Fabrication of Monolayer WTe_2 Josephson Junctions

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Systems combining superconductors with topological insulators offer a platform for the study of Majorana bound states and a possible route to realize fault-tolerant topological quantum computation. Among the systems being considered in this field, monolayers of tungsten ditelluride (WTe_2) have a rare combination of properties. Notably, it has been demonstrated to be a Quantum Spin Hall Insulator[1] (QSHI) and can easily be gated into a superconducting state.[2] Measurements on gate-defined Josephson weak-link devices fabricated using monolayer WTe_2 are reported. We find that consideration of the 2D superconducting leads are critical in the interpretation of magnetic interference in the resulting junctions.

The formation of good contacts to the monolayer material relies on the interfacial properties of a sputtered underlayer of Pd in the contact region and the WTe_2, which ultimately forms a superconducting $PdTe_x$ region,[3] evidence of which is seen in transport measurements. Recent reports have even suggested that this process may be related to a novel growth mechanism,[4] making it a subject of significant interest. We further report on efforts to utilize this mechanism in combination with 2D material Atomic Layer Etching (ALE) methods[5] to create the next generation of WTe_2 Josephson weak-links, which we hope to study and reveal transport signatures related to Majorana bound states. The reported fabrication procedures suggest a facile way to produce further devices from this technically challenging material and the results mark the first step toward realizing versatile all-in-one topological Josephson weak-links using monolayer WTe_2.

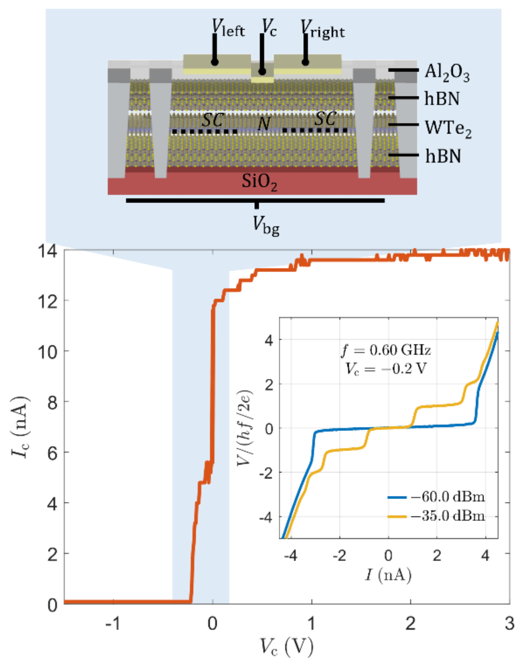

Fig. 1: Plot of critical current for a gate defined WTe_2 Josephson junction as a function of channel gate V_c. In the shaded region a junction is formed as depicted in the illustration. (inset) I-V trace showing the I-V of the junction and Shapiro steps as confirmation of the Josephson effect.

References

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