実験報告書様式(元素戦略)

(※本報告書は英語で記述してください。ただし、産業利用課題として採択されている方は日本語で記述していただいても結構です。)

CROSS TOKAI Experimental Report J-PARC	承認日 Date of Approval 01/04/2015、23/03/2014 承認者 Approver J. Suzuki、M. Takeda 提出日 Date of Report 2014/12/26
課題番号 Project No. 2013S0001 実験課題名 Title of experiment Study on coercivity mechanism of rare-earth permanent magnets from magnetic microstructures and microtextures using neutron and synchrotron radiation 実験責任者名 Name of principal investigator Kanta Ono 所属 Affiliation KEK	装置責任者 Name of Instrument scientist J. Suzuki、M. Takeda 装置名 Name of Instrument/(BL No.) BL15、BL17 実施日 Date of Experiment 2014/3/9-3/12、2014/3/23-3/25

試料、実験方法、利用の結果得られた主なデータ、考察、結論等を、記述して下さい。(適宜、図表添付のこと)
Please report your samples, experimental method and results, discussion and conclusions. Please add figures and tables for better explanation.

1. 試料 Name of sample(s) and chemical formula, or compositions including physical form.

BL15

Nd-Fe-B sintered magnet, Nd-Fe-B hot deformed magnet

BL17

L10-FeNi thin film

2. 実験方法及び結果 (実験がうまくいかなかった場合、その理由を記述してください。)
Experimental method and results. If you failed to conduct experiment as planned, please describe reasons.

BL15

We have performed magnetic SANS experiment at BL15 TAIKAN.

At first, we tried to measure SANS under high magnetic field. We can apply the magnetic field up to 8T, since there is no neutron transmitted above 8T. We found that TAIKAN has an advantage on high-q region, where the intensity is very strong compared to other SANS facilities.

We measured SANS for (1) two Nd-Fe-B sintered magnet with and without Dy, (2) three Nd-Fe-B hot-deformed nanocrystalline magnet with different grain boundary compositions, (3) three Pr-Cu infiltrated Nd-Fe-B hot-deformed nanocrystalline magnet with different infiltration, and (4) three Nd-Cu infiltrated Nd-Fe-B hot-deformed nanocrystalline magnet with different annealing temperature.

Data reduction for the SANS data of Nd-Fe-B magnet measured at TAIKAN is rather difficult, because neutron absorption of Nd-Fe-B magnet shows strong wavelength dependence. We have already solved the data analysis problem, and we will get good results in next experiment in FY2014

2. 実験方法及び結果（つづき） Experimental method and results (continued)

BL17

A multilayer sample was fabricated by the molecular-beam epitaxy (MBE) method. An Fe seed layer (1 nm), a Cu3Au buffer layer (70 nm), and a Au6Cu51Ni43 buffer layer (50 nm) were grown on a MgO(001) substrate (10 × 15 mm2). One-monolayer (ML)-thick Ni and Fe atomic layers were alternately deposited for fifty times on the Au6Cu51Ni43 buffer layer. The L10 order parameter (S) was evaluated as S ~ 0.5 from the X-ray diffraction experiment. The magnetic properties are measured using a superconducting quantum interference device (SQUID) magnetometer at room temperature. A saturation magnetization and magnetocrystalline anisotropy were 1280 emu/cm3 and 4.5 × 106 erg/cm3 , respectively.

The PNR experiment was performed at BL-17 SHARAKU of the Materials and Life Science Experimental Facility (MLF) in the Japan Proton Accelerator Research Complex (J-PARC). An external magnetic field (Hext) of 1 T, generated by an electromagnet, was applied to the in-plane direction of the film. The sample was fully magnetized along the direction of the external magnetic field. A pulsed neutron beam impinges the sample at different angles (θ int = 0.3, 0.9, and 1.5 degrees) to cover the momentum transfer (qz) range between 0.075 to 1.46 nm−1. The neutron polarization was perpendicular to the scattering plane, and can be switched between the parallel (+) and antiparallel (−) directions to the external magnetic field. Specular reflection (θ in = θ out) was measured by a 3He detector without polarization analysis. The PNR experiment was performed at room temperature. Data reduction was done by UTSUSEMI software. Fitting analysis was performed using Motofit for IGOR Pro. We have analyzed structural and magnetic depth profiles for a multilayer sample with the L10- FeNi layer by polarized neutron reflectometry. We found significant contrast in SLD which depends on the neutron spin polarization, which indicates the sizable magnetic moments in the sample. Layer thicknesses, interface roughnesses, and magnetic moments were evaluated. Magnetic moment in the FeNi layer was separately determined in spite of the existence of the buffer and seed layers with magnetic atoms