discontinuity across the transition are obtained from dP/dT. In the LFP, the authors find a weak field-dependence of the entropy. The magnetization is almost temp.-independent. The entropy discontinuity, $\Delta S/R\ln 2$, at the LFP–PP transition changes from 0.42 for B = 0 to 0.38 for B = 0.39 T. The magnetization discontinuity across the LFP–PP phase boundary, $\Delta M/M_{sat}$ obtained from ΔS and the slope dT_N/dB, is proportional to the magnetic field. The measurements are also extended to LFP–HFP and HFP–PP transitions.

(Pm)

C.A. 1994, 121, N12

He

1994

· 121: 142878h The specific heat of confined helium near the lambda point. Nissen, J. A.; Chui, T. C. P.; Lipa, J. A. (Dep. Phys., Stanford Univ., Stanford, CA 94305-4060 USA). *Physica B (Amsterdam)* 1994, 194-196, 615-6 (Eng). Heat capacity measurements of the liq. He lambda transition in confined geometries have long been in disagreement with scaling theories of 2nd order phase transitions. The authors present measurements of a 19 μ He film which extend previous work to near macroscopic size. The new data are in substantial agreement with recent renormalization group theory calcns.

(Ср. вблизи λ перехода)

C.A. 1994, 121, № 12

3 He

1994

121: 142280g A thermodynamic calculation of the vapor pressure vs. temperature relation of ^{3}He. Reesink, Alex L.; Durieux, Marten (Kamerlingh Onnes Lab., Rijksuniv. Leiden, 2300 Leiden, Neth.). *Physica B (Amsterdam)* 1994, 194-196, 29-30 (Eng). Vapor pressures of ^{3}He have been calcd. from exptl. data on the virial coeffs. of the vapor phase and heat capacities and densities of the liq. phase, together with a chosen value for the heat of vaporization at T = 0. The results of the calcns. are compared with the vapor pressure equations for ^{3}He which define international temp. scales (EPT-76 and ITS-90). Between 1 K and 0.5 K differences from the latter scales have been found, amounting to + 1 mK at 0.5 K, similar to results obtained from magnetic thermometry and thermodn. calcns. by other authors.

(P, расчёт)

C.A. 1994, 121, N 12

^3He 1994

123: 323420q **Entropy and heat capacity of the ideal Fermi-gas ^3He in an external linear field in the range 0–20 K.** Rudakov, E. S.; Davidenko, G. I. (Inst. Fiz. Org. Khim. Uglekhim., Donetsk, Ukraine 340114). *Ukr. Fiz. Zh.* 1994, 39(7–8), 819–22 (Ukrain). Chem. potential, potential $\bar{\Phi}$ and kinetic $\bar{K}$ energies, entropy S, and heat capacity C_v were calcd. for the ideal Fermi-gas ^3He in the external field $\varphi = \lambda x$. It is shown that the inequality $S \leq S^*$ and the inequalities $C_v \geq C^*$, when $T \leq T_a$ and $C_v \leq C_v^*$ when $T \leq T_d$ are held. Here S^* and C_v^* are entropy and heat capacity of the system in the absence of the field under the same T, V, N (T_d is the parameter). It is also found that $\partial\bar{K}/\partial\lambda^2 > 0$ and $\partial(\bar{\Phi}/\lambda)/\partial\lambda < 0$.

(Cp)

C. A. 1995, 123, N 24

He

1994

121: 142877g Specific heat of confined ^4He near T_λ in 3 dimensions. Sutter, Peter; Dohm, Volker (Inst. fur Theor. Phys., Tech. Hochsch., Aachen, Germany). *Physica B (Amsterdam)* 1994, 194–196, 613–4 (Eng). The authors present the results of a renormalization-group calcn. of the sp. heat of confined ^4He near T_λ for 3 different geometries: parallel plates, rectangular box, and cube in 3 dimensions. The results for the plate geometry are compared with existing data and with recent $4 - \epsilon$ expansion results at $\epsilon = 1$. Predictions are made for measurements close to T_λ under microgravity conditions.

