Manipulation of Topological Surface States in III–V Compounds: Case of InBi Semimetal

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Abstract. InBi is a non-symmorphic semimetal, lacking a mirror plane along the [001] axis, which exhibits a 1D nodal line in the vicinity of the X point [1]. Here we show how InBi(001) can be formed on a III-V semiconductor substrate by depositing Bi on to a In-rich InAs(111)-A. Angle-resolved photoemission spectroscopy measurements reveal new topological electronic surface states, close to the M high symmetry point. Theoretical calculations based on relativistic density functional theory with a one step-model photoemission model [2,3] clarify the relationship between InBi(001) surface termination and these surface states, supporting a predominant role of a Bi bilayer termination. A tight-binding model based on the Bi bilayer with only Bi-Bi hopping terms, and no Bi-In interaction, reproduces the calculated spin texture. Our study gives a consistent physical picture of the topological surface electronic structure of InBi(001) based on an intact Bi bilayer rather than a surface formed by splitting to a Bi monolayer termination. Moreover, regardless of its III–V membership, InBi shows direct coexistence of Bi and In surface terminations at its pristine cleavage plane.

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