Polarized Neutron Scattering - Powder Diffraction -

Kazuhisa Kakurai[1,2]
Neutron Science and Technology Center, Comprehensive Research Organization for Science and Society (CROSS)[1], Center for Emergent Matter Science, RIKEN[2]
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Neutron being a spin 1/2 particle can have two spin states; namely +1/2 and -1/2 state with respect to a quantization axis. Although there has been a strong interest in polarized neutron beams right after the discovery of the neutrons by Chadwick in 1932, it took over twenty years to construct the first two-axis polarized neutron beam diffractometer at the Brookhaven National Laboratory. The full understanding of the polarization-dependent magnetic cross-section and the advent of modern research reactors for neutron beam science were the prerequisites for this development. They used a ferromagnetic crystal magnetized in the vertical direction as a monochromator, providing a monochromatic, polarized beam. A neutron spin flipping device mounted after the monochromator allowed reversal of the incident neutron polarization. When elemental ferromagnets are fully magnetized by the vertical magnetic field at the sample position, the ratio of Bragg scattering intensities for + and - incident polarization, the so-called 'flipping ratio', would give directly the ratio of magnetic and nuclear scattering amplitude. When the nuclear structure is known, the magnetic amplitude can be determined to accuracies much better than with unpolarized neutrons.

This technique was then rather quickly adopted at neutron scattering facilities around the world and has been contributing to the precise determination of magnetic form factors and spin density distributions using single crystals since then.

Recently this polarized neutron diffraction technique has been applied for powder diffraction experiments and covers many novel functional magnetic materials not available as single crystal samples.

In this talk, I shall be reviewing the basics of polarization-dependent neutron magnetic scattering and presenting examples of polarized neutron powder diffraction experiments.