Electron transmission of Pb/NbP superconductor-Weyl semimetal junction

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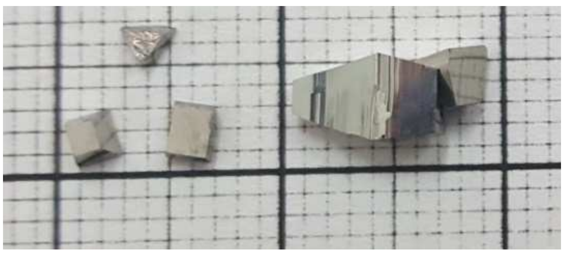
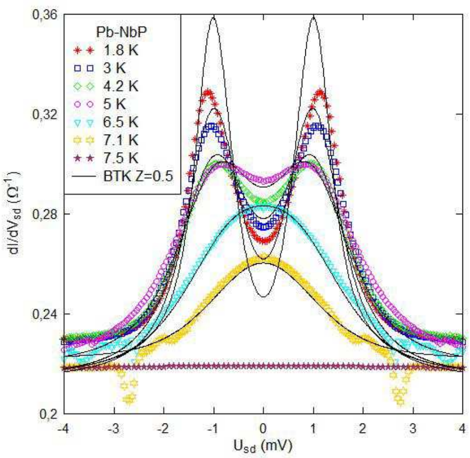
Currently, there is a strong interest in topological semimetals with massless relativistic electrons, known as Weyl semimetals (WSMs) [1]. Their conduction and valence bands form one or more pairs of crossing points, so-called Weyl points, and each of them acts as a magnetic monopole of opposite chirality. This leads to unusual surface states as Fermi arcs, already observed in ARPES images [2]. Recently, an idea of introducing superconductivity in WSMs has been developed [3]. It was predicted that such system can support the zero-energy modes that are equivalent to Majorana fermions, which have potential for realization of fault-tolerant topological quantum computation [4]. In the current work, we experimentally study the possibility of inducing superconductivity in WSMs through coupling their surface to a superconductor.

We have grown single crystals of WSM niobium phosphide (NbP) using chemical vapor decomposition method (see Fig.1). Initial electron transport data have shown typical values of the net electron concentration $n = 3\times10^{19}$ cm^{-3} and mobility about 5×10^{4} cm^{2}/Vs, at T = 1.8 K. Metallic Pb layer of the 240 nm thickness was deposited on the (100) surface of the NbP crystal in the MBE chamber. The measuring wires were attached to the Pb layer and the NbP crystal's opposite surface using non-superconducting silver paste. We measured differential conductance as a function of bias voltage applied across the junction and analyzed results using Blonder-Tingham-Klapwijk (BTK) theory [5] (Fig.2). Obtained barrier transparency parameter, Z=0.5, indicates quite high transmission of the junction which implies real possibility of inducing superconducting state in NbP by proximity effect.

Fig.1: (a) (below) NbP single crystals, (b) (right) Differential conductance of Pb/NbP junction measured at different temperatures. Solid lines are calculated using BTK theory.





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