Melting curve of ^{3}He with 0.2% ^{4}He impurity.

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We investigated the melting curve of ^{3}He containing of 0.2% ^{4}He (such ^{3}He are produced at our works) from 0.05 to 0.7 K. Cell design is shown in Figure 1, in which a parallel-plate capacitor senses the displacement of the diaphragm. The interior volume of ^{3}He chamber is 154 mm^3 and contains about 50% of volume of sintered copper powder. The BeCu diaphragm have the diameter 15 mm and thickness 0.6 mm, minimal spacing between capacitor plates is about 6 μm. The sensitivity of such gauge was about 1 Pa, but calibration at 1 K was not so good, because our external pressure standard had uncertainties approximately 1 kPa.

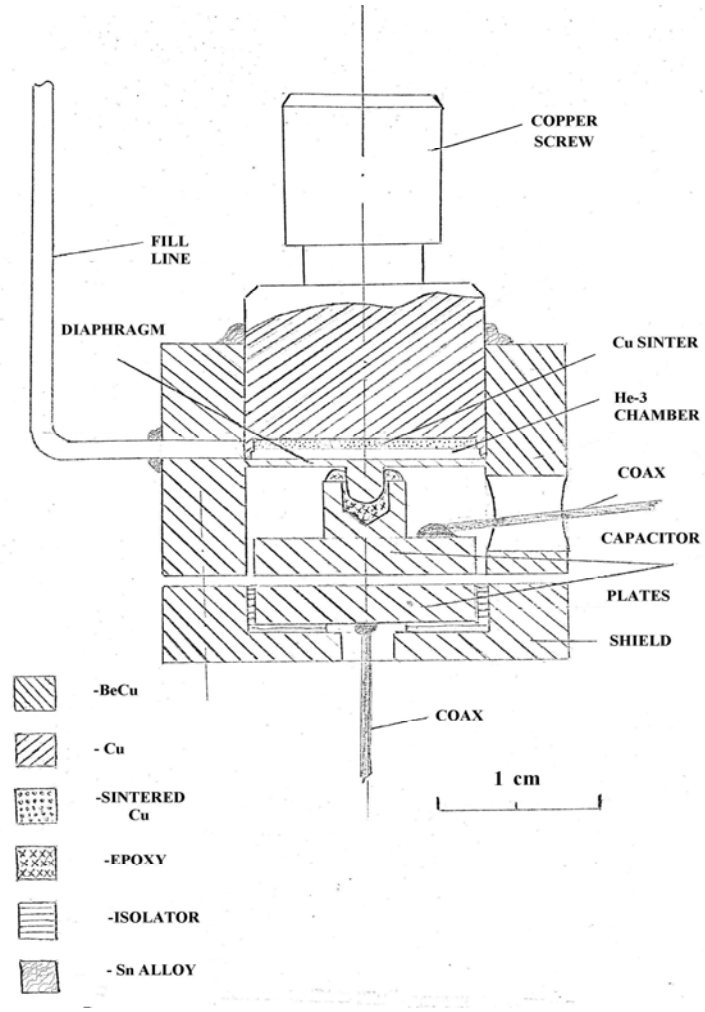

Figure 1. ^{3}He melting-pressure cell.

In copper body of the cell was placed carbon resistance thermometer (in Figure 1 is not shown), which was calibrated from 2 K to 0.05 K in other refrigerator relative to magnetic powder CMN thermometer, which (in one's turn) was calibrated at point 0.05 K relative to ^{60}Co gamma-anisotropy thermometer. The uncertainties of these magnetic scale is not more then 1 mK.

Making corrections for hydrostatic head in the fill capillary, we are described P_m-T data for our ^{3}He sample with polynomial such as in PLTS-2000 [1]. The equation adopted for our melting pressure P_m is :

$$\mathbf{P_m / MPa} = \sum_{i=-3}^{9} \mathbf{A_i (T/K)^i}$$

with the following coefficients:

$A_{-3} = 2{,}7452234 \cdot 10^{-4}$ $A_3 = 4{,}9025185 \cdot 10^3$

$A_{-2} = -2{,}2158311 \cdot 10^{-2}$ $A_4 = -1{,}5897102 \cdot 10^4$

$A_{-1} = 0{,}7393473 \cdot 10^0$ $A_5 = 3{,}5040167 \cdot 10^4$

$A_0 = -9{,}8654414 \cdot 10^0$ $A_6 = -5{,}1639017 \cdot 10^4$

$A_1 = 1{,}4166019 \cdot 10^2$ $A_7 = 4{,}8645161 \cdot 10^4$

$A_2 = -1{,}0229806 \cdot 10^3$ $A_8 = -2{,}6460530 \cdot 10^4$

$A_9 = 6{,}3173899 \cdot 10^3$

Standard error was not more then $1{,}1 \cdot 10^{-3}$ MPa and for pressure minimum received next values:

$T_{min} = 0{,}31658$ K , $P_{min} = 2{,}92312$ MPa

that points out that the pressure and temperature of the minimum shift by -8.0 kPa and +1.34 mK. There is also a change in the slope of the melting curve above and below the minimum. In Figure 2 shown as the melting curve of ^{3}He with 0.2% ^{4}He differ from melting curve of pure ^{3}He described by equation of PLTS-2000.

