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A Thermal Neutron Imaging Detector Using a Gd-doped Micro-channel Plate

Tokyo Univ. [1], Tsinghua Univ. [2],　°Tian Yang[1, 2], Yang Yigang[2]

E-mail: cycjty@sophie.q.t.u-tokyo.ac.jp

A Gd-doped micro-channel plate (MCP) is a combination of a compact thermal neutron convertor and a signal amplifier. The desirable range (some tens of microns) of internal conversion electrons resulting from neutron absorbing by Gd in MCP's bulk volume can guarantee a high spatial resolution as well as a high detection efficiency. Our first neutron imaging result at an accelerator-driven pulsed neutron source (Hokkaido University Neutron Source) is presented (Fig. 1). The MCP used in the test with a diameter of 50 mm is doped with 3 mol % $^{nat}Gd_2O_3$. A wedge strip anode (WSA) is used as a 2-D readout. The spatial resolution is calculated to be only 213 μm, which is mainly limited by the small collimation ratio (around 100: 1). Our pervious test at a reactor source shows a much better spatial resolution of 72 μm (collimation ratio around 350: 1). The relative neutron detection efficiency compared with a ^{3}He tube is estimated to be 8 %. However the detection efficiency for thermal neutrons should be much higher because of the non-negligible epithermal neutron content which is shown in Fig. 2. A time-of-fight measurement is needed to calculate the thermal neutron detection efficiency of the Gd-doped MCP, which will be carried out using our new detector with a delay-line readout.

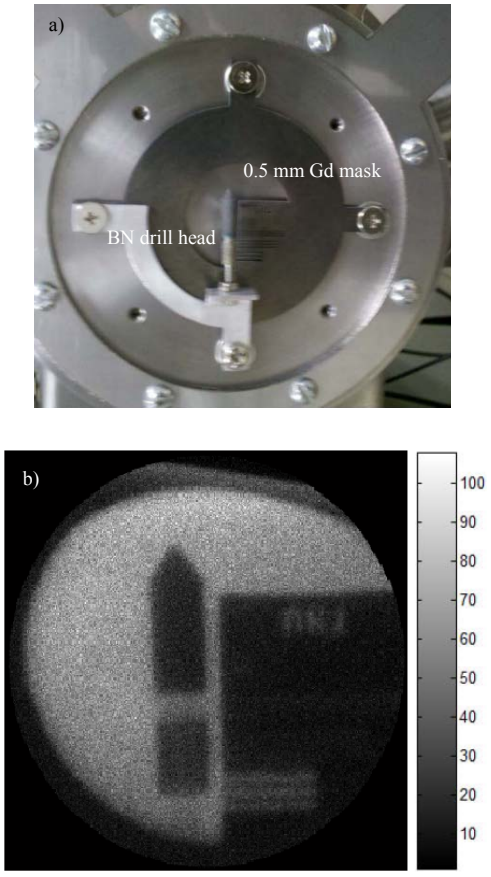

Fig. 1. The neutron imaging result. The imaging objects are a 0.5 mm Gd mask and a boron nitride drill head.

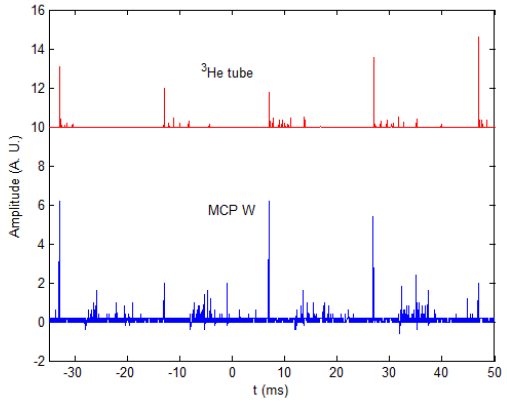

Fig. 2. The signals of the MCP detector and the ^{3}He detector recorded by an oscilloscope. The big pulses are the interferences by the accelerator which can be treated as references of t_0.

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