Efficient generation of transverse orbital currents by light metals

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Efficient manipulation of nanomagnets using spin-orbit torques (SOTs) is critical to the development of spintronics for non-volatile memory applications [1]. Thus far, the spin-orbit coupling (SOC) of a material has been utilized to produce SOTs, which have been primarily limited to heavy metals (HMs) [1]. However, recent predictions of large transverse orbital current generated by the orbital Hall effect (OHE) and the orbital Rashba Edelstein effect (OREE) have opened up a new possibility to efficiently control nanomagnets without necessarily being constrained by the SOC of the material [2]. Here, we experimentally demonstrate large OREE and OHE generated by a broad range of nonmagnets, such as CuOx [3,4], Nb, Ru [5], and noncollinear antiferromagnet Mn3NiCuN. We show the key signatures of the transport of orbital Hall currents, such as strong ferromagnet dependence and long-range action, which distinctly distinguishes orbital-Hall torques from regular SOTs.

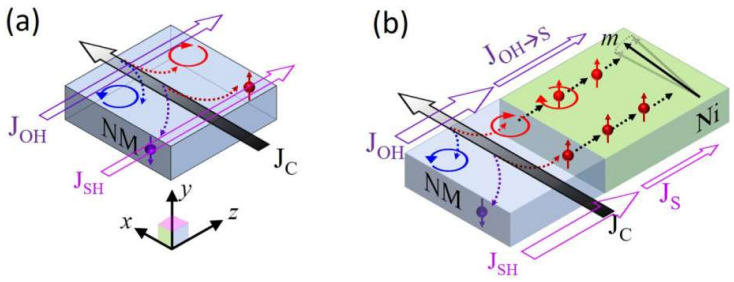

Fig. 1. Differences between the orbital-Hall torques and spin Hall torques

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[4] S. Ding, et al., Phys. Rev. Lett. **128**, 067201 (2022).
[5] A. Bose, et al., Phys. Rev. B **107**, 134423 (2023).