Superconductivity in Cd_3As_2 Films

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Introduction

We report the first experimental observation of superconductivity in Cd_3As_2 thin films synthesized by magnetron sputtering without application of external pressure. The EDX mapping reveals a homogeneous distribution of the film components, implying that transport characteristics of the films are related solely to the Cd-As binary system. The EDXS demonstrates that at μm scale the Cd-to-As ratio is constant and close to stoichiometric Cd_3As_2 within the 2% accuracy. The presence of Cd_3As_2 phase is also supported by Raman spectroscopy.

Experimental

The magnetoresistance and the differential resistance dV/dI of Cd_3As_2 films were measured in 18T magnets SCM1 and SCM2 at various temperatures, magnetic field values, and the field orientation with respect to the film normal.

Results and Discussion

Transport measurements of studied films reveal a pronounced transition below 0.5 K. A resistance drop shifts to lower temperatures upon increasing magnetic field, which supports the assumption of the superconducting (SC) phase emergence. The actual transition regions are rather broad, which agrees well with the polycrystalline structure of the films. The differential resistance measured at various temperatures clearly shows zero-resistance plateaux (Fig. 1). The critical current value, I_c, decreases as the temperature approaches T_c (see insert in Fig. 1). However, at lowest temperatures I_c appears to be temperature-independent. The magnetoresistance (MR) demonstrates typical features of field induced SC-to-normal state transition (Fig. 2). As the temperature increases zero-field resistance becomes higher, although the shape of MR curves remains similar. We observe clear anisotropy: H_c values for longitudinal field are considerably higher than those for transverse field, which is common for thin SC films. The corresponding H_c - T_c plots (Fig. 3) reveal a clearly pronounced linear behavior within the intermediate temperature range, similar to that observed for bulk Cd_3As_2 and Bi_2Se_3 films under pressure [1, 2, 3], suggesting the possibility of nontrivial pairing in the films under investigation.

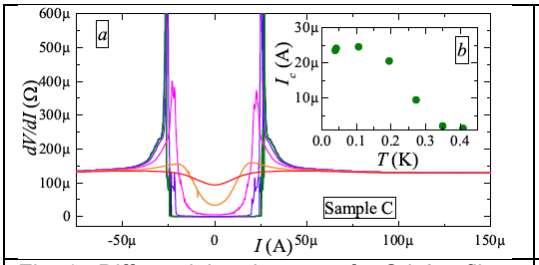

Fig. 1. Differential resistance of a Cd_3As_2 film at various temperatures. Inset: Corresponding temperature dependence of critical current, I_c.

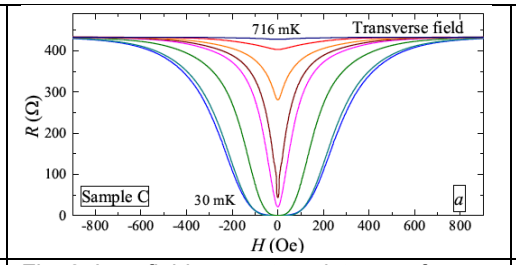

Fig. 2. Low-field magnetoresistance of a Cd_3As_2 film at various temperatures

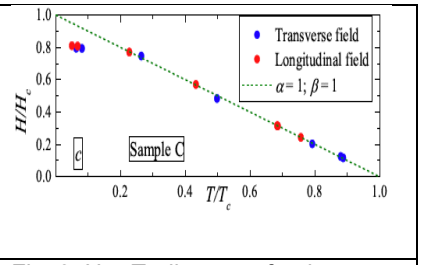

Fig. 3. H_c - T_c diagrams for the superconducting transition in a Cd_3As_2 film.

Conclusions

The formation of a superconducting phase in films under study is confirmed by the characteristic behavior of temperature and magnetic field dependence of samples resistances, as well as by the presence of pronounced zero-resistance plateaux in the differential resistance. These films might be a promising platform for studies of topological superconductivity.

Acknowledgements

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