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High-temperature superconductivity in topological insulators

ALEX HAYAT, University of Toronto

Interest in the superconducting proximity effect has been reinvigorated recently by novel optoelectronic applications as well as by the possible emergence of the elusive Majorana fermion. However, all previously studied structures were based on low- T_c materials. We have produced high-temperature superconductivity in topological insulators Bi_2Se_3 and Bi_2Te_3 via proximity to $\text{Bi}_2\text{Sr}_2\text{CaCu}_2\text{O}_{8+\delta}$, using our new mechanical bonding technique. We have shown proximity-induced superconductivity up to a temperature of at least 80K – an order of magnitude higher than any previous observations. We have also demonstrated hybrid high- T_c -superconductor-semiconductor tunnel junctions combining $\text{Bi}_2\text{Sr}_2\text{CaCu}_2\text{O}_{8+\delta}$ with graphite, with bulk semiconductors and with semiconductor quantum wells. Our approach provides a simple method of constructing high- T_c tunnel junctions which can conceptually facilitate tunneling spectroscopy studies of novel materials.