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Effect of High Pressure on the Energy Gap of Indium and Thallium Superconducting Films

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The effect of high pressure (up to 15000 atm) on the energy gap of In and Tl superconducting films was investigated by the tunnel effect on superconductor-barrier-superconductor systems. As directly found in the experiments, the In values $2 \Delta/kT_c$ indicate a reduction of the electron-phonon interaction under pressure for this metal. In the range up to 8 katm the value $2 \Delta/kT_c$ for Tl remained constant within the experimental error and was found to be 3.64 ± 0.06 .

Методом туннельного эффекта на системах сверхпроводник-барьер-сверхпроводник изучалось влияние высоких (до 15000 атм) давлений на энергетическую щель сверхпроводящих пленок In и Tl. Непосредственно найденные в экспериментах значения $2 \Delta/kT_c$ для индия указывают на ослабление электрон-фононного взаимодействия под давлением для этого металла. Для таллия в области давлений до 8 катм в пределах погрешности эксперимента величина $2 \Delta/kT_c$ оставалась постоянной и составляла $3,64 \pm 0,06$.

1. Introduction

The central part of microscopic theory of superconductivity [1] is the presence of an energy gap in the spectrum of elementary excitations:

$$\Delta = \frac{\hbar \omega}{\sinh \left(\frac{1}{N V} \right)}, \quad (1)$$

where ω and V are cut-off frequency and interaction strength, respectively, N is the state density on the Fermi surface. In this theory the energy gap is coupled with the critical temperature by the universal relation

$$\frac{2 \Delta}{kT_c} = 3.528. \quad (2)$$

This value characterizes the electron-phonon interaction strength which differs for real superconductors from 3.528, reaching a maximum value of 4.6 for Hg [2].

It is interesting to investigate the influence of different factors on $2 \Delta/kT_c$ for one crystal modification. In this respect high pressures as a method are most perspective.