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APPLICATION OF NEUTRON TOMOGRAPHY IN THE STUDY OF METEORITES, ROCKS, AND CULTURAL HERITAGE OBJECTS

Neutron tomography creates a 3D image by reconstructing a series of radiographs to visualize the inner structure of industrial, engineering, geological, biological, and other samples of interest. The significant depth of neutron penetration makes it possible to obtain neutron images of the internal structure of studied objects with spatial resolution at the micron level. Currently, neutron radiography and tomography methods have been realized in almost all neutron centers in the world. Since 2015, the NRT station [1] at the IBR-2 high-flux pulsed reactor (FLNP JINR, Dubna) has been operated regularly for neutron tomography experiments. In 2020, a neutron imaging facility [2] was commissioned on the 5th horizontal channel of the stationary reactor WWR-SM (INP AS RUz, Tashkent), developed jointly with FLNP JINR. This report presents the main technical parameters of the neutron imaging facility and the results of studying fragments of the Chelyabinsk and Kunya-Urgench meteorites, lamprophyre dikes, and cultural heritage objects with the neutron tomography method. In particular, tomography of meteorite fragments helped to reveal the 3D distribution of metal components corresponding to the troilite and kamacite phases. Segmented particles of kamacite in the Kunya-Urgench meteorite volume were found to have a weak axial shape texture, which could have been formed as a result of collision. Lamprophyre dikes were studied to reveal the possible connection between the inclusions in the dike body and the magma flow. With neutron tomography, it was possible to obtain the 3D distributions of such inclusions, to analyze their size, shape, and orientation, and to confirm the connection between the spatial orientation of the inclusions and the direction of magma movement. Within the framework of cooperation with archaeologists, the phase composition and spatial distribution of various phases inside the Qarakhanid dirham were obtained. It has been established that the main phases of the corrosion fraction are cuprite Cu2O, tenorite CuO, and chalcocite Cu2S. The uneven distribution of corrosion penetration into the coin volume is reconstructed. Also, 3D models of clay mortar fragments from the walls of the Uzundara fortress, mineral composition, and spatial distribution of the main phases in the volume of these fragments were obtained.

References:

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Section

Energy and materials science (Section 2)

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