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Robustness of topologically protected surface states in layering of Bi_2Te_3 thin films[1] KYUNGWHA PARK, JEAN HEREMANS, VITO SCAROLA, DJORDJE MINIC, Virginia Tech — Recently, topological insulators with time-reversal symmetry have drawn great attention due to their topologically protected states. Topological insulators differ from band insulators in that a bulk energy gap opens up due to strong spin-orbit coupling and that metallic surface states reside in the energy gap. The surface states of topological insulators are topologically protected in that impurities preserving time-reversal symmetry neither destroy the surface states nor impact the topological nature of the surface states. Recently, bulk bismuth-based alloys were shown to be topological insulators. Thin films offer valuable probes of topological insulators as well as device applications. Additionally, bismuth-based thin films of a thickness of a few nanometers were fabricated on substrates or suspended across trenches. We investigate surface states of Bi_2Te_3(111) thin films of one to six quintuple layers using density-functional theory including spin-orbit coupling. We construct a method to identify topologically protected surface states of thin film topological insulators. Applying this method to Bi_2Te_3 thin films, we examine the topological nature of the surface states as a function of the film thickness and compare our results with experimental data and other theoretical reports.

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