

The Hall effects Edwin Hall never imagined

seminar

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Abstract

The anomalous Hall effect (AHE) is one of the oldest and most prominent transport phenomena in magnetic materials. However, the microscopic mechanism of the AHE has remained unresolved for more than a century because its rich phenomenology defies standard classification, prompting conflicting claims of the dominant processes. We differentiate these processes through temperature-dependent measurements on epitaxial Fe, Ni, Co, and $\text{Ni}_x\text{Cu}_{1-x}$ films of varying thickness. The results allow an unambiguous identification of both intrinsic and extrinsic mechanisms of the anomalous Hall effect.

The more recently discovered spin Hall effect (SHE) has attracted a great deal of attention because of its potential applications in spin current devices. Various methods have been developed to generate and detect the SHE and search for materials with large spin Hall angles. These efforts notwithstanding, reliable and accurate determination of spin Hall angle remains a challenge.

In this lecture I will first give a comprehensive discussion on the basic concepts of AHE and SHE. Exploiting the attributes of epitaxial magnetic thin films, I will then explain how to control independently the different scattering processes through temperature and layer thickness and how to identify unambiguously the intrinsic and extrinsic mechanisms of the AHE.

Finally, based on the understanding of the microscopic mechanisms of the AHE, I will describe how we develop a new method using H-patterned films to measure quantities inherent in the SHE.

Speaker

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