Neutron Diffraction Studies for Magnetic Materials

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Neutron diffraction is a very powerful experimental tool to study simultaneously a magnetic and crystal structure in a microscopic point of view. After refining the neutron diffraction diagrams, we can get the impotent structural information such as atomic position, lattice parameter, thermal motion, magnitude of spin, spin configuration etc. The local structure change detected by neutron diffraction experiment can give us a key clue to understand the physical property of our system.

In this talk, we will introduce High Resolution Powder Diffractometer (HRPD) of HANARA with various sample environments and how we can use neutron powder diffraction for studying magnetic materials. Also, I will present some crystal/magnetic structure research examples using neutron diffraction. For example, in order to investigate a possible structural change of $RMnO_3$ at the magnetic transition temperature, I have carried out high-resolution structural studies using neutron diffraction. Here I show that the hexagonal manganites $RMnO_3$ undergo an isostructural transition at T_N with unusually large atomic displacements: two orders of magnitude larger than those seen in any other ordinary materials, resulting in a uniquely strong magneto-elastic coupling. For the first time, I could follow the exact atomic displacements of all the atoms in the unit cell as a function of temperature and found consistency with theoretical predictions based on group theories. We argue that this gigantic magneto-elastic coupling of $RMnO_3$ arises from geometrical frustration, and holds the key to the recently observed magnetoelectric phenomenon in this intriguing class of materials. Also, the some examples to define commensurate/incommensurate magnetic structure and ferroelectricity driven by magnetic ordering will be presented [2]. It is very important to understand the change of crystal/magnetic using neutron diffraction studies for developing new material. After finishing my talk, I hope everyone recognize neutron diffraction is key experimental tool to enhance the physical properties of permanent magnet.

References

[1] Seongsu Lee *et al.* Nature 451, 805 (2008)

[2] T. Choi *et al.* Science 324, 63 (2009), Seongsu Lee et al. Appl. Phys. Lett. 92, 192906 (2008), V. Kiryukhin *et al.* PRL 102, 187202 (2009)