

Energy-selective neutron imaging: methods and applications

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Neutron radiography and its extension to tomography is based on transmission contrast by varying macroscopic cross sections in the sample of interest. Traditionally, a polychromatic beam is used, which enables to discriminate between different sample materials and thicknesses.

By using a tunable monochromatic, cold neutron beam one can scan in transmission polycrystalline samples over the cold energy range, where so-called Bragg edges dominate the cross section. Those edges can be understood in the context of the Bragg law $2dhkl\sin(\theta hkl)=\lambda$, where coherent elastic scattering at the hkl lattice plain is possible until $2dhkl=\lambda$, after which a sharp increase in transmission intensity is observed because of decreased sample scattering out of the beam. In energy selective neutron imaging around these Bragg edges lays a new source of image contrast that contains microstructural information on the sample. It has the potential of becoming a new tool for material research complementary to existing diffraction techniques. The approach can also be extended to 3D tomography studies on request.

A first part of this poster is dedicated to a study on the use of two monochromator types for energy selective imaging: the neutron velocity selector and a newly developed monochromator called TESI. The first features a large field-of-view and a monochromaticity $\Delta\lambda/\lambda=15\%$ realized through mechanical selection of the desired neutron energies. TESI uses a set of single crystals to scatter neutrons of unwanted energies out of the direct beam, to obtain a final monochromaticity of $\Delta\lambda/\lambda=2\%-5\%$.

The second part of the poster deals with applications of energy-selective neutron imaging, with special focus on the combination with neutron diffraction imaging.

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