Induced superconducting correlations in the quantum anomalous Hall insulator

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Crossed Andreev reflection (CAR) has been reported in a hybrid quantum Hall (QH)/Superconductor (SC) system [1]. Similar experiments would be of great interest for quantum anomalous Hall (QAH) systems. It has been predicted that if Cooper pairing is induced in a QAH insulator, the system turns into a stereotypical spinless chiral p-wave superconductor associated with chiral Majorana edge states. In the QAH/SC system superconductivity can be suppressed by applying a magnetic field while keeping the 1D chiral edge state intact. Here, we report on multi-terminal hall-bar devices of V-doped $(Bi_xSb_{1-x})_2Te_3$ thin films with Nb electrodes of different widths. We observe a notable drop in the R_D when the SC electrode undergoes the normal-to-superconducting phase transition with decreasing magnetic field. Furthermore, a negative nonlocal voltage was observed for the narrowest Nb electrode contacting the chiral edge state of a QAHI, indicative of the CAR process. By changing the Nb width, the characteristic length of the CAR process is identified to be about 100 nm, which is three times longer than the superconducting correlation length in Nb. Our theoretical simulations suggest that strong disorder and induced superconductivity in the QAH insulator are crucial for this CAR process.

References

[1] G. H. Lee, K.-F. Huang, D. K. Efetov, D. S. Wei, S. Hart, T. Taniguchi, K. Watanabe, A. Yacoby, and P. Kim, Nat. Phys., 13 (2017) 693-698