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Microstructural effects in TOF neutron transmission imaging

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Abstract

Spallation sources coupled with novel detector technologies have opened the possibility of imaging the wavelength-dependant neutron transmission of macroscopic specimens with spatial resolution < 100 μm. The microstructure of common structural materials manifest through several features in the total cross section for thermal and sub-thermal neutron energies. Here we discuss the effect of elastic and plastic strain, crystallographic texture. impurity level and porosity on the neutron transmission of polycrystalline materials. We illustrate the imaging possibilities resulting from the analysis of the wavelength-dependant transmission through experiments performed at the ENGIN-X beamline, Isis, using a novel ^{10}B-loaded microchannel plate (MCP) detector. The studies were focussed on Zr2.5%Nb pressure tubes corroded with hydrogen over periods of several months, in order to simulate possible degradation mechanisms occurring during service at nuclear power plants. In order to assess the performance of the technique to be expected from future neutron sources, we propose figures-of-merit for different imaging applications.