Josephson Junction based on Bismuth Nanowires

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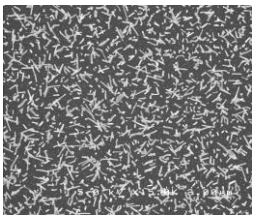
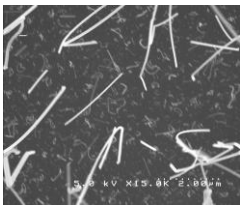
Recent studies have suggested that single crystal Bismuth is a high-order topological insulator in which topologically protected surface states appear along the 'hinges' that connect surface facets [1]. Ballistic edge (or hinge) states on bismuth nanowires have been experimentally observed in micrometer-long single crystal bismuth nanowire channels connected to superconducting electrodes [2]. By depositing a layer of vanadium on silicon in advance, we can grow high density single crystal bismuth nanowires through the ebeam evaporation. We continue to evaporate the superconductor materials in high vacuum chamber, then the shadows of neighbor nanowires could form natural Josephson junction on some bismuth nanowires.

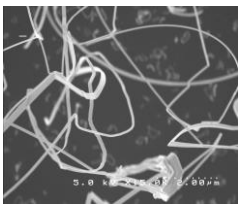
Bismuth nanowire growth at different temperature



293 K



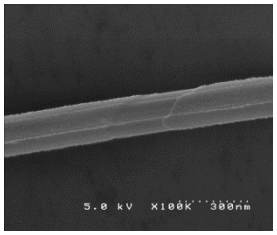
313 K



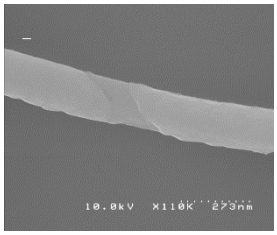
333 K

Different superconductor materials were deposited on bismuth nanowires, experimental measurement results indicate that the Aluminum-bismuth Josephson junction adopts both clear shadowed junction and clean superconductor proximity effect. We observed some hints of the supercurrent oscillation under magnetic field and π-periodic Shapiro steps in Aluminum-bismuth nanowire junction, now we are trying to measure the 4πperiodic Josephson supercurrent. We will report on our fabrication process and characterization of devices in electrical transport.

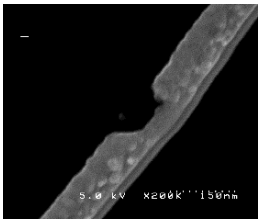
Shadow deposited junctions on Bismuth nanowires



Niobium-Bismuth Junction



Tin-Bismuth Junction



Aluminum-Bismuth Junction

[1] F. Schindler et al., Nature Physics 14, 918 (2018).

[2] A. Murani et al., Nature Comms. 8, 15941 (2017).