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In-situ neutron powder diffraction temperature capabilities at SAFARI-1

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Abstract content
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The recently commissioned neutron powder diffractometer at the SAFARI-1 reactor of Necsa, aptly named Powder Instrument for Transition in Structure Investigations (PITSI), is equipped with both heating and cooling sample environments to allow in-situ temperature dependent studies in the temperature range 3 K to 1800 K. SAFARI-1 is a 20 MW light-water moderated tank-in-pool materials testing reactor that has an in-core flux of 4×10ˆ14 neutrons cm-2s-1. The monochromatic flux of the PITSI instrument at the sample position is ≈ 106 neutrons cm-2s-1. The interchangeable heating and cooling sample environments were both procured from AS Scientific Products Ltd., UK and are specifically configured for use on neutron scattering instruments. The closed-cycle cryostat is equipped with a SHI Cryogenics RDK-408D2 cold head rendering 1W cooling power at 3.5 K, which in conjunction with a LakeShore 340 temperature controller, facilitates achieving accurate temperatures covering the range 3 K < T < 350 K. The vacuum furnace employs radiant heat generated and focussed with a 3600 W Niobium element and heat shrouds in conjunction with a West 4100+ temperature controller covers temperatures from 300 K to 1800 K. Both these sample environments are under full computer control. Temperature set points can be maintained to accuracies better than ±1 K and logged throughout the data acquisition. With envisaged modifications, the furnace system could be extended to incorporate in-situ reaction chambers.

PITSI in conjunction with its temperature environments, amongst others enable in-situ studies of chemical and / or magnetic phase transitions, determination of thermal expansion coefficients, quantification of phases, etc. A number of investigations have been completed and will be reported on to demonstrate the capabilities of this instrument that is available to the research community under the R&D User Program.

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