(※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 2015/11/30
承認者 Approver YamazakiDai
提出日 Date of Report 2014/11/24

課題番号 Project No.
2014A0138

実験課題名 Title of experiment
Phase Determination in Neutron Reflectmetry using Composite Polymer Thin Films 3

実験責任者名 Name of principal investigator
MIYATA Noboru

所属 Affiliation
CROSS Tokai

装置責任者 Name of Instrument scientist
TAKEDA Masayasu

装置名 Name of Instrument/(BL No.)
SHARAKU/BL17

実施日 Date of Experiment
5/24 10:00 – 5/27 10:00

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.

#1. dPS-PI/Si/Fe/Si wafer

The sample was fabricated as follows. Firstly, Fe and Si layer are deposited on n-type Φ3-inch Si wafer by magnetron sputtering. Next, dPS-PI is deposited using spin coater at User Experiment Preparation Lab. III of CROSS Tokai. X-ray reflectivity (XRR) is measured before dPS-PI deposition for the estimation of thickness and roughness of each layer. Figure 1 shows the XRR curve of the sample before dPS-PI deposition. By the curve fitting of this data, the structure of this sample has four layer structures Parameters of fitting results are shown in table 1.

Some parts of sample-fabrication work (magnetron sputtering and XRR measurements) was conducted at the AIST Nano-Processing Facility, supported by "Nanotechnology Platform Program" of the Ministry of Education, Culture, Sports, Science and Technology (MEXT), Japan.

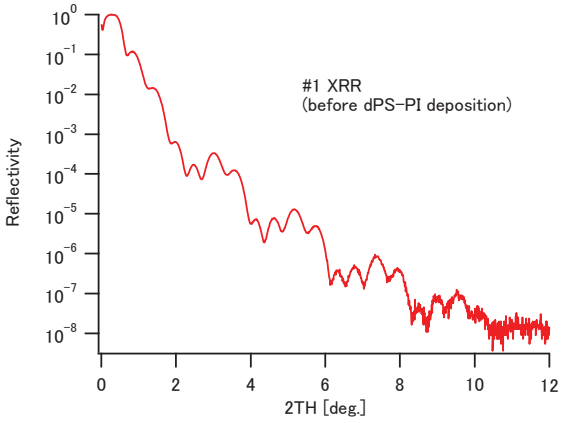

Figure 1. X-ray reflectivity of sample #1.

Material (assumed)	Thickness [nm]	Density [g/cm3]	Roughness [nm]
SiO2	1.01	1.96	0.323
Si	10.91	2.1	0.21
FeSi	1.4	6.94	0.319
Fe	2.592	7.07	0.7
Si sub.	===	2.33	0.314

Table. 1. Fitted parameters of XRR of sample #1 before dPS-PI deposition..

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.

Figure 2 shows the polarized neutron reflectivities (PNR) of sample #1under the condition of the magnetic field of 1[T]. The purpose of this proposal is to estimate the structure of polymer films by reference-layer method. But now the converter software for the reference layer analysis is not good enough. As a second best, two curves are fitted simultaneously with 5 layers model in the same parameters except for scattering length density (SLD) of magnetic layers. Current status of fitting curves and parameters are shown in Fig. 3 and Table 2. Fitting results is not good, especially in thickness and SLD of Fe and FeSi layer. So we are planning further analysis of those measuring results.

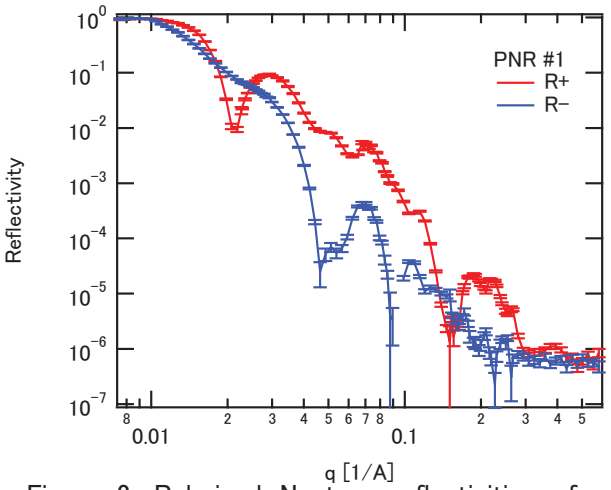

Figure 2. Polarized Neutron reflectivities of sample #1.

Table. 2. Fitted parameters of PNR of sample #1 (temporary).

Material (assumed)	Thickness [nm]	SLD [*10^{-6} Å^{-2}]	Roughness [nm]
Polymer	143.8	4.36	0.1
Si,O,polymer	0.45	2.49	9.32
Si	14.32	0.04	0.08
FeSi	27.91	0.005(+), 0.96(−)	0.76
Fe	121.9	6.57(+), 0.795(−)	5.22
Si sub.	===	2.33	15.34

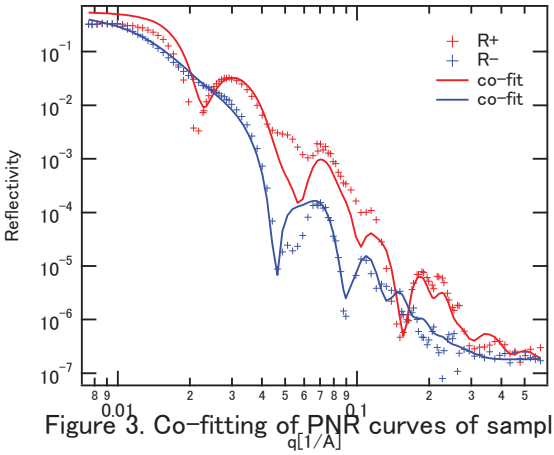

Figure 3. Co-fitting of PNR curves of sample #1. (temporary)

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