（ ※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。 ）

MLF Experimental Report	提出日 Date of Report 2014/07/12
課題番号 Project No. 2014A0307 実験課題名 Title of experiment Neutron Beam Imaging for Therapeutic Devices using energy-resolved neutron imaging techniques 実験責任者名 Name of principal investigator Toshihiro Sera 所属 Affiliation Kyushu Univ.	装置責任者 Name of responsible person Kenichi Oikawa 装置名 Name of Instrument/（BL No.） NOBORU/BL10 実施日 Date of Experiment 2013 5/8 9:00～2013 5/10 9:00

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.

We imaged a detached platinum coils in aneurysm using energy-resolved neutron imaging techniques at BL10. The detached coil in aneurysm was placed in the aluminum cylinder which is filled with the physiological saline to prevent desiccation (Fig.1 bottom). And, we made the aneurysm model using 3D printer, and also imaged a detached platinum coils in this aneurysm model (Fig.1 top).

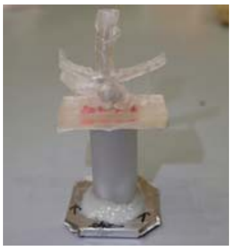

Fig. 1 Aneurysm with detached platinum coils.

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.

Method

Figure. 2 shows the experimental setup at BL10. The sample was located at the sample position on the table (14.3 m from the moderator surface). At the back of the sample, a two-dimensional detector with the spatial resolution of 0.1-0.2 mm is located (the distance between sample and detector: 55 mm). In this study, we used time-resolved neutron imaging detector employing the micro-pixel chamber (μPIC). And, Pb filter (thickness: 25 mm) was used and disk chopper was set 25 Hz and 350°. The exposure time was 10 hours. The neutron images were obtained with sample and without sample at two different angels (front and side view).

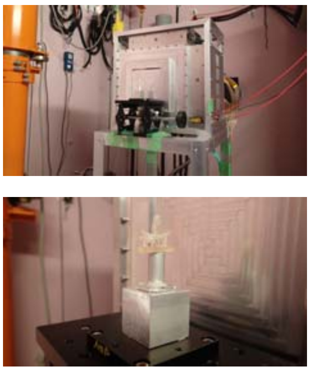

Fig. 2 Experimental setup.

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

Result

Fig. 3 shows the neutron radiography image of the detached platinum coils in aneurysms and the aneurysm model. The segmentation of the detached platinum coils in aneurysm is difficult. So, we investigated the main component of coils using neutron time of flight measurement at red area in Fig. 3.

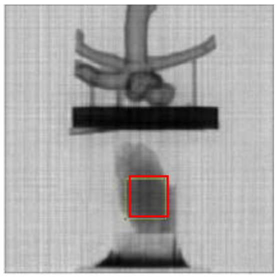

Fig. 3 The neutron radiograph. Red area is used for neutron time of flight measurement.

Fig. 4 shows the neutron time of flight of sample and background, indicating that the detached coils in aneurysms was mainly made of platinum. Fig. 5 shows the relationship between neutron transmission and energy. Platinum has a strong resonance neutron absorption at 11.9eV. And, this result indicates that the energy-resolved neutron imaging techniques is very useful to visualize detached platinum coils in aneurysms. Therefore, we measured two energy-selected neutron radiography images at 11.9 eV and 10.5 eV, and obtained the normalized image using these two images (Fig. 6). We can distinguish Platinum region in the sample compared by two images.

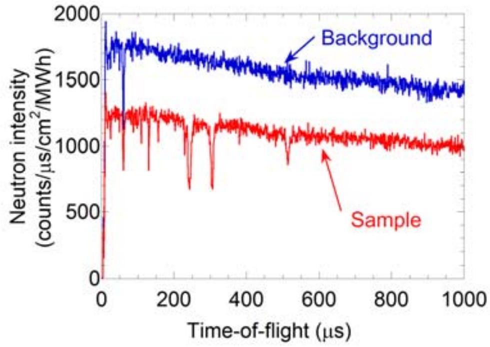

Fig. 4 The neutron time of flight.

Summary

In this study, we imaged the detached platinum coils in aneurysms using energy-resolved neutron imaging techniques at BL10. We found that the coils in aneurysms has a strong resonance neutron absorption at 11.9eV and can be visualized using the energy-resolved neutron imaging techniques. We are planning to visualize the detached platinum coils in aneurysms three-dimensionally. From this preliminary experiment, we obtained to fundamental results for computed tomographic images.

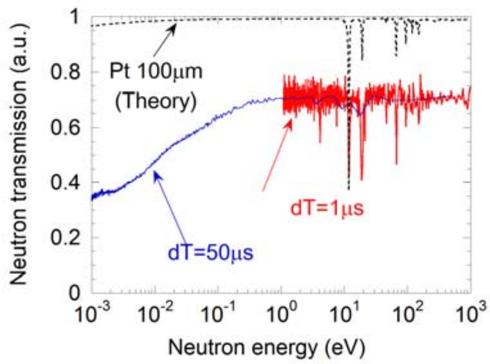

Fig. 5 Neutron transmission.

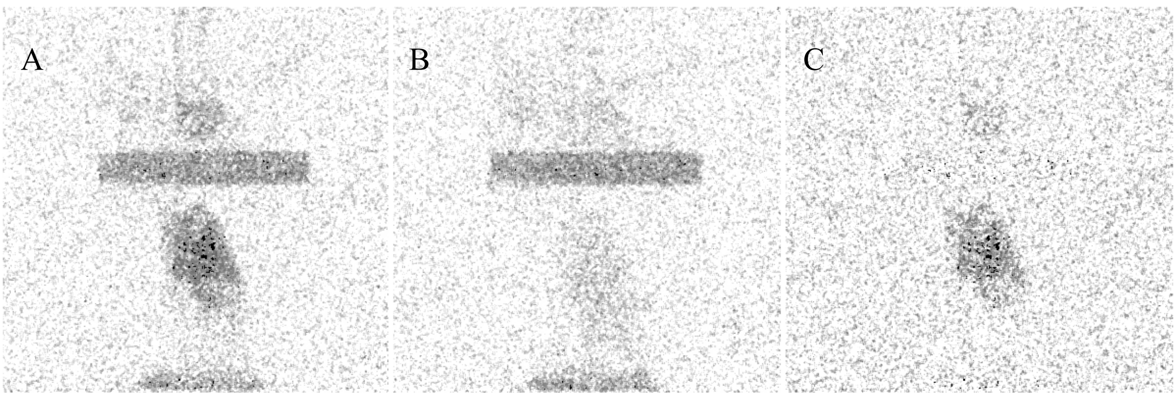

Fig. 6 Two energy-selected neutron radiography images at 11.9 eV (A) and 10.5 eV (B), and the normalized image (C).