Induced superconductivity in epitaxial superconductor/TCI bilayer devices

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Tin telluride is a topological crystalline insulator (TCI) [1]; it hosts surface states which are topologically protected by the crystal symmetry of the bulk. Nanowire networks of this material were selective-area grown epitaxially on an indium phosphide substrate [2], to study the coherence of the topological surface states in low-temperature electronic transport measurements. Strikingly, intrinsic induced superconducting behavior was observed, which we attribute to the formation of a few nanometer thin interlayer of the superconductor $In_xSn_{1-x}Te$ ($x > 0.03$ [3]) at the substrate/nanowire interface. Effectively this yields an epitaxial superconductor/TCI bilayer. Extensive characterization of the induced superconducting phase was performed in electronic transport measurements. Apart from some device to device variations in the magnitude of the induced superconducting gap (T_c=300-350mK, B_c=100-200mT, I_c=70-120nA), all measured devices show highly similar behavior. Coherent mesoscopic transport signatures are observed in the form of Little-Parks oscillations, demonstrating long (> 2 μm) coherence lengths. The coexistence of topological surface states and induced superconductivity make this a promising material platform for the study of topological superconductivity and the related exotic quasiparticles. Follow-up research will include tunnel spectroscopy measurements on these epitaxial bilayer devices.

References

[1] T. Hsieh et al., *Nat Commun* 3:982 (2012)
[2] A.G. Schellingerhout et al., *Adv. Funct. Mater.* 33, (2023) 2305542
[3] R. Zhong et al., *Crystals* 7:2 (2017), 55

Figures

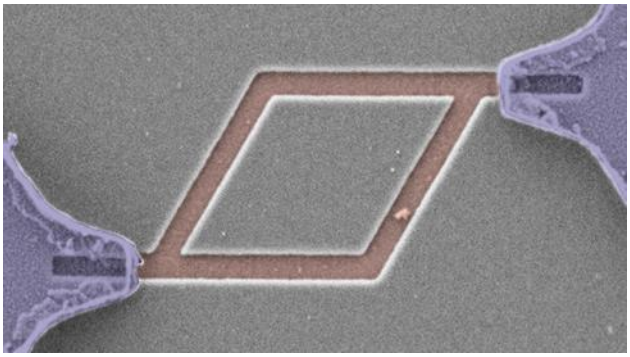

Figure 1: False-colored top view SEM image of a selective-area grown tin telluride loop (red) in a silicon nitride mask (grey), with titanium/ palladium contacts (purple).

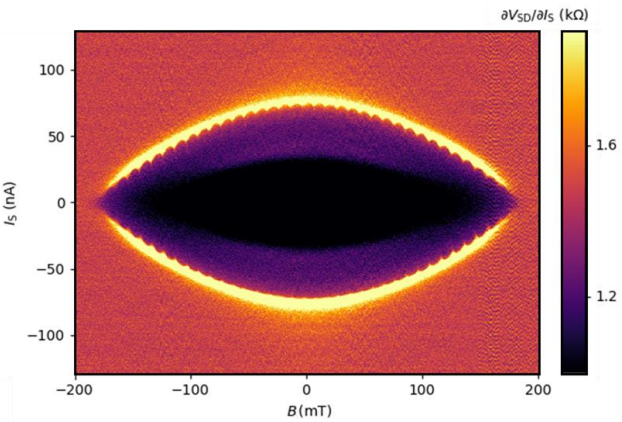

Figure 2: Magnetoconductance map of one of the loop devices. Notably, the resistance vanishes for low applied currents and magnetic fields, and Little-Parks oscillations in the critical current can be seen.