The Electronic Structure and Transport Properties of Niobium Doped Bismuth Selenide

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It is believed that topological superconductivity can be realized in bismuth selenide, Bi_2Se_3, doped with metals. One such material is niobium (Nb) doped Bi_2Se_3, but little is known about the properties of this system. For this reason, the electronic structure and transport properties of $Nb_{0.25}Bi_2Se_3$, $Nb_{0.20}Bi_2Se_3$, and $Nb_{0.10}Bi_2Se_3$ have been investigated.

Angle-resolved photoemission spectroscopy (ARPES) reveals that the presence of Nb in the Bi_2Se_3 crystal leads to n-doping. The ARPES measurements also pointed towards an inhomogeneous surface structure of the samples which was further supported by results from scanning tunneling microscopy and atomic force microscopy. Transport measurements performed in a magnetic field (up to 12 T) show that samples from the $Nb_{0.20}Bi_2Se_3$ and $Nb_{0.10}Bi_2Se_3$ crystals become partly superconducting with the critical temperature, T_C, ranging between 2.3 K and 3.2 K. In both cases, not the entire sample volumes become superconducting.

The experiments performed so far indicate that the $Nb_xBi_2Se_3$ system crystallizes in an inhomogeneous manner with different crystalline phases present. This makes it challenging to understand the nature and origin of the superconductivity in $Nb_xBi_2Se_3$ and motivates further work on this project utilizing different techniques.