THE STUDY OF THERMAL NEUTRON TOMOGRAPHY BASED ON PORTABLE COMPACT ACCELERATOR OF D-T NEUTRON SOURCE

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Keywords: Thermal Neutron Tomography, Portable Compact Accelerator, D-T neutron Source, Low Signal to Noise Reconstruction

Summary: In China, one new portable compact accelerator of D-T neutron source have been constructed and been used for neutron imaging include fast neutron imaging and thermal neutron imaging. We took thermal neutron tomography on this facility. With 181 images of 360 º(angle interval as 2 º), we successfully reconstructed structure of special object. The small structure of diameter 0.2mm has been reconstructed clearly.

1. INTRODUCTION

The neutron imaging team at Institute of Nuclear Physics and Chemistry (INPC of CAEP, China) constructed multi-use neutron imaging facility based on portable compact accelerator of D-T neutron source. The facility includes fast neutron imaging module and thermal neutron imaging module, and off-line detection method based on NIP or film, on-line detection method based on scintillator screen cooperated with CCD camera could be chosen.

The thermal neutron imaging module is composed of portable compact accelerator of D-T neutron source, moderator of tungsten–steel-polyethylene, carrying system and detection system. It could supply FOV from 100mm×100mm to 200mm×200mm at L/D ratio as 25, and time of exposure is from 8min to 2h at neutron flux as 5×10^{10}/s. The thermal neutron on-line detection system is compose of ZnS:Ag(Cu) scintillator screen, thickness as 200 μm, custom-built lens and cooled CCD camera, which could be used for neutron radiography and thermal neutron tomography. The thermal neutron imaging module has been applied on detection of residual material in the nickel alloy blade and detonator of aviation application.

2. EXPERIMENTAL METHOD

We carried out thermal neutron tomography based on this facility. The object is made by aluminium, polyethylene and gadolinium as Fig. 1(a). The thermal neutron tomography collected 181 images with rotation from 0º to 360º, angle interval as 2º, each image exposed 8min.

3. RESULTS

The reconstructed images are shown in Fig. 1(b), with reconstructed method of FBP. The results show that this facility could be used for thermal neutron tomography, and multi-material objects could be reconstructed clearly. The smallest line of gadolinium of diameter 0.2mm could be reconstructed.

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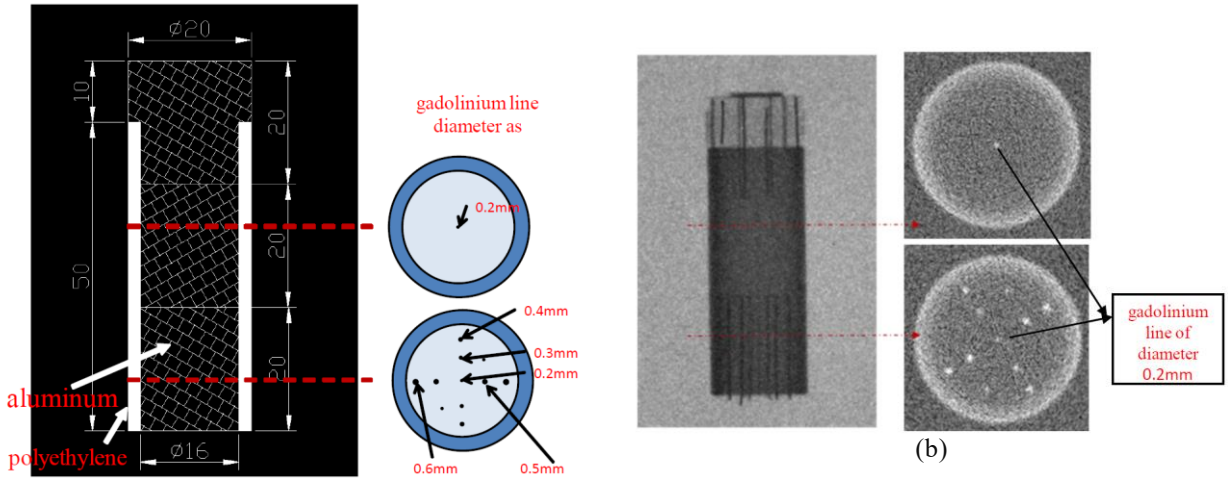

(a) (b)

Figure 1: (a) Blueprint of Object for Thermal Neutron Tomography. (b) The Reconstructed Images of Thermal Neutron Tomography.