

An imaging technique to enhance cadmium in oil paints as a demonstration of element selective neutron imaging

Thursday, 12 September 2013 10:50 (20 minutes)

Neutron radiography has been utilized for a non-destructive imaging taking advantage of high transmission properties of neutrons. New imaging techniques utilizing the neutron energy (wavelength) dependence of the transmission rate have attracted attention over the years. Such two-dimensional information of a specimen as lattice, elements, temperature and magnetic-field are obtainable by analyzing the changes of transmission rate with neutron energy. In this presentation, recent activities of the element selective imaging and the dedicated imaging beam line in the Japan Proton Accelerator Complex (J-PARC) are reported.

Experimental studies of the element selective imaging in J-PARC have been performed in the beam line NOBORU which is often used to develop new techniques. The element enhanced imaging were demonstrated by using metal foils of cobalt, silver, cadmium, indium, tantalum and gold, sodium in glass, copper and zinc in coins and iridium in catalyst of a satellite. Most recently, a study of the element enhanced neutron imaging have performed to visualize cadmium in oil paints. Neutron transmission rate of cadmium exhibits local minimum at 0.2 eV which is specific for cadmium. It was estimated that the neutron transmission rate locally decreased by 20% (it was expected to give clear image of cadmium) at 0.2 eV assuming 5 mg/cm² of cadmium was included in an oil paint. For example the cadmium thickness of 5 mg/cm² is equivalent to the oil paint thickness of 0.2 mm if cadmium content is 3wt% and the oil paint density is 1.0 g/cm³. A preliminary measurement was performed by using oil paints labeled cadmium-yellow, vanadium yellow, cadmium orange, cadmium red and two kinds of cadmium green. Each oil paint was put on a 15 x 15 mm aluminum plate of 1 mm in thickness, and was kept at 80 degrees C for about 100 hours. The dried weights were between 58 mg and 93 mg. Shadows caused by cadmium were recognized in the neutron transmission image of 0.2 eV at the positions of oil paints except the vanadium yellow and one of the cadmium green. The cadmium contents in these two oil paints were indicated to be much less than those in the others. Quantitative analysis will be performed in the next step. The authors wish this technique is helpful in some research fields.

A dedicated neutron imaging beam line is in construction now, and will start user programs in 2015. Even before that, proposals of the neutron energy selective imaging and conventional radiography are welcomed for NOBORU beam line in J-PARC.

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Session Classification: Last session

Track Classification: NINMACH