(Cp вблизи λ перехода)

C.A. 1994, 121, N 12

He

1994

121: 142879j **Heat capacity of thin films of ^4He in Vycor near the critical coverage.** Van Keuls, F. W.; Crowell, P. A.; Reppy, J. D. (Mater. Sci. Cent., Cornell Univ., Ithaca, NY 14853-2501 USA). *Physica B (Amsterdam)* 1994, 194-196, 623-4 (Eng). The authors report on a study of the heat capacity of thin films of ^4He adsorbed in porous Vycor glass for temps. between 20 and 700 mK. As in previous work, the authors find a crit. coverage, $n_c \sim 26.6 \mu mol/m^2$, above which superfluidity was obsd. For coverages greater than n_c, the heat capacity varies linearly with temp. above the superfluid transition temp. T_c. A linear dependence at high temps. for coverages below n_c was also obsd. At lower temps., however, the heat capacity for these coverages decreases with a much stronger temp. dependence. These data are discussed in the context of recent theor. work on the onset of superfluidity in disordered systems.

(Ср. вблизи
λ перехода)

C. A. 1994, 121, N 12

He

1994

121: 142876f Finite-size scaling of the specific heat of ^{4}He near T_λ. Wacker, Andreas; Dohm, Volker (Inst. fur Theor. Phys., Tech. Hochsch., Aachen, Germany). *Physica B (Amsterdam)* 1994, 194–196, 611–2 (Eng). The authors reanalyze specific-heat data of ^{4}He near T_λ confined to pores. Unlike earlier analyses the authors do not find a contradiction to finite-size scaling within the error bars of the data. Comparison with a calcd. scaling function suggests that a pure surface exponent should be observable only in systems of larger size.

(Ср. статьи λ перехода)

C.A. 1994, 121, N 12

He

1995

122: 116303t **Heat capacity of helium confined to 8–μm cylinders near the λ point.** Coleman, M.; Lipa, J. A. (Physics Dep., Stanford Univ., Stanford, CA 94305 USA). *Phys. Rev. Lett.* **1995**, 74(2), 286–9 (Eng). Reported are the results of heat capacity measurements on helium confined in 8–μm diam. cylinders in the temp. region spanning the λ point. The data allow improved tests of the emerging history of finite size phenomena and crossover to lower–dimensional states. In contrast to earlier work with much smaller holes, good agreement was found with scaling using exponents derived by renormalization methods. Also found was a reasonable agreement with more detailed calcns. of crossover behavior based on explicit inclusion of boundary conditions.

(C_p)

C. A. 1995, 122, N10

^4He 1995

(Cp)

вблизи λ-перехода

124: 68122a Specific heat and superfluid density of bulk and confined ^4He near the λ-transition. Williams, Gary A. (Dep. Phys., Univ. California, Los Angeles, CA 90095 USA). *J. Low Temp. Phys.* 1995, 101(3/4), 421–6 (Eng). The sp. heat and superfluid d. of liq. ^4He are calcd. using a vortex-ring renormalization group theory, both for the bulk fluid and for confinement in a sphere of diam. L. In the finite geometry the superfluid d. remains finite and universal at T_λ, in agreement with Monte Carlo simulations and with finite-size scaling. The specific-heat peak is flattened in the finite geometry, and the onset temp. of the deviation from bulk behavior approaches T_λ more closely as L is increased.

C.A. 1996, 124, N6

^3He, ^4He

1995

123: 210049g **Specific heat of He adsorbed on Y-zeolite cluster model approach.** Tasaki, Shuichi (Institute for Fundamental Chemistry, Kyoto, Japan 606). *Prog. Theor. Phys.* 1995, 93(5), 857–69 (Eng). The sp. heats of ^3He and ^4He adsorbed on Y-zeolite are studied by considering the behavior of at. clusters in a single void. A tetrahedral lattice model is used to describe the cluster behavior. Qual. features of the obsd. low-temp. sp. heat are explained. The model can predict a low-temp. peak of the sp. heat for the case where three ^3He atoms per void are adsorbed onto the second layer. key heat capacity helium adsorbed zeolite.

(C_p)

C-A. 1995, 123, N 16.

