Suppression of supercurrent in metallic $NbSe_2$ superconductor via injection of hot carriers

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Abstract

Metals are impervious to electric fields because their screening lengths are extremely short, typically just a few nanometers. Conversely, in superconductors, electric fields are suppressed exponentially over the London penetration depth. We report a gate-controlled superconducting switch that employs the Dayem bridge structure in metallic $NbSe_2$ superconductors. Our devices demonstrate an asymmetric field effect that completely suppresses the supercurrent at 35V for electron doping and -25V for hole doping. As suppression is reached, the Dayem bridge begins to mimic the behavior of Josephson junctions, exhibiting a distinct Fraunhofer pattern under a magnetic field for both electron and hole doping scenarios. Our findings indicate that within the electron doping domain, Cooper pairs break apart and the quasiparticles are injected into the gate, while in the hole doping domain, quasiparticles move from the gate into the superconductor.