Topological phase diagram of $Pb_{1-x-y}Sn_xMn_ySe$

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$Pb_{1-x}Sn_xSe$ is a topological crystalline insulator (TCI) exhibiting metallic, spin-polarized surface electron states with linear energy dispersion. These states are topologically protected by crystalline mirror plane symmetry and form four Dirac cones. In this work, we study the effect of incorporating Mn ions into TCI materials on their magnetic, structural and topological properties, in particular the band gap inversion and the transition temperature to the TCI state. We applied angle-resolved photoemission (ARPES) spectroscopy technique to study the electronic structure of (001) surface of $Pb_{1-x-y}Sn_xMn_ySe$ (x=0.28-0.385, y=0-0.03) bulk crystals. In the crystals with inverted band structure we found the Dirac-like topological surface states and show that the incorporation of just 1 at.% of Mn decreases the topological transition temperature by about 100 K. These experimental observations are summarized in the form of temperature-composition topological phase diagram and are analyzed based on band structure calculations. Increasing Mn content results in a rapid increase the gap for the trivial band ordering but a decrease for the inverted one.