Тв. раствор изотопов гелия

1996

126: 23517h Heat capacity of solid solution of helium isotopes. Antsygina, Tatyana N.; Chishko, Konstantin A.; Slusarev, Vladislav A. (B. Verkin Institute Low Temperature Physics & Engineering, Ukrainian National Academy Sciences, Kharkov, Ukraine 310164). *Czech. J. Phys.* 1996, 46(Suppl., Pt. S1, Proceedings of the 21st International Conference on Low Temperature Physics, 1996, Part S1), 505–506 (Eng), Institute of Physics, Academy of Sciences of the Czech Republic. The addnl. low-temp. heat capacity of helium isotope solid solns. with a concn. x_3 of a few percent ^3He is calcd. theor. The impurity contribution to the thermodn. of the soln. is assumed to be result of phase sepn. of the solid soln. and the formation of quasi–1–dimensional structures of the second phase of ^3He atoms by their setting on lines of lattice dislocations or by the buildup of fractal structures. The excess heat capacity in the temp. interval 50–200 mK, is in the form of a peak, whose position essentially depends only on the depth of the potential well $\epsilon_0 \simeq -1$ K created by a dislocation for an impurity atom. The height of the peak is detd. primarily by the parameter $\xi \simeq 10^{-6}–10^{-3}$, which represents the fraction of matrix lattice sites that can be occupied by the 1–dimensional phase. The energy of interaction between impurities, $U \simeq 0.1$ K is found to have an insignificant influence on the shape and position of the peak. The theor. results exhibit good agreement with published exptl. data for a soln. with $x_3 = 0.9\%$ ^3He for one and only one choice of fitting parameters: $\xi = 0.0058$; $U = 0.13$ K; $\epsilon = -0.92$ K.

(Г)

C. A. 1997, 126, N 2

3 He

1996

125: 20154f **Enhanced heat capacity of amorphous helium films.** Golov, Andrei; Pobell, Frank (Physikalisches Institut, Universitaet Bayreuth, D-95440 Bayreuth, Germany). *Physica B (Amsterdam)* **1996**, 219&220, 650-652 (Eng). The low-temp. heat capacity was measured of ^3He films adsorbed on porous Vycor glass at coverages <16 atoms/nm^2. At very low temps., such films represent an amorphous solid state of condensed helium. At temps. T>100 mK, when magnetic exchange heat capacity is negligible, the sp. heat could be fit with $aT + bT^2$ dependence. The same temp. dependence has already been reported for the sp. heat of nonsuperfluid films of ^4He on Vycor (R. Tait and J. Reppy (1979)), and the linear term was related to a band of extended states of ^4He atoms. The properties of ^3He films as compared to those of ^4He films are discussed.

(Cp)

C.A. 1996, 125, N2

He (ж)

1996

124: 213212m **Heat capacity and thermal relaxation of bulk helium very near the lambda point.** Lipa, J. A.; Swanson, D. R.; Nissen, J. A.; Chui, T. C. P.; Israelsson, U. E. (Dep. Phys., Stanford Univ., Stanford, CA 94305 USA). *Phys. Rev. Lett.* **1996**, 76(6), 944–7 (Eng). New high–resoln. measurements are reported of the heat capacity of liq. helium to within 2 nK from the lambda transition, performed with a large sample in earth orbit. The optimum value for the crit. exponent characterizing the divergence of the heat capacity below the transition was found to be −0.01285, giving improved support for the renormalization–group theory of phase transitions. Some information on the temp. dependence of the thermal cond. just above the transition was also obtained.

Cp вблизи 2nK

C.A. 1996, 124, N16

He (K) 1996.

126: 149190q **Thermal and physical characteristics of impurity-helium solid phase.** Martynenko, M. V.; Novikov, V. N.; Pel'menev, A. A.; Popov, E. A.; Shidov, E. V. (Mosk. Gos. Univ., Moscow, Russia). *Vestn. Mosk. Univ., Ser. 3: Fiz., Astron.* 1996, (5), 53–60 (Russ), Izdatel'stvo Moskovskogo Universiteta. Results are described of the first expts. of detn. of thermophys. properties of solid He phases formed by condensation in surface flowing He streams. Thermal cond. and heat capacity were detd. at temp. interval 2.2–3 K.

