

Magnetization Signature of Topological Surface States in a Nonsymmorphic Superconductor

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Abstract

We report a highly anomalous behavior of surface superconductivity in topologically nontrivial 3D superconductor In_2Bi , where the surface states result from its nontrivial band structure, itself a consequence of the non-symmorphic crystal symmetry and strong spin-orbit coupling. In contrast to smoothly decreasing diamagnetic susceptibility above the bulk critical field, H_{c2} , as seen in conventional superconductors, a near-perfect, Meissner-like screening of low-frequency magnetic fields well above H_{c2} is observed. The enhanced diamagnetism disappears at a new phase transition close to the critical field of surface superconductivity, H_{c3} . The anomalous screening is shown to be consistent with modification of surface superconductivity by the topological surface states. The possibility of detecting signatures of the surface states using macroscopic magnetization provides a new tool for the discovery and identification of topological superconductors..

References

- [1] W. J. Kuang, *et al.*, *Adv. Mater.*, **33** (2021) 2103257.

Figures

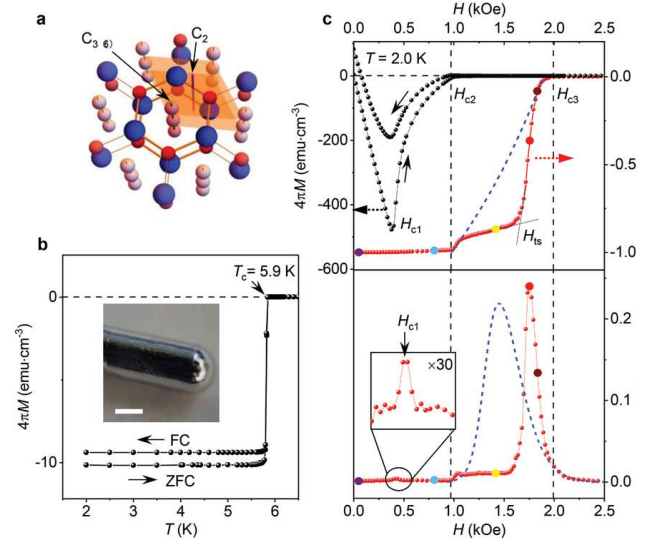


Figure 1: Anomalous AC susceptibility of In_2Bi . **a**, Schematic crystal structure of In_2Bi . Bi atoms are shown in blue and In atoms in different shades of red, to distinguish between In atoms within the hexagonal planes (dark red) and those making up In chains (light red). The shaded areas denote the unit cell containing four In and two Bi atoms. Symmetry axes are indicated by arrows. **b**, ZFC and FC magnetization as a function of T at $H = 10$ Oe. Inset: photo of our typical cylindrical crystal; scale bar: 1 mm. **c**, AC susceptibility measured using $h_{ac} = 0.1$ Oe and frequency $f = 8$ Hz (red curves). Black curves: DC magnetization and its hysteresis for this sample. As a reference, the blue dashed curves show the standard response expected for surface superconductivity. The inset in the lower panel shows a zoom of χ'' indicating the transition to the vortex state at H_{c1} . The vertical dashed lines indicate H_{c2} and H_{c3} , and the arrows the sweep directions.