（ ※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。 ）

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| 課題番号 Project No.<br>2017A0219<br>実験課題名 Title of experiment<br>Neutron transmission measurements using a boron-type neutron grid<br>実験責任者名 Name of principal investigator<br>Kaoru HARA<br>所属 Affiliation<br>Hokkaido University | 装置責任者 Name of responsible person<br>Kenichi OIKAWA<br>装置名 Name of Instrument/（BL No.）<br>NOBORU (BL10)<br>実施日 Date of Experiment<br>2017Jun03 – 2017Jun05 |

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) Iron plate1, Fe, 10 cm × 10 cm area, 0.5 cm thick, Solid
(2) Iron plate2, Fe, 10 cm × 10 cm area, 1 cm thick, Solid
(3) Gold disc, Au, 1 cm diameter, 0.05 cm thick, Solid
(4) Boron disc, B, 1 cm diameter, 0.2 cm thick, Solid
(5) Sodium chloride disc, NaCl, 1 cm diameter, 0.1 cm thick, Solid
(6) Boron nitride plate, BN, 2.5 cm × 2.5 cm area, 0.1 cm thick, Solid
(7) Sodium chloride plate, NaCl, 2.5 cm × 2.5 cm area, 0.3 cm thick, Solid
(8) Aluminum plate, Al, 10 cm × 10 cm area, 0.08 cm thick, Solid
(9) Cobalt plate, Co, 10 cm × 10 cm area, 0.07 cm thick, Solid
(10) Silver plate, Ag, 10 cm × 10 cm area, 0.05 cm thick, Solid
(11) Gold sheet, Au, 10 cm × 10 cm area, 0.002 cm thick, Solid

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.

For a pulsed neutron imaging, neutron transmissions of some samples were measured with and without a boron-type neutron grid in NOBORU at BL10. The neutron grid is a pair of crossing slits which are composed of many layers of neutron absorption (boron) and transparent materials (silicon), where the slit width, area, and depth are 0.4 mm, 60 mm × 60 mm, and 22 mm, respectively. Because the boron have a large neutron total cross section, the neutron grid is expected to restrict a solid angle of neutrons scattering off the sample and suppress the scattered neutrons entering into a detector.

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

The schematic view of the experimental setup is shown in Fig. 1. The neutron grid was set on stages of rotary and swivel between the sample and the detector. The measurements for each sample were performed according to the following procedure. First, the angles of the slits with respect to the incident neutron beam were adjusted by using the stages of rotary and swivel, where the neutron beam size was collimated less than the slit area of the neutron grid. The angles at the maximum counting rate were surveyed. After the adjustment, the two-dimensional transmission images for the sample were measured with the neutron time-of-flight (TOF) technique by a gas electron multiplier (GEM) detector. Next, the neutron grid was removed from the beam line while the sample was remained at the same position of the measurements with the neutron grid in order to measure the neutron transmission for the sample without the neutron grid. A plate of iron (or plates of boron nitride, and sodium chloride and discs of gold, boron, and sodium chloride) was used as the samples as shown in Fig. 2(a) (or Fig. 2(b)). In addition, to estimate other backgrounds except the scattered neutron from the sample, the plates of Co, In, Ag, and Cd were used as the filters. The neutron transmission for a gold sheet was also measured for the energy calibration of neutron flight time.

The neutron transmissions for a 0.5-cm thickness iron plate which were measured with and without the neutron grid are shown by the blue solid and gray dashed lines, respectively, in Fig. 3. The distance between the iron plate and GEM detector was about 14 cm. As compared to the neutron transmission measured without the neutron grid, the neutron transmission measured with the neutron grid was under in the neutron wave length region of 0.2 – 0.6 nm. In the neutron transmission measurements for a 1-cm thickness iron plate, the similar results were obtained. The analysis of data measured using other samples is in progress. The usefulness of the boron-type neutron grid for reducing the neutron background will be evaluated by this experiment.

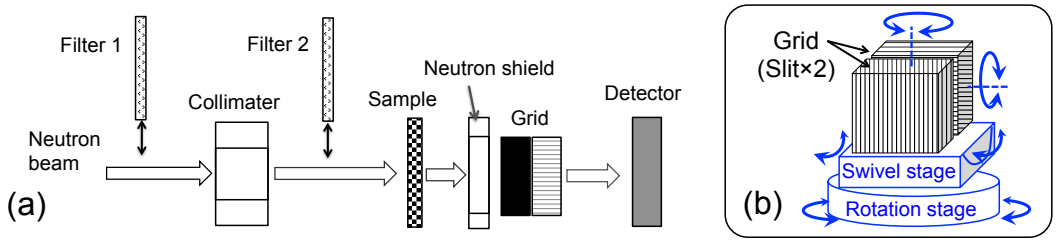


Figure 1: Schematic view of experimental setup with the neutron grid

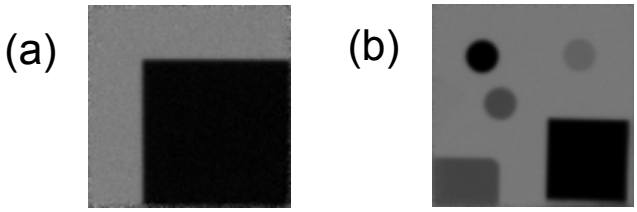


Figure 2: Transmission images for the iron plate (a), and three discs (B, Au, NaCl) and two plates (NaCl, BN) (b)

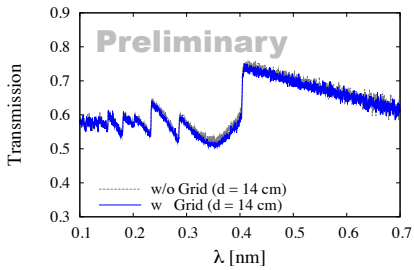


Figure 3: Neutron transmissions for a 0.5-cm thickness iron plate