Spin Transport in the Proximity of a Ferromagnet

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Transport of charge, spin, and heat in a non-magnetic metal (e.g., Pt) in the proximity of ferromagnetic metal or insulator, such as that realized in spin transport, spin pumping, and spin Seebeck effect (SSE) [1], have attracted much attention recently but not without complications. For example, in the transverse SSE geometry with an in-plane ($\nabla_x T$) temperature gradient, there exists also an out-of-plane ($\nabla_z T$) temperature gradient in the case of thin magnetic films on substrate that gives rise to the anomalous Nernst effect (ANE). The voltages of SSE with $\nabla_x T$ and ANE with $\nabla_z T$ are additive with the same field dependence, symmetry, and hence inseparable [2]. In the longitudinal SSE geometry, using exclusively $\nabla_z T$ in a ferromagnetic insulator (e.g., YIG), one encounters magnetic proximity effects (MPE) [3] and new magnetoresistance (MR) in Pt that complicate SSE and other pure spin current phenomena. Recently, we report the observation of the intrinsic longitudinal SSE in Au/YIG without appreciable MPE [4], whereas the new MR in Pt/YIG is likely to be associated with the MPE.

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