(C_p, 2.2-3K)

C.A. 1997, 126, N 11

$^3He - ^4He$ смесь

1996

126: 37911u **Specific heat of $^3He-^4He$ mixtures at low temperatures and high ^3He concentrations.** Simons, R.; Mueller, Robert M. (Institut fuer Festkoerperforschung, Forschungszentrum Juelich GmbH, D52425 Juelich, Germany). *Czech. J. Phys.* **1996**, 46(Suppl., Pt. S1, Proceedings of the 21st International Conference on Low Temperature Physics, 1996, Part S1), 201–202 (Eng), Institute of Physics, Academy of Sciences of the Czech Republic. The heat capacities of dil. liq. mixts. of ^3He in ^4He were measured for ^3He concns. from 1.3% up to 9.45%, and for temps. between about 15 mK and 200 mK. Pressures ranged from the satd. vapor pressure up to 20 bar. The effective mass of the ^3He quasiparticles was detd. from the heat capacities and was found to increase monotonically with concn. at each of the pressures, in contrast to some previous reports. These new results agree well with the values of effective mass detd. from isochoric pressure measurements by Yoruzu, et al., (1992) in the overlapping region of pressure and concn. but also include accurate data for higher concns. not covered in that expt.

(C_p)

C. A. 1997, 126, N 3

$^3He - ^4He$ смесь

1996

126: 37910t **Heat capacity measurements on $^3He-^4He$ mixtures in aerogel.** Tulimieri, D. J.; Mulders, N.; Chan, M. H. W. (Department Physics, Pennsylvania State University, University Park, PA 16801 USA). *Czech. J. Phys.* 1996, 46(Suppl., Pt. S1, Proceedings of the 21st International Conference on Low Temperature Physics, 1996, Part S1), 199–200 (Eng), Institute of Physics, Academy of Sciences of the Czech Republic. The authors have measured the heat capacity of $^3He-^4He$ mixts. in aerogels for high ^3He concns. For temps. greater than 150 mK the heat capacity is linear in T. This linear region grows substantially with increasing ^4He concn. and for sufficiently low temp. the heat capacity per unit vol. becomes independent of the total concn.

(C_p)

C. A. 1997, 126, N 3

He

1996

124: 243691j Heat capacity of confined helium very near the lambda point. Swanson, D. R.; Nissen, J. A.; Qin, X.; Williamson, P. R.; Lipa, J. A.; Chui, T. C. P.; Israelsson, U. E.; Gasparini, F. M. (Stanford University, Stanford, CA 94305 USA). *J. Spacecr. Rockets* 1996 (Pub. 1996), 33(1), 154–9 (Eng). The authors describe the background and status of a Shuttle mission to measure the heat capacity of helium confined by parallel plates with 57–μm spacing very close to the superfluid transition. The purpose of the expt. is to compare the results with the emerging theory of confined systems with emphasis on the behavior during crossover from three to two dimensions. The expt. will use a cylindrical copper calorimeter of very high thermal cond., partly filled with evenly spaced thin silicon plates. It will be attached to a pair of high–resoln., fast–response paramagnetic salt thermometers with rms noise levels below 0.1 nK/Hz$^{1/2}$ and suspended from a high–stability thermal isolation system previously used on the Shuttle. It is expected to obtain heat capacity data to within 1 nK of the lambda point. In addn., wide–range data contg. information on the behavior of the surface sp. heat will be collected.

Ср. вблизи λ-точки

C. A. 1996, 124, N18

^3He 1997

127: 113513d **Heat capacity of ^3He in Vycor glass.** Golov, A.; Pobell, F. (Physikalisches Inst., Univ. Bayreuth, D-95440 Bayreuth, Germany). *Europhys. Lett.* **1997**, 38(5), 353-358 (Eng), Editions de Physique. The authors have measured the heat capacity of ^3He confined in porous Vycor glass at temps. from 10-500 mK and pressures from 0-28 bar. No significant change of the Fermi temp. or other size-effect corrections to the heat capacity of the liq. part in the center of the Vycor pores have been found. A broad heat capacity peak from the surface layer appears below 50 mK due to the ordering of spins in amorphous solid ^3He. Replacing all the surface ^3He by ^4He removes this contribution and thus reveals the linear heat capacity of confined liq. ^3He along.

