

10 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 ESICMM Project in 2013. Figure 1 indicates the neutron diffraction patterns of a Sm₂Fe₁₇N₃ permanent magnet. Powder neutron measurements were performed at iMATERIA of J-PARC/MLF and D20 of Institut Laue Langevin (ILL). Due to the strong absorption of Sm, neutron diffraction studies of Sm₂Fe₁₇N₃ have not been performed yet. We have successfully measured the neutron diffraction pattern and determined the magnetic structure. Figure 2 shows the magnetic structure of the permanent magnet, revealing a strong correlation

between the Fe-N distance in Sm₂Fe₁₇N₃ and the magnetic moment of the Fe atom.

