Growth, magnetotransport properties and evidences of topological states in the solid solutions based on cadmium arsenide

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The cadmium arsenide (Cd_3As_2) is one of the most interesting materials among the II-V group due to an unusually high carrier mobility and inverted band structure. Recently, three-dimensional topological Dirac semimetal phase was predicted theoretically and confirmed experimentally in Cd_3As_2 [1].

The existence of solid state phase transitions on the Cd – As equilibrium diagram leads to difficulties in growth of non defects Cd_3As_2 monocrystals.This problem can be avoided by using growth from the vapor phase technique. Another way to produce single crystal quantum materials based on Cd_3As_2 is heavy doping [2] or using of solid solutions [3].We synthesized single crystals of $Cd_{3-x}Zn_xAs_2$ ($x< 0.8$) by low pressure vapor phase depositions and $(Cd_{1-x-y}Zn_xMn_y)_3As_2$ ($x + y = 0.4$) by modified Bridgeman method. After performing structural investigations (Fig.1) the magnetotransport properties of samples have been examined.

Samples with highest carrier mobilities demonstrated 3D Shubnikov – de Haas oscillations with isotropic nonzero phase shift, which is expected for Dirac semimetals. While transverse magnetoresistance (MR) for the most part of studied systems is positive, longitudinal MR (with magnetic field parallel to electrical current) for some of them appeared to be negative (Fig.2). Latter is usually associated with the chiral anomaly in 3D Dirac systems. Thus, our data allows us to assume the presence of topologically nontrivial states in studied sample, although the exact impact of solution composition on observed properties is yet to be defined.

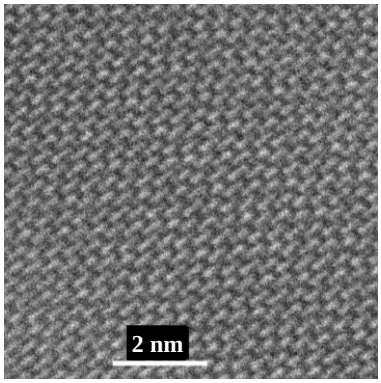

Fig.1 Transmission electron microscope image of $Cd_{3-x}Zn_xAs_2$ (x = 0.13).

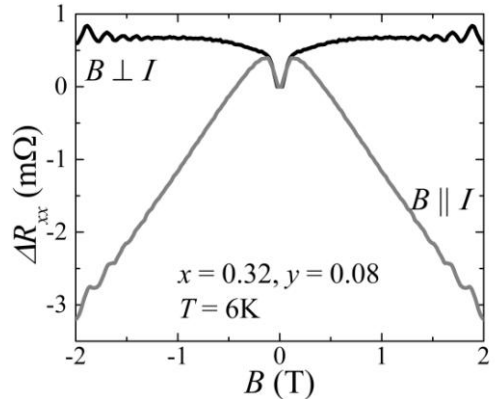

Fig. 2 Transverse and longitudinal MR of the $(Cd_{0.6}Zn_{0.32}Mn_{0.08})_3As_2$ sample at 6K.

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