

Efficient Field-Free Spin-Orbit Torque Switching of Perpendicular Magnetization

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Spin-orbit torque (SOT) has gained much attention because it promises efficient magnetization switching in spintronic devices [1]. In order to realize SOT-based devices in practice, it is important to develop materials that enable switching of perpendicular magnetization without an external magnetic field at low current densities.

In this talk, I will present two approaches to reducing field-free SOT switching current by exploiting out-of-plane spin-polarized spin current. The first approach is to laterally modulate the Rashba effect in Pt/Co/AIOx structures by electric voltages to generate out-of-plane SOTs. This enables both field-free switching of the perpendicular magnetization and reduction of SOT switching current density with gate voltage [2]. The second is to exploit spin currents with all three spin polarizations in a ferromagnet/non-magnet/ferromagnet trilayer. This approach reduces the field-free SOT switching current compared with those that exploit only one part of the three polarizations [3].

Reference

- [1]. J. Ryu, S. Lee, K.-J. Lee, and B.-G. Park, *Adv. Mater.* 32, 1907148 (2020)
- [2]. M.-G. Kang, et al, *Nat. Commun.* 12. 7111 (2021)
- [3]. J. Ryu, et al, *Nat. Electron.* 5, 217 (2022)

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