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Coupled electron-magnon spin transport in magnetic heterostructure[1] YIHONG CHENG, KAI CHEN, SHUFENG ZHANG, Department of Physics, University of Arizona — Both conduction electrons and magnons are angular momentum carriers that are capable of propagating spin information in magnetic multilayers. In conducting ferromagnets or antiferromagnets, conduction electron spin currents are correlated with magnon currents through strong exchange coupling between itinerant spins and localized moments. Here we develop a theory of angular momentum transport by explicitly taking into account the electron-magnon coupling. In our Boltzmann approaches, the distribution functions for electrons and magnons are mutually dependent, and thus, the electron spin current would drag a magnon current and vice versa. To determine these distributions, we investigate the roles of different scattering terms, including the electron spin diffusion and magnon diffusion. We find that relative strengths of the spin and magnon currents depend not only on the spin-magnon coupling, but also on the relative relaxation times of the non-equilibrium magnons and electron spins. A coupled spin-magnon diffusion equation has been constructed and the effective spin-magnon diffusion lengths are obtained. We predict the temperature and spatial dependence of the total angular momentum current for a number of layered structures by explicitly solving the spin-magnon diffusion equations. We discuss possible experimental realizations of our predictions.

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