MLF Experimental Report	提出日 Date of Report 2011/06/20
課題番号 Project No. 2010A0038 実験課題名 Title of experiment Development of new type MgB2 neutron detector 実験責任者名 Name of principal investigator Prof. Takekazu Ishida 所属 Affiliation Osaka Prefecture University	装置責任者 Name of responsible person Dr. Fujio Maekawa 装置名 Name of Instrument/（BL No.） BL-10 実施日 Date of Experiment Oct 16 - Oct 17, 2010

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.

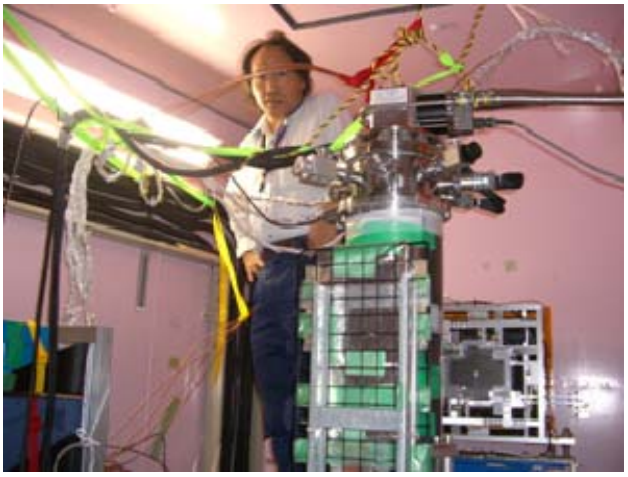
MgB2 thins films
Crystal structure is hcp.
The sample was processed by nanofabrication technique to use as a superconducting nanowire neutron detector.
The sample is quite stable in air and for neutron irradiation.

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.

High-quality as-grown MgB2 thin films were prepared by using a multiple-target sputtering system with Mg and B targets at a low substrate temperature (Ts) on the C-plane of A2O3 substrates without post annealing. The lack of post annealing for preparing the MgB2 films is crucially important for considering superconducting electronics applications because multiple processes at relatively lower temperatures are required to build the superconducting devices. The sample surface thus obtained is extremely smooth so as to allow nanofabrication of MgB2 films by using electron beam lithography. The MgB2 detector consisted of a 200-nm-thick MgB2 thin-film meander line, a 300-nm-thick SiO protective layer and 150-nm-thick Nb electrodes. Transition to superconductivity in the R-T curve of the MgB2 radiation detector is very sharp even when it is shown in a logarithmic vertical scale. The critical temperature of the film was 27.25K with a 0.25-K transition width at 250A/cm2.
For this device, the 3-micorometer width of the formed meanderline reached 6.2mm. in whole lengths while the total meander pattern size was confined into 200x200 micrometer area. The resistance of the MgB2 sensor part is 5.8 k-ohm at 300K and 4.7 k-ohm at 30K.

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

The block diagram of our measurement system consists of several different electronics. The MgB2 devices were placed in a 4-K refrigerator to control at a certain temperature below Tc. Neutrons are irradiated in a pulsed beam of J-PARC (NOBORU) of JAEA (Tokai, Japan) when the MgB2 detector was biased by dc current with the magnitude of 150-micro ampere. Output signals were observed by a 5-GHz digital oscilloscope through an ultra-low-noise amplifier.



As the first trial, we were not able to measure signals from the detector, but this is due to tremendous amount of electro-magnetic noise appeared in BL-10. We will consider several possible procedures to reduce electronic noise. It is obviously important to note that our experimental system was successfully installed in a limited experimental space of BL-10. The compressor unit of the 4-K refrigerator was located outside of the BL-10 experimental room, but we are able to cool down the sample down to 4 K. This means that BL-10 is the right place to do experiment on MgB2 detectors. Further trials at BL-10 would be very promising because we are able to take various experiences in the first trial machine time at BL-10.

We also performed a cold run experiment from Nov 19 to Nov 26, 2010 to obtain optimum conditions of the experiments. We requested the BL-10 administrator to assign another machine time to us. However, it was not successful because the total machine time requested from others exceeded acceptable machine time. We decided to do more experiments as cold runs.

Meantime, the Earthquake at East Japan happened on March 11, and the facilities at J-PARC also suffered the tremendous damage. This is quite sad for us, and we hope a quick recovery of J-PARC. We plan to do experiments after being restored.

In summary, we obtained various important experiences at J-PARC to organize the experiments in the future. We will submit a plan to do further experiments at BL-10. Photographs show that our measurement system was successfully installed in the experimental room at BL-10.