Bottom-up grown nanowire quantum devices

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InSb nanowires are used to detect first signatures of quasi particles called Majorana fermions. Recently, different schemes for performing braiding operations and uncovering the non-Abelian statistics of Majorana fermions are proposed. Such operations are fundamental for topological quantum computing. For such a universal computational architecture the realization of a near-perfect nanowire network assembly is needed in which Majorana states are coherently coupled.

Here, we demonstrate a generic process by which we can design any proposed braiding device by manipulating an InP substrate and thereby the nanowire growth position and orientation [1]. This approach combines recent advances in materials growth and theoretical proposals. Our method leads to highly controlled growth of InSb nanowire networks with single crystalline wire-wire junctions. Additionally, nanowire "hashtag" structures are grown with a high yield and contacted. In these devices, the Aharonov–Bohm (AB) effect is observed, demonstrating phase coherent transport. These measurements reveal the high quality of these structures. This generic platform will open new applications in quantum information processing. Furthermore, these structures are well suited for epitaxial shadow growth of a superconductor on the nanowire facets. We study the growth of superconductors on nanowires and reveal the electronic properties.

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