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Tuning of topological states in Bi_2Te_3 with magnetic impurities

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A_2B_3 (A=Bi, Sb and B=Se, Te) is a new family of three-dimensional topological insulators. A lot of efforts such as chemical doping have been made to manipulate the original topological states. Quantum oscillations in topological insulators with two-dimensional transport properties have been suggested to be indirect proof of the metallic surface state. However, due to the lack of two-dimensional surface conduction to the electrical transport, there have been a small number of reports on the quantum oscillations in topological insulators. Here we report the exotic quantum oscillations of larger linear magnetoresistance behavior, and new quantum oscillations. This is the first observation to show the magnetoresistance and magnetization in Fe-doped Bi_2Te_3. Owing to the small amount of Fe doping in Bi_2Te_3, which does not only make less antisite defects between Bi and Te but also stronger transport channel between the quintuple layers, we have achieved higher mobility, crossover between two-dimensional surface state to three-dimensional bulk phase, depending on the direction of applied magnetic field. On the other hand, a different family of $LnBiTe_3$ (Ln=rare earth elements), which share the same structure with A2B3 family, has been theoretically proposed to have novel topological states such as quantum anomalous Hall insulator, axionic insulator, and topological Kondo insulator. For example, LaBiTe3 is predicted to be a strong topological insulator. If La is replaced by other rare-earth elements which have localized 4f magnetic moments, the topological Mott insulator state can be realized. In this talk, we report the exotic properties of $CeBiTe_3$, where half of Bi is replaced by Ce. The Curie-Weiss fit of magnetic

susceptibility demonstrates that Ce ion is trivalent, expecting that Ce doping cannot provide any dopants in this system. Nevertheless, we find larger carrier density and lower carrier mobility than Bi_2Te_3. Furthermore, our experimental data indicate the coexistence of the antiferromagnetic ordering and the superconductivity in $CeBiTe_3$. The diamagnetic signal below the superconducting transition temperature T_C = 4.6 K is not apparent because of the strong suppression of magnetization below the antiferromagnetic transition temperature T_N = 3.7 K. In order to address the novel topological states in $CeBiTe_3$, more experimental results will be discussed later.

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