Phil. Mag., 18, 655 (1968)

DOID-PR 68-0413

CORRESPONDENCE

Evidence for a Third Phase of Mercury

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[Received 16 March 1968 and after revision 7 May 1968]

Abstract

It has been found that tensile deformation at liquid helium temperature partially transforms α-mercury to a γ phase which is distinguished from the α and β phases by having a lower superconducting critical field curve and a lower transition temperature ($T_{c\gamma}=3{\cdot}74\pm0{\cdot}05^\circ$K compared with the values found by Schirber and Swenson (1961), $T_{c\alpha}=4{\cdot}153^\circ$K and $T_{c\beta}=3{\cdot}949^\circ$K). Resistance measurements show that the γ phase transforms back to α-mercury at about 53°K.

The simple rhombohedral α phase of mercury remains unchanged at atmospheric pressure down to liquid helium temperatures (Barrett 1957). Bridgman (1935) first observed a transition under pressure to the β phase, which was found to have a body-centred tetragonal structure by Atoji, Schirber and Swenson (1959). Swenson (1958) found that this β phase, once formed, was stable at atmospheric pressure up to 79°K, at which temperature it transformed back to the α phase. High pressure was found to be necessary and in addition shear was helpful in forming the β phase, and Schirber and Swenson (1962) suggested that the transformation was martensitic in nature. In the present investigation we have found that simple tensile deformation of α-Hg at 4·2°K partially transforms it to a phase which has a lower superconducting transition temperature and critical field curve than those of either the α or β phases as found by Schirber and Swenson (1961); we therefore call it the γ phase.

For superconducting magnetization measurements rod specimens 7 cm long and 2·4 mm diameter were prepared from triply distilled mercury having about 1 p.p.m. non-gaseous impurities. The rods were gripped in a simple tensometer and pulled in tension in liquid helium. The magnetization M was determined from fluxmeter deflections on moving a pair of oppositely wound co-axial coils from one position around the middle of the specimen to another remote from the specimen; in both positions there was zero mutual inductance between the empty coil pair and the field coil.

Evidence for the γ phase is shown in the magnetization curves of figs. 1 (a) and (b), which were obtained in increasing field from, respectively, a