Contribution ID: **70** Type: **Oral Presentation**

The PITSI neutron powder diffractometer at the SAFARI-1 Research Reactor

Thursday, 2 July 2015 10:20 (20 minutes)

Abstract content
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A new neutron powder diffractometer, named Powder Instrument for Transition in Structure Investigations (PITSI), has recently been built and commissioned at the SAFARI-1 Research Reactor. SAFARI-1 is a 20 MW light-water moderated tank-in-pool materials testing steady-state reactor that has an in-core flux of 4 x 10ˆ14 neutrons cmˆ-2sˆ-1. Notwithstanding the growing demand to study an ever increasing mix of interesting materials with neutron powder diffraction, PITSI is the only such instrument available to the African neutron scattering community.

PITSI has been developed as a medium resolution multipurpose instrument offering various wavelength options, with special attention paid towards maximising the available useful thermal neutron flux and having both high intensity and high resolution settings in one instrument. The latter is achieved by having a large double focused monochromator in conjunction with a large area detector and variable sample-to-detector distance. Special care was taken throughout to minimise the neutron background. This renders good peak-to-background ratio over the complete accessible two-theta range. The monochromatic flux at the sample position is 10ˆ6 neutrons cmˆ-2sˆ-1. Data reduction is done with an in-house developed program ScanManipulator.

Rietveld refinements of measured data from Si and Al2O3 standard powder using Topas 4.2 used for instrument calibration rendered a maximal resolution $\Delta d/d \approx 0.3$ %. Quantification studies of chemical phase content have been completed for a number of multi-phase samples to complement X-ray powder diffraction (XRPD) studies. In these cases the neutron results provided substantial additional information largely owing to its ability for bulk analyses and not suffering the form factor fall off of XRPD. Incorporating the ancillaries, a number of in-situ temperature dependent studies have been completed.

PITSI can add significant value to different scientific disciplines.

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Session Classification: DPCMM

Track Classification: Track A - Division for Physics of Condensed Matter and Materials