実験報告書様式(一般利用課題・成果公開利用)

(※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 2014/6/17 承認者 Approver Masayasu Takeda 提出日 Date of Report 2014/6/16
課題番号 Project No. 2013A0144 実験課題名 Title of experiment GISANS measurement using precisely figured focusing mirrors 実験責任者名 Name of principal investigator Dai Yamazaki 所属 Affiliation J-PARC Center, JAEA	装置責任者 Name of Instrument scientist Masayasu Takeda 装置名 Name of Instrument/(BL No.) BL17 実施日 Date of Experiment 4/29 – 5/5

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.

$Fe_{99.35}Cu_{0.65}$, solid, 20x20x1 mm^3

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.

In the experiment, we successfully focused neutron beam vertically with a 1-dimensional elliptic supermirror and then observed a small angle scattering (SANS) with neutron beam vertically focused and horizontally collimated. Scattering signal was observed at 3-5 digits below the peak intensity. The measurement was not a grazing incidence SANS (GISANS) but a conventional SANS putting the sample at a right angle to the incident beam and measuring the transmitted beam from the sample. We could not carry out GISANS measurement because of lack of time which was consumed in setting up a 2-dimensional RPMT detector system.

The 1-dimensional elliptic supermirrorr (focusing supermirror) was fabricated as a test piece for GISANS measurements at BL17. The focusing supermirror is composed of an aluminum base the surface of which is precisely figured by numerically controlled mechanical sanding and polishing and a neutron supermirror bonded with pressure on the base. The focusing mirror was 400 mm in length and surface figure of it corresponds to a portion of an ellipsoid with eccentric angle θ = 1.180-1.257 rad in the ellipsoid $ax^2+by^2 = 1$, a = 5525 mm, b = 79.65 mm.

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

The beam line was configured as follows: the neutron beam was narrowed with the first slit, reflected vertically by the elliptic supermirror and then focused to the surface of the detector. The elliptic supermirror was installed on the goniometer system for optics of BL17 (in front of the 6th beam slit) correspond to 7430 mm from the initial focal point (the first slit) and 3620 mm to the final focal point (the detector surface).

Figure 1 shows shape of the vertically focused and horizontally collimated beam measured without sample. Focused (vertical) beam width was found to be 6 pixels = 2.0 mm in full width at half maximum (FWHM) while ideal size is 1.0 mm. The reason of this blur can be attributed to the figure error of the elliptic mirror which should be improved by adopting another method for bonding the mirror to the base.

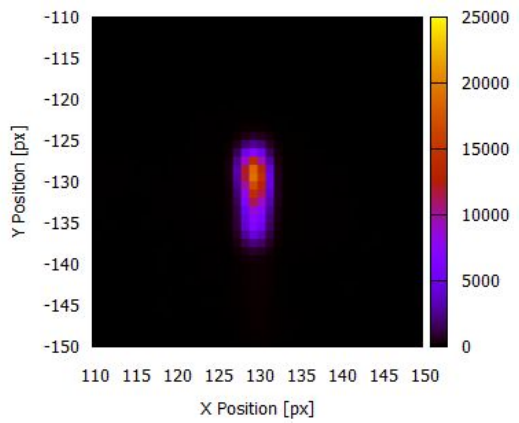

Fig.1
Vertically focused and horizontally collimated neutron beam measured with a 2-dimensional RPMT detector installed at 3620 mm from the elliptic supermirror. Size of the detector pixel is 0.33 mm.

Using the narrow neutron beam shown in Fig.1, we tried a small angle scattering measurement. The sample was put at the center of the sample stage (6950 mm from the initial focal point and 2500 mm to the detector surface). The sample was a plate of $Fe_{99.35}Cu_{0.65}$ the dimension of which is 20x20x1 mm^3.

Figure 2 compares the profiles of measured beams with and without the sample as a function of distance "R" from the beam center. Neutron counts have been integrated along circular rings with the same width (3 pixels) and with 16.1 – 17.1 ms in time of flight (3.542–3.762 Å in neutron wavelength).

We can see the difference in neutron counts about 3–5 digits below the peak intensity which stems from small-angle scattering by the sample. Detailed analysis is now in progress.

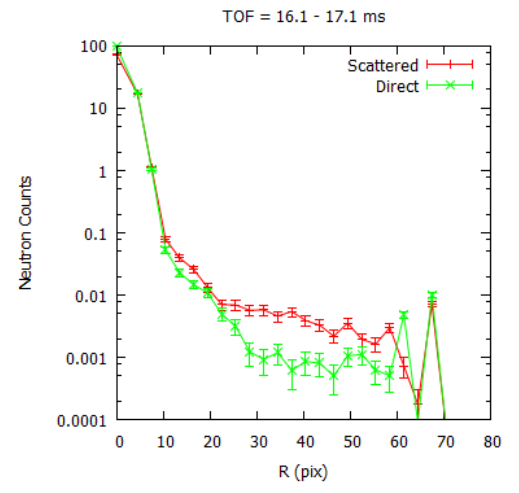

Fig.2
Profiles of beams measured with the sample (red) and without it (green) as a function of distance from the beam center. The difference in neutron counts corresponds to small angle scattering by the sample ($Fe_{99.35}Cu_{0.65}$). Size of the detector pixel is 0.33 mm.