3D Topological Insulator eutectic heterostructures: enabled by crystal growth

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Three-dimensional topological insulators attract great deal of interest due to their potential use of the topologically protected gapless surface states in topological spintronics and quantum computation [1]. However, challenges such as the high sensitivity of the surface states to the atmosphere, the low surface-to-volume ratio, and the need for various material heterojunctions currently limit the application of these materials [2]. Here, we report successful fabrication of the topological insulator heterostructures by an easy, fast and single-step process, which could meet all those challenges and pave the way for exploring other exotic phenomena in the near future. Utilizing directional solidification different topological insulator based eutectic composites were produced, where two crystalline phases are combined in a structured form with joined interfaces. The material exhibits lamellar micro/nanostructures with atomically smooth interfaces. Existence of the metallic surface states and the formation of p-n junction have been confirmed throughout specific characterization methods.

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