Extraordinary Hall Effect on Fe-rich amorphous thin films and Fe-rich/Cu multilayers

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The extraordinary Hall effect (EHE), a spin-dependent scattering phenomenon observed in ferromagnetic materials occurs because the asymmetry of magnetic scattering is proportional to magnetization. Interest has been growing for thin films with potential applications as magnetic sensors or memory devices using the EHE. Ferromagnetic amorphous alloys are known to have a high degree of magnetic disorder and are good candidates for increasing spin-orbit scattering, a key ingredient for enhancing the EHE. In this study we investigated the magnetic and transport properties of thin Fe-rich amorphous films and Fe-rich/Cu multilayers. We compared the extraordinary Hall effect (EHE) in these two types of samples and discussed it in terms of thickness and sample structure. The thicker films exhibited stripe magnetic domains and a strong in-plane magnetic anisotropy. Decreasing film thickness reduced in-plane anisotropy while both saturated Hall resistivity and Hall sensitivity increase. A Hall resistivity value of 20 microOhm.cm is observed in 100 nm thick Fe-rich films at 12 K and a sensitivity of 1.3 Ohm/T is obtained at room temperature. Electrical conductance increases and Hall resistivity decreases when the films are sandwiched with Cu. EHE measurements at low temperatures provide hints on the magnetic response of the multilayers.