

NEUTRON DIFFRACTION STRESS MEASUREMENT – REMARKS ON CALIBRATION AND ALIGNMENT

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Abstract

The topics of this presentation are generally well known and understood. However, this leads to situations where appropriate attention is sometimes lacking in residual stress measurement.

The work presented here is based on long established principles, but sheds some new light on calibration and alignment procedures in certain areas.

Monochromatic neutron diffraction instruments for stress analysis are generally calibrated for their wavelength and detector angular response by measuring several diffraction peaks of a well characterized powder material. While there is no argument that calibration is necessary to measure lattice spacing reliably, the question has to be asked, how well an instrument needs to be calibrated to measure strain. In strain measurement, the dominant factor is the relative peak shift between a measurement from a material under stress and from the corresponding unstressed material. A peak shift can be very well measured without calibrating the instrument. A brief and simple analysis should indicate how important calibration is when making this consideration. Subsequently, an example is given from a real measurement campaign at the JRC, where a small calibration related error has been detected long after completion of the measurements and the data analysis.

In addition to the above main considerations on calibration, some comments are made on the use of

$$\varepsilon \approx -\cot \theta \Delta \theta .$$

In the context of this presentation, specimen alignment will be looked at. No consideration is given to the alignment of the instrument. For aligning a specimen with respect to the sampling volume there are basically several possibilities. Neutron intensity scanning is the option looked at here. Under the assumptions of idealized sampling volume shapes and homogeneous materials response there are some cases, which have analytical solutions to fit the neutron intensity data against. Some of the known cases are reiterated, with comparison to real measurement data. One additional solution is looked at – tentatively called sideways intensity scanning. Finally, some old examples from VAMAS TWA 20 and RESTAND are shown to demonstrate the importance of knowing where the specimen is with respect to the neutron beams.