DE HAAS VAN ALPHEN EFFECT IN TPHREE-DIMENTIONAL DIRAC SEMIMETAL Cd_3As_2 DOPED BY Fe

A. Nateprov[1,*], L. Konopko[2], V. Fritsch[3]
[1]*Institute of Applied Physics, Moldova State University, Chișinău, Republic of Moldova;*
[2]*Technical University of Moldova, D.Ghitu Institute of Electronic Engineering and Nanotechnologies, Chișinău, Republic of Moldova*;
[3]*University of Augsburg, Augsburg, Germany*
[*]E-mail: alexandr.nateprov@ifa.usm.md

Despite a large number of studies devoted to Cd_3As_2, the canonical 3D Dirac material, the effect of iron doping on the properties of that compound has not been investigated so far. This is why the effect of iron impurity on the electrical and magnetic properties of Cd_3As_2 have been investigated for the first time. The unoriented monocrystalline Cd_3As_2:Fe samples were cut from the ingots obtained by the modified Bridgman method. The X-ray phase analysis confirmed the correspondence of the obtained samples to the low-temperature α–phase Cd_3As_2, space group I41cd, with the lattice parameters a=b= 1.2628(13) nm, and c=2.544(5) nm. The energy dispersive analysis (EDA) showed low iron solubility of up to 1 mol% in the studied samples and the presence of small inclusions with more iron. The samples retain metallic conductivity with high electron mobility (μ_H=3.2∗10^4 cm^2/V*sec) at 12 K, ρ_{295}/ρ_{10}=20, with the electron concentration n=2.8*10^{18}cm^{-3}. At the same time, the iron-doped samples are paramagnetic, unlike undoped cadmium arsenide which is diamagnetic [1]. At the temperature dependence of magnetic susceptibility (2-300 K), no signs of a transition to a magnetically ordered state have been established. There was noticed a marked difference in magnetic susceptibility for the case of sample cooling in the presence of a magnetic field (fc) and a zero magnetic field (zfc) in the temperature range studied. This may be due to the influence of inclusions of iron – arsenic compounds in the samples. A slight hysteresis was observed on the dependence of magnetization χ at the low magnetic field B at a temperature of 2 K. In the fields B>2 T, oscillations of magnetization are clearly visible (de Haas van Alphen (dHvA) effect). The oscillation frequencies after a fast Fourier transform found from the dHvA effect were 51.0 T and 54.6 T. The presence of two frequencies in the oscillation spectrum indicates the splitting of the Fermi surface of electrons in the samples studied. The splitting of the Fermi surface of electrons was previously established elsewhere for pure Cd_3As_2 [2]. From the Landau index n plotted against 1/B for the dHvA oscillation, two intercepts at 0.46 and 0.73 were found due to the presence of two frequencies. This result clearly demonstrates a nontrivial Berry's phase in the samples Cd_3As_2 doped by Fe.

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