

Neutrons to study magnetism - especially in functional materials

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Abstract

Since the pioneering experiment by Shull and Smart on MnO the magnetic neutron scattering experiments have been playing the major role in solving the spin structures of the magnetically ordered materials. Owing to the dipolar nature of the interaction between the neutron and atomic magnetic moment the unpolarized neutron diffraction method even with powder samples works remarkably well for collinear spin structures. But more recently, especially in studying modern functional materials, one is confronted with more complicated spin configurations, for example, non-collinear, incommensurate magnetic structure such as helimagnetic structure as a result of frustrating magnetic interactions. Since the giant functional responses in these materials are direct consequences of these complicated magnetic structures, the detailed knowledge of the structure is mandatory to understand the essence of the magnetic functional materials. For these investigations the single crystal diffraction and even more the polarization analysis experiments will be essential.

In this lecture I would like to introduce the principles of neutron magnetic scattering to study magnetic structures with the emphasis on the recent advances in the utilization of polarized neutron scattering. The principles of polarization dependent scattering, linear polarization analysis and 3-D polarization analysis (polarimetry) will be explained and some recent examples in multiferroic materials investigation will be presented.