(C_p)

C. A. 1997, 127, N 8

Не

1998

пайка алмазов при высоких темп-рах

Dutchi F., et al.,
Koatsuryoku no Kagaku to Gijutsu 1998, 7,
778-780

(см. Кго; I)

^3He 1998

130: 72183n **Specific heat anomaly in bcc solid ^3He.** Kambara, H.; Kishishita, S.; Saitoh, M.; Matsushita, T.; Mamiya, T. (Department of Physics, Nagoya University, Nagoya, Japan 464-8602). *J. Low Temp. Phys.* 1998, 113(5/6), 729–734 (Eng), Plenum Publishing Corp.. The authors have studied the origin of the excess sp. heat (anomaly) above 10 mK in bcc solid ^3He near melting pressure. We applied strong magnetic fields to the sample to see whether the anomaly arises from spin polarons due to vacancies. The sp. heat is the same before and after applying magnetic fields of 10–12 T. This result possibly indicates that the anomaly arises from an origin different from vacancies. Next, in order to check whether the anomaly comes from the surface magnetism, we measured the sp. heat by coating the surface of sintered silver with three layers and two layers of ^4He. The results showed that unexpected large heat capacity due to phase sepn. of solid $^3He-^4He$ surpassed and smeared the original sp. heat anomaly. We are investigating the origin of the anomaly further.

(G)

C. A. 1999, 130, N6

^3He

1998

130: 72176n Low temperature heat capacities of submonolayer solid ^3He. Morishita, M.; Nagatani, H.; Fukuyama, Hiroshi (Institute of Physics, University of Tsukuba, Tsukuba, Japan 305−8571). *J. Low Temp. Phys.* 1998, 113(3/4), 271−276 (Eng), Plenum Publishing Corp.. Heat capacities (C) of ^3He submonolayer solids adsorbed on a graphite surface are measured down to 100 μK, a factor of twenty lower temps. than previous work. At areal densities near the commensurate $\sqrt{3}\times\sqrt{3}$ solid (6.4 nm^{-2}), an anomalous temp. dependence, $C \propto 1/T$, is obsd. in a wide temp. range over two orders of magnitude ($0.1 \leq T \leq 20$ mK). Similar behavior was obsd. for the commensurate $\sqrt{7}\times\sqrt{7}$ solid in the second−layer with the same d., suggesting a common microscopic mechanism. It is, however, a puzzle that the $\sqrt{3}\times\sqrt{3}$ solid is ferromagnetic according to recent magnetization measurements by ISSP group, while the $\sqrt{7}\times\sqrt{7}$ solid is known to be antiferromagnetic. Possible explanations for this conflict, such as vacancy effects or multiple−spin exchanges modulated by a substrate potential corrugation, are discussed.

(G)

C. A. 1999, 130, N6

^3He 1998

130: 72177p **Heat capacities of monolayer ^3He fluids floated on a superfluid ^4He thin film.** Morishita, M.; Nagatani, H.; Fukuyama, Hiroshi (Institute of Physics, University of Tsukuba, Tsukuba, Japan 305-8571). *J. Low Temp. Phys.* 1998, 113(3/4), 299-304 (Eng), Plenum Publishing Corp.. The authors have measured heat capacities of monolayer ^3He floated on a superfluid ^4He thin film (three at. layers) adsorbed on graphite at low temps. The ^3He films behave as degenerate 2D Fermi fluids with $m^* = 1.3m_3$, where m^* is the quasiparticle effective mass and m_3 is the bare mass of ^3He, in the whole temp. range we studied ($1 \le T \le 80$ mK). No anomalous behavior suggesting "puddling" nor other phase transitions is obsd. In contrast to our previous measurements for pure ^3He films without the underlying ^4He film, the temp. independent heat-capacity contribution is not obsd. This can be explained by the second-layer localized spins trapped on substrate heterogeneities being replaced by nonmagnetic ^4He.

(C_p)

C. A. 1999, 130, N6.

He II

1998

129: 166715u **Theoretical study of the specific heat of helium II.** Pao, Lu (Dep. Physics Astronomy, Arizona State Univ., Tempe, AZ 85287 USA). *Chin. Phys. Lett.* 1998, 15(5), 364–366 (Eng), Chinese Physical Society. We present the calcn. of the sp. heat of helium II under pressure of 1 atm from very low temp. to approx. 1.8 K (the transition temp. T_λ = 2.712 K). Exptl., the sp. heat jumps from a finite value to infinity at T_λ. We have been able to reproduce the sp. heat theor. up to 1.8 K.

