Effect of electron irradiation on the magnetotransport properties of half-Heusler topological semimetal GdPtBi

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Several half-Heusler compounds have been proposed as topological materials more than a decade ago [1], yet interest in this group of materials continues to grow. Among the most intensively studied half-Heusler topological materials is GdPtBi that is the first example of a topological Weyl semimetal in which Weyl nodes are induced by external magnetic field [2]. The observation of negative longitudinal magnetoresistance and anomalous Hall effect is the main evidence for the existence of Weyl states in this material [2, 3].

In this work, we employed high-energy electron irradiation technique to tune the Fermi level in GdPtBi and thus modify its electrical transport properties. Single crystals of GdPtBi were irradiated with several doses from the range between 1.5 and 7 C/cm^2, and then electrical resistivity, magnetoresistance and Hall effect of the irradiated samples were studied. Analysis of the Hall effect data showed that the concentration of carriers changes with increasing the dose, confirming the Fermi level shift. Interestingly, for each sample we observed the anomalous Hall effect, the magnitude of which was found to depend on the irradiation dose. In addition, we noticed that the values of transverse and longitudinal magnetoresistance (which is negative) decrease when the irradiation dose increases. All these features concomitantly point to a diminishing role of the chiral magnetic anomaly in the magnetotransport properties in GdPtBi as the position of the Fermi level is shifted.

References:

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