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Topological insulators for high performance terahertz to infrared applications XIAO ZHANG, Stanford University, JING WANG, Tsinghua University, SHOU-CHENG ZHANG, Stanford University — Topological insulators in the Bi₂Se₃ family have an energy gap in the bulk and a gapless surface state consisting of a single Dirac cone. Low frequency optical absorption due to the surface state is universally determined by the fine structure constant. When the thickness of these three dimensional topological insulators is reduced, they become quasi-two dimensional insulators with enhanced absorbance. The two dimensional insulators can be topologically trivial or non-trivial depending on the thickness, and we predict that the optical absorption is larger for topological non-trivial case compared with the trivial case. Since the three dimensional topological insulator surface state is intrinsically gapless, we propose its potential application in wide bandwidth, high performance photo-detection covering a broad spectrum ranging from terahertz to infrared. The performance of photodetection can be dramatically enhanced when the thickness is reduced to several quintuple layers, with a widely tunable band gap depending on the thickness.

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