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Quantum transport in topological insulator nanoribbon based structures

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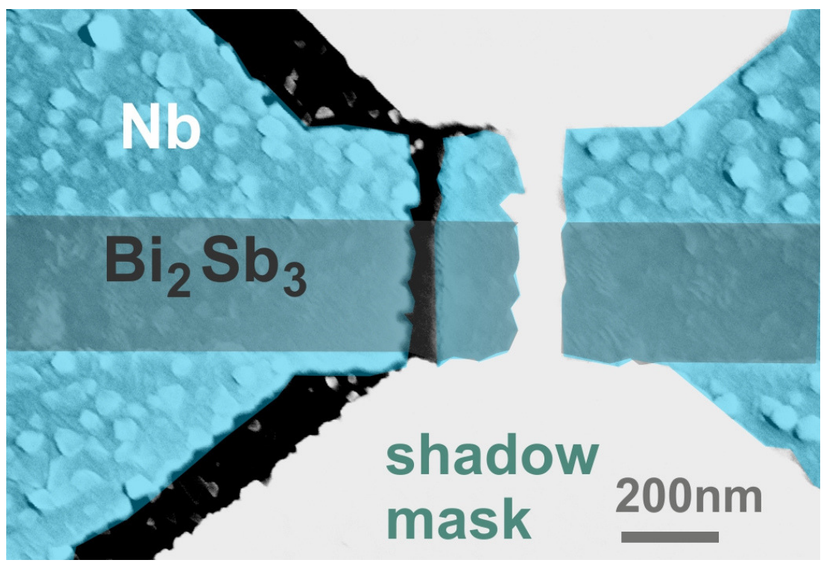
Abstract: Three-dimensional topological insulators have been subject of increased interest in the past few years due to their robust topologically protected surface states enclosing an insulating bulk. Especially the spin-momentum locking of these surface states makes this novel material class very attractive for spintronic applications. However, often the transport in the surface states is masked by a pronounced bulk conductance contribution owing to a relatively large background doping. By preparing topological insulator nanoribbons a more favorable surface-to-volume ratio can be achieved. In addition, these nanostructures allow to study confinement related carrier transport. Our topological insulator Bi2Te3 and Sb2Te3-based nanostructures were fabricated by selective-area molecular beam epitaxy using a SiO2/Si3N4-masked Si (111) substrate. We performed low temperature magnetotransport measurements on the nanoribbons, in order to investigate phase-coherent phenomena. Furthermore, nanoribbons were covered in-situ with superconducting electrodes to form topological Josephson junctions. Here, a clear Josephson supercurrent was observed. Measurements under microwave irradiation revealed a series of Shapiro steps. The observed missing of the first step indicates the presence of Majorana states.



In-situ prepared Bi2Sb3 nanoribbon/Nb Josephson junction

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