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Feng Liu

Department of Materials Science & Engineering, University of Utah, USA

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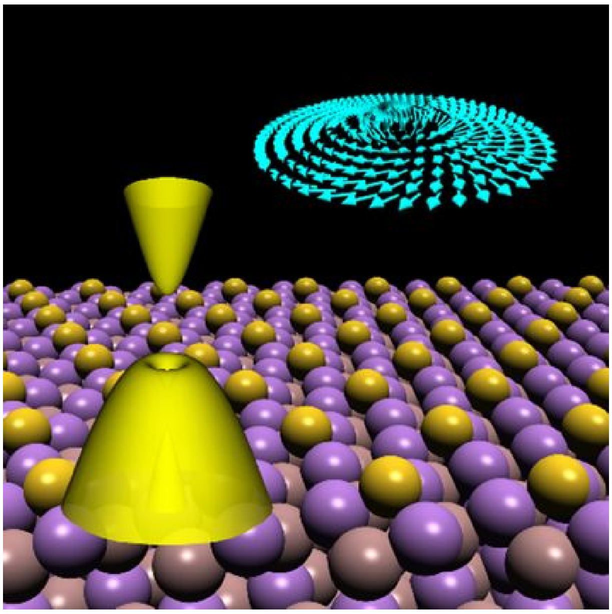

Two-dimensional topological insulators: past, present and future

Feng Liu

Department of Materials Science & Engineering, University of Utah, USA

Abstract Two-dimensional (2D) topological insulators (TIs) are special quantum conductors that possess an insulating bulk but metallic edge with quantized charge and spin conductance protected by electron band topology. The concept of topology and TI has not only renewed our fundamental understanding of electronic properties of solid materials, but also opened an exciting avenue towards potential applications of topological quantum devices with minimized heat dissipation and robustness against disorder. In this video article, I will first introduce and review the concept of TIs within the context of transport properties of solid-state materials. I will then use two examples, the organic 2D TIs and the surface-based 2D topological states, to recap the rapid theoretical and experimental developments made in this emerging field. The existence of quantized edge conductance and topological edge states of 2D TIs has been so far confirmed experimentally in several systems, such as semiconductor quantum wells, 2D transition metal dichalcogenides, metallic overlayer of bismuth on a semiconductor surface. However, discovery of high-temperature 2D TIs and construction of functional TI-based quantum devices remain largely elusive. At the end of this video article, I will offer briefly my personal perspective and possible future directions in low-dimensional topological materials.

Keywords two-dimensional materials, electron band topology, topological insulators, organic materials, surfaces and epitaxial growth

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E-mail: fliu@eng.utah.edu

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