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High Resolution Imaging and Strain Characterisation at Pulsed Neutron Sources with a Microchannel plate detector

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Recent advances in neutron detection technology are enabling collection of neutron transmission data with unprecedented spatial and time resolution [1,2]. Microchannel plates coupled with TimePix area detectors are now being used to perform time-of-flight neutron radiography experiments at 55 micron2 spatial resolution and 1 &mus temporal resolution. These sensors are suited to a diverse range of neutron studies such as microtomography of material composition or phase and strain tomography [2,3,4].
In neutron time-of-flight transmission experiments each neutron arriving at the detector is tagged with its arrival time, this allows the determination of the energy-resolved transmission spectrum from the known time structure of the incident pulse. Variation of these transmission spectra can be used to obtain spatially-resolved maps of projected crystallographic properties within polycrystalline materials; such as average elastic strain, plastic strain, texture and grain size distributions.
Here, we present results from a recent experiment at the Engin-X beamline, ISIS, UK. The transmission spectrum of an additively manufactured jet engine turbine blade was measured and used to determine spatially-resolved maps of the average elastic strain in the transmission direction. This is a sample of intrinsic scientific interest due to questions that remain about the residual strains imparted during fabrication compared to those manufactured conventionally.

[1] Tremsin et al. Nuc. Instr. Meth. Phys. A 2012
[2] Zhang et al. Mat. Today 2009
[3] Abbey et al. Procedia Engineering 2009
[4] Kirkwood et al. Trans. American Crystallographic Association 2013

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Strain mapping, Neutron tomography, Neutron Bragg-edge transmission, Residual strain

Summary

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