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#4-32 Preliminary Study on Joint Imaging Detection Technology of Wide Energy Zone n/ gamma ray Based on Research Reactor

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X/γ/neutron radiography is the most important radiography technology at present, of which X-ray imaging with different energy and different imaging forms is the most developed and widely applied. At the same time, however, due to differences in the principles of neutron imaging and matter interaction, neutron imaging can complement X/gamma imaging in specific areas, such as detection of hydrogen-containing substances in heavy metals (e.g. water, oil, plastics, resins, biological tissues, etc.) and detection of highly radioactive samples. In view of the complementarity of neutron imaging and X/γ imaging technology in nondestructive testing, in recent years a number of research institutions have started to build joint neutron X/ gamma imaging detection platforms and developed related experimental methods, image processing techniques and quantitative analysis techniques. The difference is that some of the joint images are mainly X-rays, while others are mainly neutron rays, with different combinations of neutron and X/ gamma-ray energy. The development of neutron-X/ gamma composite imaging has broad application prospect. According to different types of detection objects, the characteristics of different rays are fully used to improve the information acquisition ability of detection objects, and the recognition ability of elements is formed through joint detection.

A thermal neutron imaging facility is built in Mianyang Research Reactor, China. The maximum thermal neutron flux intensity at the imaging position is about 1e8 cm-2s-1, which can achieve a spatial resolution of up to 50 μ m. Based on this device, fission neutrons (energy > 0.1 MeV) have been obtained by a combined filter on the basis of the original thermal neutron beamline. When the collimation ratio is approximately 172, the flux of the fission neutrons is close to 3e5 cm-2s-1. The fission neutron imaging system has a maximum field of view of 400 mm x 400 mm and experimental spatial resolution is better than 0.5 mm. Imaging detection of three kinds of rays can be achieved by using thermal neutrons, fission neutrons and gamma rays in the beamline. At present, the device has completed three kinds of ray imaging and preliminary tomography experiments. For samples consisting of copper and polytetrafluoroethylene, it has the ability to detect internal flaws, as cracks with a minimum width of 0.1 mm and as holes with a minimum diameter of 1mm. In the future, gamma-ray imaging detection ability will be optimized, the reconstructed images from three rays will be fused, and the element identification capabilities of joint imaging detection technology will be validated through standard sample experiments.

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