Contribution ID: **2** Type: **not specified**

Analyzing crystalline structures by means of neutron imaging at pulsed and continuous neutron sources

Monday 7 April 2014 14:30 (30 minutes)

When the grains in polycrystalline materials (crystallites) are large enough (compared to the spatial resolution), diffraction of neutrons out of the direct beam depends on whether or not a crystallite in the beam path is oriented as such fulfilling Bragg's law. Spatial variation in transmission contrast appears across the sample between those grains that do and those that do not. Rotating the sample changes these conditions and makes tomographic extension non-trivial as a grain does not contribute equally to all projections.

The energy-dependent coherent elastic scattering cross-section exhibits distinct peaks rather than the well known Bragg edges in this case. The ensemble of peaks holds information on the crystallite's phase, orientation and shape. High energy-resolution is required to accurately resolve these peaks which have a typical width of < 0.05Å. Hence, preference is given to the time-of-flight option, stressing the importance of neutron imaging at pulsed sources. Based on energy-scans of coarse grained iron and nickel-based superalloy samples made at ISIS (RAL, UK), we present the feasibility of grain mapping and an outlook towards tomography.

At continuous sources, convolution of the sample cross-section with the monochromator wavelength spread, compromises this method. However, one can think of the crystallites as monochromators themselves, diffracting a particular wavelength out of the polychromatic direct beam based on their orientation. Capturing these diffracted neutrons yields a projection of that grain, with the position on the detector indicative of the orientation. These projections can in turn be used for algebraic reconstruction, which yields a grain volume as well. An example of neutron diffraction contrast tomography (nDCT) performed on an aluminium strain sample made at SINQ (PSI, CH) will be shown.

The methods for imaging with the transmitted or diffracted neutrons for coarse grained material will be presented, examples given, pros and cons assessed and necessary hardware discussed.

Primary author: Mr PEETERMANS, Steven (Paul Scherrer Institut)

Co-authors: Dr KING, Andy (Synchrotron Soleil, 91192 St-Aubin, France); Dr LEHMANN, Eberhard (Paul Scherrer Institut); Dr KELLEGHER, Joe (Rutherford Appleton Laboratory, Didcot, UK)

Presenter: Mr PEETERMANS, Steven (Paul Scherrer Institut)

Session Classification: Applications I