Neutron beam monitors using B_4C thin films for neutron scattering instruments

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1. Introduction

Neutron beam monitors are usually used for neutron beam experiments to confirm neutron beam intensity and normalize [1-2]. Among thermal neutron scattering instruments of HANARO, Thermal neutron Triple Axis Spectrometer (Th-TAS) will be installed soon, and the neutron beam monitor for Th-TAS will be needed as shown in Figure 1. The required efficiency of neutron beam monitor for Th-TAS is from $\sim10^{-4}$ to $\sim10^{-2}$ because neutron intensity at beam monitoring position is from $\sim10^{6}$ to $\sim10^{8}$ depending on monochromatic system [3]. To get neutron detection efficiency of $\sim10^{-2}$, we have developed neutron beam monitors using B_4C thin films with mixed gas instead of helium or nitrogen gas.

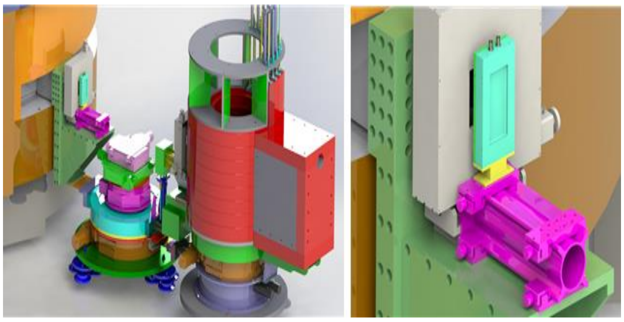

Fig. 1. The illustration of Thermal neutron Triple Axis Spectrometer and neutron beam monitor

2. Methods and Results

Neutron beam monitors have been developed using B_4C thin films with mixed gas, and the schematic of neutron beam monitors are shown in Figure 2. Two types of neutron beam monitor were designed. One creates continuous signal, and the other which has a wire at center creates pulsed signal. The developed neutron beam monitor consists of an aluminum case, a B_4C thin film, PCBs, and SMA connectors as shown in Figure 3. The effective area for neutron detection is height 11cm x width 5cm, and the thickness of aluminum is 2mm. The specification of neutron beam monitor for Th-TAS is shown in Table 1.

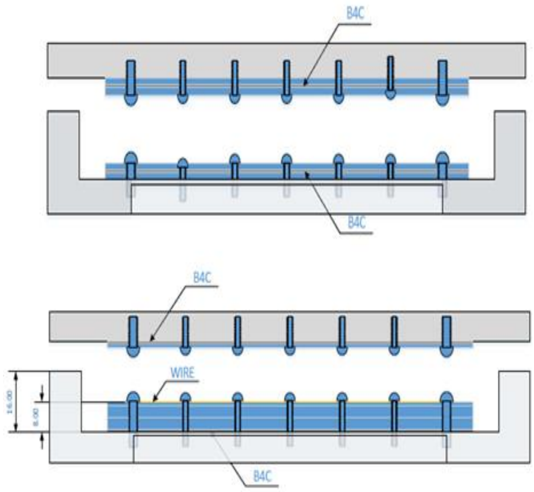

Fig. 2. The schematics of continuous signal type (upper) and pulsed signal type (bottom)

Neutron beam monitors should be evaluated using high flux thermal neutrons more than about 10^{6} because neutron detection efficiency is very low. However, we could not use high flux thermal neutrons after shutdown of research reactor HANARO. Instead of research reactor source, we have plan to evaluate the neutron beam monitors using ^{252}Cf neutron source and confirm that neutron beam monitors are working when neutrons come.

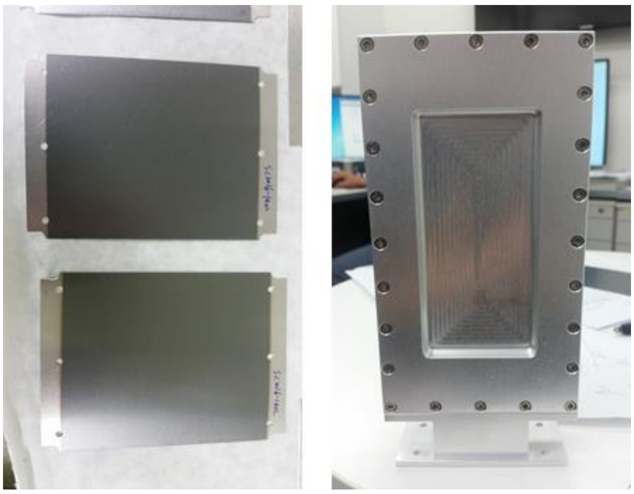

Fig. 3. The pictures of B_4C thin films (left) and developed neutron beam monitor (right)

Table I: The specification of neutron beam monitor

General Specifications	
Gas filling	Mix Gas(C_2H_6 20 %/ CF_4 2 %/ Ar Balance) and B_4C coated plate
Gas pressure (torr)	760
Sensitive area (cm)	5 cm x 11 cm
Sensitive depth (cm)	1.2
Window thickness (cm)	0.2
Window material	Aluminum
Connector	SHV
Electrical Specifications	
Recommended operating voltage (volts)	500
Operating voltage range (volts)	450 - 550
Detection Efficiency	
Efficiency at 1.8 Å	10^{-2} - 10^{-4}

3. Conclusions

The neutron beam monitors using B_4C thin films with mixed gas have been developed to get neutron detection efficiency of ~10^{-2} for Th-TAS. The performance of developed neutron beam monitors will be evaluated at on-site and discussed further after restart of HANARO. We are expecting that the developed neutron beam monitor will be used for various neutron scattering instruments.

REFERENCES

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