

9 Elements Strategy Initiative Center for Magnetic Materials (ESICMM)

– in situ analysis using neutrons and X-rays –

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The goals of the Elements Strategy Initiative Center for Magnetic Materials (ESICMM) at the National Institute of Material Science (NIMS) are: (1) laboratory-scale synthesis of mass-producible high-performance permanent magnets without using critical rare-earth elements for the next generation and (2) framework-building and provision of basic science and technology for industrial R&D. To achieve these goals, ESICMM focuses on theoretical research and mining of new permanent magnet materials, and simultaneously pursues various processing technologies to improve the existing high-performance permanent magnet materials through cooperative activities in the three research fields of computer physics, structural and property characterization, and material processing. Another important mission of ESICMM is to train scientists who will contribute to the future development of magnetic functional materials. In CMRC, the In-situ Analysis Using Neutrons and X-rays Project was started in July 2012 as an analysis group of ESICMM. The complementary use of neutrons at J-PARC/MLF and synchrotron X-rays at the Photon Factory is very useful for characterizing magnetic materials from the atomic scale to micrometer scale.

The figures show some results of the project. Figure 1 indicates the magnetic structure of a Nd₂Fe₁₄B permanent magnet obtained by neutron powder diffraction at the iMATERIA beamline of J-PARC/MLF. We have successfully determined its magnetic structure using pulsed neutrons for a short beamtime of about one hour. Figure 2 shows the spin-wave dispersion of the Nd₂Fe₁₄B permanent magnet determined by neutron Brillouin scattering at the HRC beamline of J-PARC/MLF. Figure 3 shows the results of single crystalline analysis of a Sm₂Fe₁₇N₃ permanent magnet using the X-ray diffraction system at the Photon Factory.

