Development of a 3D Pulsed Neutron Imaging System using a High-speed Video Camera at J-PARC

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A neutron energy resolved three-dimensional (3D) imaging system with a high-speed video camera (CMOS, up to 1300 k frame/sec) and time-of-flight technique has been newly developed and installed at Japan Proton Accelerator Research Complex (J-PARC). The aim is to investigate a spatial distribution of several elements and crystals in various kinds of materials or substances more rapidly. The system allows us to obtain TOF images consecutively resolved into narrow energy ranges in the pulsed neutron energy region from 0.01 eV to a few keV [1, 2]. The camera system was successfully demonstrated to obtain the reconstructed 3D images for Cu, Fe, Pb, and Polyethylene samples and the neutron energy dependence of the CT values, which are proportional to the total neutron cross sections. With use of the energy dependence of each CT values, it is possible to emphasize the selected materials, even if materials such as Cu and Fe have similar energy dependence of CT values.

The system consists of a neutron converter made of Li/ZnS, lens, image intensifier, high-speed video camera and control-PC. An experiment was performed with use of the high-speed camera with 4 k frame/sec and the images were obtained at 45 steps of every 4 degree. Using transmission ratio images obtained by every 4 degrees step, the energy-resolved 3D images were calculated by filtered back projection method.

The results showed that this technique has the possibility to visualize material alternatively by choosing neutron energy and emphasize materials with use of the energy dependence of CT values.

References

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