(C_p, T_λ)

CA 1998, 129, № 13

^3He (ж) 1998

128: 327160f Specific heat of liquid ^3He under pressure in a restricted geometry. Schrenk, R.; Konig, R. (Physikalisches Institut, Universitat Bayreuth, D-95440 Bayreuth, Germany). *Phys. Rev. B: Condens. Matter Mater. Phys.* 1998, 57(14), 8518–8525 (Eng), American Physical Society. The authors have investigated the sp. heat of liq. ^3He confined to an Ag sinter with an av. pore size of about 1000 Å in the temp. range 1 mK≤T≤20 mK and at pressures 4.8 bar≤p≤34.0 bar. The sp. heat of normal-fluid ^3He in the sinter pores shows the linear temp. dependence expected for a Fermi liq. However, the effective mass of the ^3He quasiparticles is clearly enhanced in the restricted geometry compared to data obtained in bulk ^3He. In addn., there is a temp.-independent contribution to the sp. heat, the origin of which can be interpreted as the sp. heat of the second layer of ^3He on the Ag surface. Moreover, compared with the results obtained for bulk ^3He, the authors observe a much broader max. in the sp. heat in the vicinity of the superfluid transition; this max. occurs about 0.4 mK below the bulk superfluid transition temp. Furthermore, in the confinement of the sinter only a part of the ^3He in the sinter (about 60%) becomes superfluid. In contrast to the results obtained with pure ^3He the sp. heat of a liq. ^3He–^4He mixt. (1% ^3He) in the Ag sinter shows no deviation from bulk data.

(Cp)

C. A. 1998, 128, N26

^{3}He 2000

134: 168896f **Crossover analyses of heat capacity and susceptibility measurements near the ^{3}He liquid–gas critical point.** Barmatz, M.; Hahn, Inseob; Zhong, Fang; Anisimov, M. A.; Agayan, V. A. (Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA 91109–8099 USA). *J. Low Temp. Phys.* 2000, 121(5/6), 633–642 (Eng), Kluwer Academic/Plenum Publishers. An expt. called MISTE (Microgravity Scaling Theory Expt.) is being developed for a future mission on the International Space Station. The main objective of this flight expt. is to perform in–situ PVT, heat capacity at const. vol., C_V, and isothermal susceptibility, χ_T, measurements in the asymptotic region of the ^{3}He liq.–gas crit. point. On the ground, gravity induces a d. gradient that does not permit an accurate test of theor. predictions within the asymptotic region. In prepn. for this flight expt., precision ground–based measurements are now being performed in the crossover region away from the crit. point to det. the crossover parameters. Recent C_V and χ_T measurements along the crit. isochore have been analyzed using a new crossover parametric equation–of–state and a field theor. Renormalization Group calcn. based upon the φ^4 model. A description of the exptl. techniques and preliminary results of the theor. analyses will be presented.

(C_p)

(вблизи критической точки жидкость – газ

C.A. 2001, 134, N12

F: He
P: 1

2000

132:353388 Heat capacity measurements of 4He at constant heat flux near T.lambda.. Harter, A. W.; Lee, R. A. M.; Chui, T. C. P.; Goodstein, D. L.

Condensed Matter Physics 114-36, California Institute of Technology Pasadena, CA 91125, USA
Physica B (Amsterdam), 284-288, 53-54 (English) 2000
The heat capacity, CQ, of superfluid 4He in the presence of a const. heat flux, Q, is expected to diverge at a depressed transition temp., Tc(We have taken preliminary measurements of CQ at various heat flux values the range 1 .mu.W/cm2 .ltoreq. Q .ltoreq. 4 .mu.W/cm2. We observe that a sufficiently small reduced temps., CQ is enhanced as a function of Q, and that the enhancement is larger than theor. predictions by Chui et al. and Hausmann and Dohm (Phys. Rev. Lett. 77 (1996) 980, 1793).

C.A.2000, 132

3He

2000

134: 168895c **A preliminary heat capacity measurement of ^3He in aerogel near its superfluid transition.** He, Jizhong; Corwin, A. D.; Zassenhaus, G. M.; Woodcraft, A. L.; Mulders, N.; Parpia, J. M.; Reppy, J. D.; Chan, M. H. W. (LASSP, Cornell University, Ithaca, NY 14853–2501 USA). *J. Low Temp. Phys.* 2000, 121(5/6), 561–566 (Eng), Kluwer Academic/Plenum Publishers. We report simultaneous heat capacity and torsional oscillator measurement of ^3He in aerogel near the superfluid transition. The heat capacity has a peak at the temp. T_c where the torsional oscillator shows the onset of superfluid decoupling. The coincidence of these signatures suggests that ^3He in aerogel does undergo a true thermodn. transition.

