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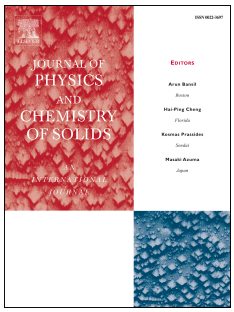

Conductance nonreciprocity on the surface of a topological insulator with magnetic electrodes

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Conductance Nonreciprocity on the Surface of a Topological Insulator with Magnetic Electrodes

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Abstract

Asymmetric electrical conductance is theoretically demonstrated on the surface of a topological insulator (TI) in the limit of infinitesimally small forward and reverse biases between two spin selective electrodes. The discontinuous behavior relies on the spin-momentum interlocked nature of TI surface electrons together with the resulting imbalance in the coupling coefficients between the electrodes and TI surface states. The analysis is based on a transmission matrix model that, in combination with a phenomenological treatment for the diffusive limit, accounts for both ballistic and scattered paths simultaneously. With the estimated conductance asymmetry over a factor of 10, implementations in the ratchet-like applications and low-voltage rectification circuits are potentially practicable.

Keywords: `topological insulator; surface conductance; nonreciprocity.`

1. Introduction

At the very dawn of semiconductor electronics, the two-terminal rectifier or diode was known as the device that breaks the conductance invariance with respect to the electric current (or bias) reversal. The significance of this nonlinear property along with the simple physical implementation has made major impacts on all areas of electronics including the information processing, communication, and power systems. On the other hand, the rectification effect in a

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