Proximity-induced Superconductivity in Epitaxial Topological Insulator/Graphene/Gallium Heterostructures

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A topological insulator/superconductor heterostructure may support a novel superconductor called a topological superconductor through the proximity effect. In this work [1], we synthesize high-quality, large area $(Bi,Sb)_2Te_3$ (BST)/graphene (Gr)/gallium (Ga) heterostructures with atomically sharp hetero-interfaces combining confinement heteroepitaxy and molecular beam epitaxy (Fig. 1a). Atomically thin Ga film superconducts at T_c~4 K, and the growth of $(Bi,Sb)_2Te_3$ preserves its superconductivity extremely well. A lithography-free, van der Waals tunnel junction is developed to perform transport tunneling spectroscopy. Our results show a robust, proximity-induced superconducting gap formed in the Dirac surface states of 5-10 quintuple-layer BST/Gr/Ga heterostructures (Fig. 1b). This novel synthesis approach opens up new avenues for the understanding of topological superconductivity and the realization of topological quantum computing. This work is supported by the Penn State Materials Research Science and Engineering Center under award NSF-DMR 2011839.

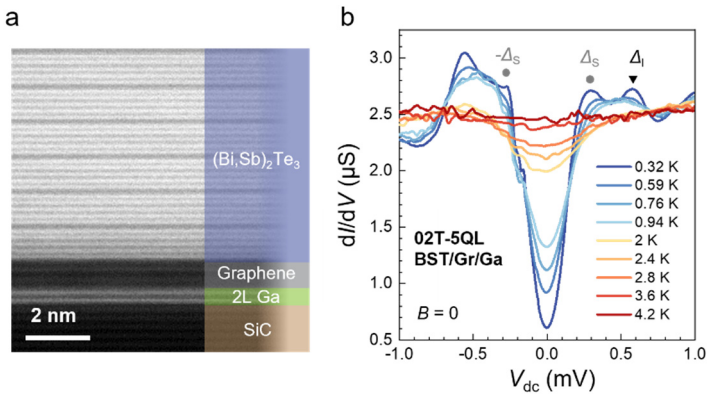

Fig. 1a, A cross-sectional STEM image showing the atomically sharp hetero-interfaces between 6QL $(Bi,Sb)_2Te_3$, epi-graphene, and the 2L-Ga. **b,** Clear two-gap feature in 5QL BST/Gr/Ga captured by $dI/dV(V_{dc})$ spectra.

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