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Topological features of quantum transport in Bi1-xSbx(0 ≤ x ≤ 0.2) bicrystals

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Abstract

High-quality Bi1−xSbx (0 ≤ x ≤ 0.2) bicrystals with nanowidth crystallite interfaces (CIs), exhibiting simultaneously superconductivity (Tc ≤ 21 K) and weak ferromagnetism, are studied. A number of unusual features of quantum transport are observed, which are due to topological changes of the Fermi surface of CIs layers, as well as the manifestation of some 3D topological phases of the matter. It is revealed that the flow of Dirac fermions is sensitive to the field orientation, and the localization process occurs only at the B||CIs plane. In doing so, the dependences of the Landau level index n on peak position at inclination interfaces are extrapolated to −0.5 if 1/Bn → 0, as expected for the massless Dirac fermions, while in crystallites and some twisting CIs with an increased degree of imperfection, electronic states are of the Schrodinger type, since n takes integer values. At Sb concentrations of x ∼ 0.04, the high-field thermomagnetic phenomena of CI layers exhibit behavior of the 3D topological semimetals, whereas in bicrystals with 0.07 ≤ x ≤ 0.2 they manifest typical features of the 3D topological insulators.

Keywords: *dirac fermions, field orientation, high quality, interface layer, localisation, quantum transport, topological changes, topological features, topological phase, weak ferromagnetism*

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