Gate Defined Josephson junctions in monolayer WTe_2

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Monolayer tungsten ditelluride (WTe_2) has been demonstrated to be a Quantum Spin Hall Insulator[1-4] which can also be gated into a superconducting state[5,6]. These discoveries make WTe_2 an interesting system for study of topological superconducting devices in which both superconductor and 2D topological insulator are comprised of the same material. Toward this goal we fabricate Josephson junctions through the electrical gating of WTe_2 monolayers encapsulated in hBN, Fig. 1(a). Contacts are formed from the in-situ RIE etching of the hBN-WTe_2-hBN stack within our deposition vacuum system and sputtering of Pd/NbTi (3/120 nm), providing superconducting edge contacts to the WTe_2 monolayer. Multiple top-gates with Al_2O_3 dielectric are utilized to electrically gate the system into a superconducting state and define a narrow channel in which the supercurrent may be controlled. The formation of a Josephson weak link is confirmed through observation of both the ac-Josephson effect (Fig. 1(b)) and magnetic response of the junction. It is found that interpretation of the magnetic response requires consideration of the lack of screening in the monolayer 2D superconducting leads. This work paves the way for study of the topological superconducting state in junctions that are gated into the Quantum Spin Hall regime.

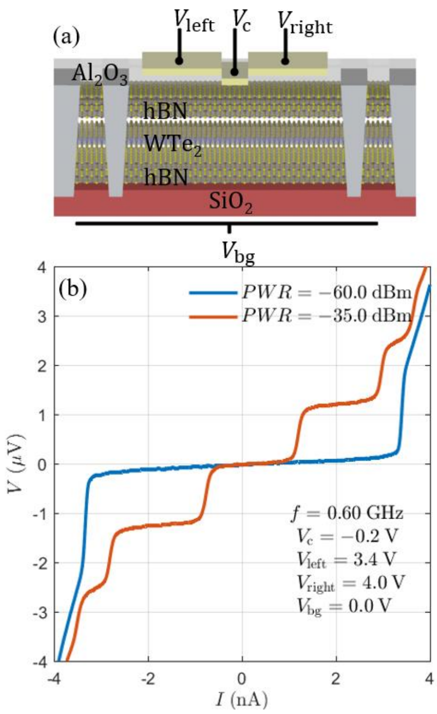

Figure 1. (a) Schematic of the device with a monolayer of WTe_2 encapsulated in hBN. Contacts are formed using in-situ etching and sputtering of Pd/NbTi. (b) $I(V)$ traces showing a supercurrent branch and Shapiro steps for an rf excitation at $f = 0.6$ Ghz, resulting in quantized steps at voltages of $\delta V = hf/2e = 1.24$ μV. Sections of the device channel (beneath V_{left} and V_{right}) are gated to the superconducting state with the voltages indicated.

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