(Cp)

C.A. 2001, 134, N12

F: 4He
P: 1 2000

132:353387 Specific heat of 4He confined to 9869 A planar geometry. Kimball, M. O.; Gasparini, F. M. SUNY, The University at Buffalo Buffalo, NY 14260, USA Physica B (Amsterdam), 284-288, 47-48 (English) 2000 The authors report new data for 4He confined between two silicon wafers spaced 9869 A apart. This spacing complements a series of previous measurements which now span a factor of 20 between the smallest and large confinements. These new data allow us to further check scaling predictio We find, as reported with previous data, that the present data scale well except near the heat capacity max., and below into the superfluid region.

C.A. 2000, 132

3He

2080

134: 168894d **Specific heat measurements of ^{3}He in ^{3}He−^{4}He mixture films.** Ho, P.-C.; Hallock, R. B. (Laboratory for Low Temperature Physics, Department of Physics, University of Massachusetts, Amherst, MA 010003 USA). *J. Low Temp. Phys.* 2000, 121(5/6), 501–506 (Eng), Kluwer Academic/Plenum Publishers. Preliminary data for the heat capacity of ^{3}He in ^{3}He−^{4}He mixt. films on a Nuclepore substrate are reported over the temp. range $90 \le T \le 165$ mK, for ^{3}He coverages between 0.05 and 1.7 bulk−d. at. layers, and a ^{4}He film thickness of 4.33 bulk−d. at. layers. In this two−dimensional Fermi liq. system, a step structure appears in the sp. heat as a function of ^{3}He coverage, similar to the step previously obsd. in the magnetization.

(Cp)

C.A. 2001, 134, N12

2000

F: He3 3He
P: 1
133:257473 Phase transitions in liquid helium 3. Kindermann, Markus; Wetterich, Christof

Inst. Theor. Phys., Univ. Heidelberg Heidelberg 69120, Germany

Los Alamos Natl. Lab., Prepr. Arch., Condens. Matter, 1-4, arXiv:cond-mat/0008332, 23 Aug 2000 (English) 2000.

The phase transitions of liq. 3He are described by truncations of an exact nonperturbative renormalization group equation. The location of the first order transition lines and the jump in the order parameter are computed quant. At the triple point we find indications for partially universal behavior.

2000

F: He
P: 1
132:256654 Specific heat of helium confined to micron-scale geometries ne the lambda point. Lipa, J. A.; Coleman, M.; Swanson, D. R.; Nissen, J. A. Geng, Z. K.; Kim, K. Physics Department, Stanford University Stanford, CA, USA Physica B (Amsterdam), 280(1-4), 50-54 (English) 2000 Most expts. to date on the effects of confinement on helium have been restricted to the submicron regime. However, using very high-resoln. thermometry techniques, it has become possible to explore the region extending up to about 100

C.A. 2000, 132

.mu.m. This development dramatically increases range over which length scaling can be tested and eases the problem of uncontrolled surface effects. At the upper end of this length scale, exp in space are needed to reduce the transition broadening due to hydrostati compression. We present the most recent results from a measurement of th sp. heat of helium confined to 57 .mu.m thick planes and compare them wit theor. predictions. We also describe some recent results obtained with helium confined to cylindrical channels with diams. of 0.26 and 8 .mu.m.

^3He

2000

нилкотемп. теплоемк.

$C(T) = \gamma_0 T - \gamma_2 T$

при низких t^0

γ_0 и γ_2 = const

C.A. 2001, 134, N12

134: 168893c **Temperature-squared terms in the heat capacities of ^3He fluid films.** Morishita, Masashi; Misawa, Setsuo (Institute of Physics, University of Tsukuba, Tsukuba, Japan 305-8571). *J. Low Temp. Phys.* 2000, 121(5/6), 483-488 (Eng), Kluwer Academic/Plenum Publishers. Recently the heat-capacity of a two-dimensional Fermi fluid was theor. shown by Misawa to vary as $C(T) = \gamma_0 T - \gamma_2 T^2$ as a function of temp. T at low temp., where γ_0 and γ_2 are consts. To check this prediction, our measured heat capacities of three different systems are reexamd.; i.e., the first-layer and second-layer ^3He fluid films adsorbed on a bare graphite surface and monolayer ^3He films floated on a ^4He thin film adsorbed on graphite. The measured heat capacities are reproduced well by the formula. The areal-d. dependence of γ_2 on each system also coincides with Misawa's prediction if the second order perturbation treatment by Fujimoto is adopted as the self-energy calcn.

