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A Scanning Tunnelling Microscopy Study on an Alloyed Topological Insulator, $Bi_{1.5}Sb_{0.5}Te_{1.7}Se_{1.3}$ WONHEE KO, INSU JEON, HYO WON KIM, HYEOKSHIN KWON, YOUNGTEK OH, Samsung Advanced Institute of Technology, SE-JONG KAHNG, Korea University, JOONBUM PARK, JUN SUNG KIM, Pohang University of Science and Technology, SUNG WOO HWANG, HWANSOO SUH, Samsung Advanced Institute of Technology — Efficient doping of topological insulators while protecting its topological nature is key ingredient to realize topological devices. Engineering the chemical potential in the alloyed compound $Bi_{2-x}Sb_xTe_{3-y}Se_y$ has been achieved by tuning its chemical composition. However, the effect of alloying in microscopic scale has not yet been fully investigated with local probes. Here we report on the atomic and electronic structures of $Bi_{1.5}Sb_{0.5}Te_{1.7}Se_{1.3}$ studied using scanning tunnelling microscopy/spectroscopy (STM/STS). Although there is significant surface disorder due to the alloying of constituent atoms, cleaved surfaces of the crystals present a well-ordered hexagonal lattice in STM topographs with 1 nm high quintuple layer steps. STS results reflect the band structure and indicate that the surface state and Fermi energy are both located inside the energy gap. The surface states do not show any electron back-scattering; due to their topological nature they are extremely robust. Landau levels generated by perpendicular magnetic field follow the massless Dirac fermions. This finding demonstrates that alloying is a promising route for efficient doping of topological insulators whilst keeping the topological surface state intact.

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