Such behavior of the melting curve for dirty sample may be explain (perhaps)

by existing Andreev-Pushkarov's clusters of the ^{4}He in solid ^{3}He [2].

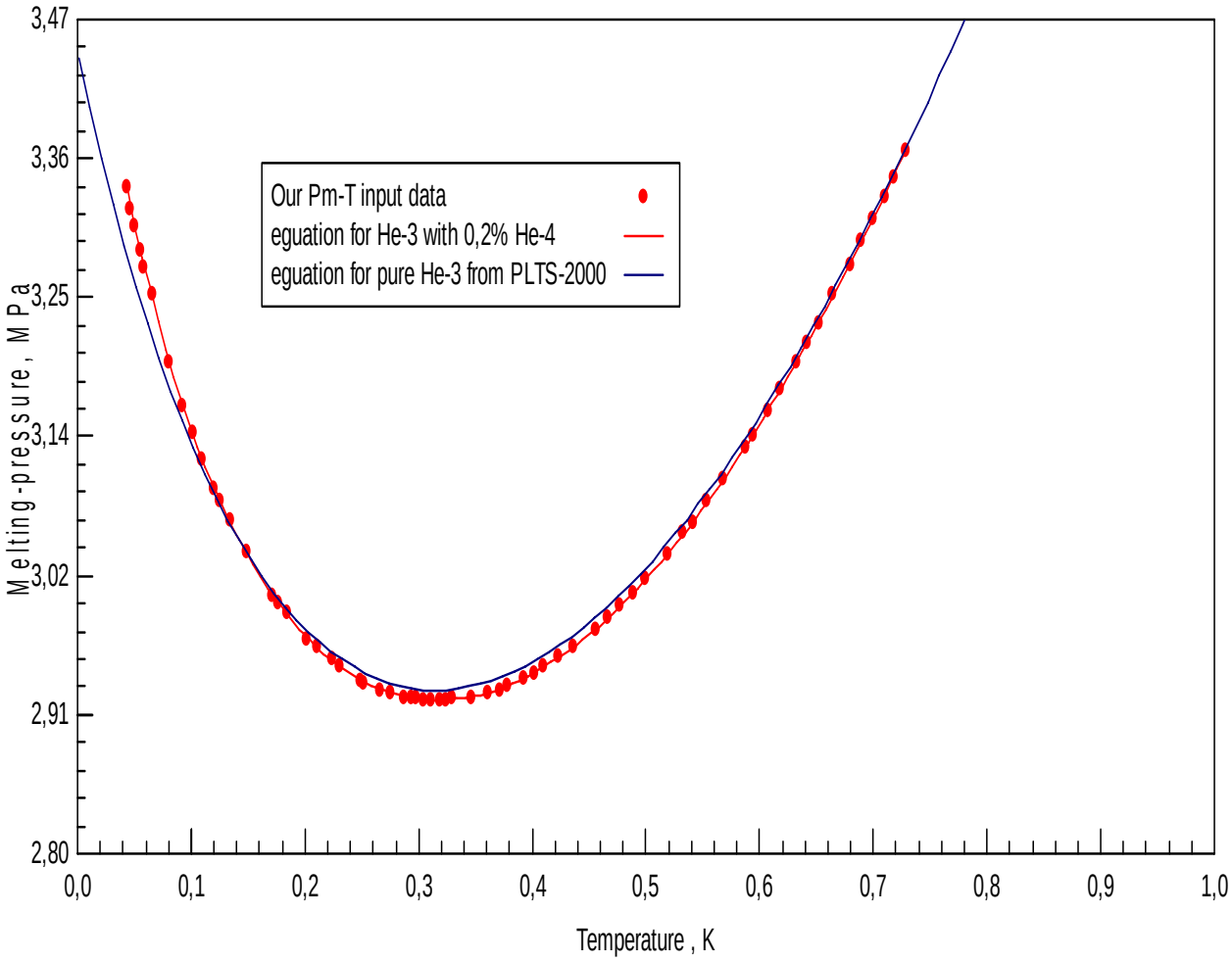

Figure 2. ^{3}He melting curve with 0.2% ^{4}He impurity.

References:

1. Supplementary Information for the Realization of the PLTS-2000.
2. Ganshin A.N.,Grigor'ev V.N.,Maidanov V.A.,Penzev A.,Rudavskii E., Rybalko A. and Syrnikov E.V.,Low Temperature Physics (*Russia*), **27**, N 6, p.509, 2001.