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Current-Induced Spin Polarizations in Surfaces of Topological Insulators TETSURO MISAWA, Tokyo Institute of Technology, SHUICHI MURAKAMI, Tokyo Institute of Technology, PRESTO, Japan Science and Technology Agency — Topological Insulators (TI) have gapless conducting states on their surfaces, which are largely spin-split. Former studies have showed that in spin-orbit coupled systems, current can induce a spin polarization. In this research, we calculate the response of the TI surface state to the dc electric field, that is, transverse conductivity and the induced in-plane spin polarization in the presence of delta-function impurities using Kubo formula. Additionally, in Bi_2Te_3, the shape of Fermi surface is warped to be 6-fold rotationally symmetric; thereby the transport properties are modified. In this warped Fermi surface, we predict that the current induces a component of spin polarization perpendicular to the surface as a nonlinear response. This out-of-plane polarization may be easier to detect than in-plane polarization. Using the 6-fold rotational symmetry, we discuss the nonlinear response of spin accumulation to the current and its implications on Bi_2Te_3. We also study another non-linear effect, the inverse Faraday effect, where the oscillating electric field induces the dc spin polarization.

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