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Neutron Imaging - Material research in real space

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Neutron imaging is a method that directly provides real-space information about the sample composition using neutrons as probing beam. In the standard configuration the resulting images represent the neutron shadow cast by the, for neutrons, semi-transparent sample. The basic principle is very similar to the more known X-ray radiography. The difference lies in the neutron matter interaction that provides a very different set of attenuation coefficients for the elements than provided by X-rays. Radiography is the basic mode for neutron imaging, but the method is not limited to the acquisition of two-dimensional images. Computed tomography using neutron projection data makes it possible to reconstruct the three-dimensional distribution of attenuation coefficients in the sample. On the other hand, processes can be followed in quasi-real-time modes. Depending on the installed instrumentation it is possible to reach voxel sizes of 13.5um for small samples while it is possible to support samples with dimensions up to 250mm at lower resolution. Most neutron imaging experiments are performed using radiography and tomography with a "white beam", but the use of optional energy selection devices in the beam makes it possible to perform Bragg edge imaging at different neutron energies. Neutron grating interferometry imaging can provide additional information about the sample by using the differential phase shift and the dark field information. The dark field images have proven useful in investigations of magnetic domains since it is sensitive to the small neutron scattering angles caused by the magnetic domain walls.

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