^{3}He

2000

132: 353389q **First measurements of the specific heat of highly polarized liquid ^{3}He.** Wolf, P.-E.; Buu, O.; Puech, L. (Centre de Recherches sur les Tres Basses Temperatures, CNRS, Laboratoire Associe a l'Universite Joseph Fourier, 38042 Grenoble, Fr.). *Physica B (Amsterdam)* 2000, 284–288, 186–187 (Eng), Elsevier Science B.V. The first measurements of the sp. heat of highly polarized liq. ^{3}He are reported. The sp. heat is obsd. to decrease with increasing polarization. These results, which agree with a quadratic extrapolation of the low polarization behavior deduced from the temp. dependence of the magnetic susceptibility through Maxwell's relation, are in contradiction with Vollhardt's 'nearly solid' model of liq. ^{3}He.

(C_p)

C.A. 2000, 132, N26

3 He

2001

134: 212932r **Phase Transitions in Liquid ^3He.** Kindermann, Markus; Wetterich, Christof (Institut fur Theoretische Physik, Universitat Heidelberg, 69120 Heidelberg, Germany). *Phys. Rev. Lett.* 2001, 86(6), 1034–1037 (Eng), American Physical Society. The phase transitions of liq. ^3He are described by truncations of an exact nonperturbative renormalization group equation. The location of the first-order transition lines and the jump in the order parameter are computed quant. At the triple point we find indications of partially universal behavior. We suggest expts. that could help to det. the effective interactions between fermion pairs.

(Тр·т)

C.A. 2001, 134, N15

^3He (ж) 2001

134: 77102c **Heat capacity of liquid ^3He in sintered silver powder.** Kishishita, S.; Kambara, H.; Mamiya, T. (Department of Physics, Nagoya University, Chikusa–ku, Nagoya, Japan 464–8602). *Phys. Rev. B: Condens. Matter Mater. Phys.* 2001, 63(2), 024512/1–024512/5 (Eng), American Physical Society. We have measured the heat capacity of liq. ^3He in silver sinter at pressures from 0 up to 3.31 MPa and in the temp. range from about 1 up to 28 mK. The heat capacity in the normal fluid is found to be the sum of the heat capacity of bulk normal fluid and a temp.–independent heat capacity ΔC due to amorphous solid layers on the silver sinter surface, where $\Delta C = 7.3 \pm 6.8\ \mu J\ K^{-1} m^{-2}$ corresponds to 1 ± 1 amorphous solid layers. This value is in rough agreement with other results, including solid ^3He and ^3He adsorbed on Vycor and silver sinter, and differs from the value for liq. ^3He in silver sinter reported by Schrenk and Konig. Our result indicates that the amorphous solid layers on a large surface area yield a universal ΔC in unit area throughout liq., solid, and adsorbed ^3He in contact with a large surface. The superfluid transition temp. of the liq. ^3He in the silver sinter is in good agreement with the theory of Kjaldman and Kurkijarvi when taking the pore diam. to be 3400 Å, and our observations differ from the results of Schrenk and Konig.

(C_p)

C. A. 2001, 134, N6

3 He

2001

135: 216726v **A thermodynamic inspection of the new Provisional Low Temperature Scale from 0.9 mK to 1 K, PLTS−2000.** Reesink, A. L.; van Beelen, H.; Durieux, M. (Kamerlingh Onnes Laboratory, Leiden University, 2300 RA Leiden, Neth.). *Physica B (Amsterdam, Neth.)* **2001**, 300(1−4), 156−166 (Eng), Elsevier Science B.V. The melting curve of ^3He is used as the new extension of the International Temp. Scale of 1990, the PLTS−2000. A thermodn. inspection of this scale is described. It has been carried out by application of the Clausius−Clapeyron equation to the available thermal and pVT data of the liq. and solid phases. The overall agreement is found to be very good. The remaining small discrepancies are within exptl. error. Nevertheless, the present thermodn. inspection does not allow a further narrowing of the uncertainty margin at the lowest temps. of the new scale.

кривая плавления

C.A. 2001, 135, N15