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Inverse Spin Hall Effect in a Ferromagnetic Metal

BINGFENG MIAO, Nanjing University

Recently, intense attention has been focused on the generation, detection, and exploitation of pure spin current. Only few mechanisms, among them spin Hall effect (SHE) [1], lateral spin valve [2], spin pumping [3] and spin Seebeck effect (SSE) [4], can generate a pure spin current. Once generated, a pure spin current cannot be detected electrically but by the inverse spin Hall effect (ISHE) that converts it back into a charge current. To date, ISHE has been observed only in non-magnetic metals, such as Pt and Au, with a strong spin-orbit coupling. We report the observation of ISHE in a ferromagnetic metal permalloy (Py) on ferromagnetic insulator yttrium iron garnet (YIG) [5]. Through controlling the spin current injection by altering the Py/YIG interface, we have isolated the spin current contribution and demonstrated the ISHE in a ferromagnetic metal, the reciprocal phenomenon of anomalous Hall effect. A large spin Hall angle in Py, determined from Py thin films of different thicknesses, indicates many other ferromagnetic metals may be exploited as superior pure spin current detectors and for applications in spin current.

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