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Charge-current induced spin polarization in $BiSbTeSe_2$ topological insulators

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Abstract

The surface states of 3D topological insulators (TIs) possess a helical spin texture in which the spin and momentum are perpendicularly locked to each other. Due to this spin-momentum locking, a net spin polarization can be induced by a charge current and vice versa. However, topological surface states are expected to give rise to only one type of spin polarization for a given current direction, which has been a limiting factor for spin manipulations. In this talk we report that in devices based on the bulk-insulating topological insulator $BiSbTeSe_2$, two different kinds of spin polarizations were observed in different devices: The spin polarization expected from the topological surface states was detected in a heavily electron-doped device, whereas the opposite polarization was reproducibly observed in devices with low carrier densities [1]. We propose that the latter type of spin polarization stems from topologically-trivial two-dimensional states with a large Rashba spin splitting, which are caused by a strong band bending at the surface of $BiSbTeSe_2$ beneath the ferromagnetic electrode used as a spin detector. This finding paves the way for realizing the "spin transistor" operation in future topological spintronic devices.

References

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