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Neutron imaging in science and technology

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Neutron imaging is a method of non-destructive investigation for objects of scientific and technological interest. Within the last decade, neutron tomography and radiography have significantly gained importance among the neutron science community. One of the reasons is the fast development in digital image recording and processing technology, which has allowed overcoming of some previous limitations in spatial and time resolution. Another reason is that in addition to the attenuation contrast technique, new innovative methods for neutron imaging are being implemented. Using monochromatic neutrons for imaging, complementary contrast due to the coherent scattering in polycrystalline materials can be obtained, providing information about structural changes or composition inhomogeneities. In addition, neutrons possess a magnetic moment which makes them sensitive to magnetic fields. The magnetic interaction can be used for two- and three-dimensional visualization of magnetic field distributions both in free space and in bulk materials. Utilization of phase contrast and dark-field contrast techniques e.g. using grating interferometry allows for visualization of low-absorbing materials and microstructural heterogeneities, as well as magnetic structures (domain walls).
The neutron tomography instrument CONRAD-2 had been in operation since 2005 at the Hahn-Meitner research reactor at Helmholtz-Zentrum Berlin (HZB). Over the last years, significant development work has been performed to expand the radiographic and tomographic capabilities of the beamline. New techniques have been provided to the user community as tools to help address scientific problems over a broad range of topics such as superconductivity, materials research, life sciences, cultural heritage and paleontology. Industrial applications including fuel cell research have also been improved through these new developments.
The instrument is used for educational purposes in the frame of the annual Berlin School on Neutron Scattering. Various studies related to a large number of diploma and doctoral theses have been performed at the beamline.

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