ECNS 2023 Garching

EUROPEAN CONFERENCE ON NEUTRON SCATTERING

Contribution ID: **376**   Type: **Poster**

The SAPHiR instrument for neutron diffraction and radiography at high pressure and temperature

Monday 20 March 2023 16:00 (2 hours)

SAPHiR is an instrument-under-construction designed for neutron diffraction and radiography under extreme pressure and temperature conditions at the FRM II neutron source. A multianvil press with six independently controlled rams subjects powder, fluid, and melt samples with volumes of 10–50 mm3 to a current maximum pressure of 15 GPa and temperatures up to ca. 2300 K. An additional cryo-system can also cool samples below room temperature to ~80 K. Neutrons are focussed on the sample position by a double-elliptic neutron guide system with a super-mirror coating m = 1.5-4. Due to geometrical restrictions by the press, neutron diffraction measurements will use the time-of-flight method with a thermal neutron wavelength of 1-2.4 Å and a flux of ~10^7 n/s/cm2 at the sample position. For diffraction, SAPHiR will use three detector banks with 640 position sensitive helium-3 detectors that are arranged at both 90° from the primary beam and in the forward scattering direction, and a wavelength-shifting-fibre scintillator system in the backscatter direction. Future applications of SAPHiR include in situ crystallography and phase relations of light-element-bearing phases, equations of state, reaction kinetics, high-resolution radiography, and rheological studies. The SAPHiR press is currently operating for offline studies whilst other components are installed. This instrument will be ready for final commissioning and neutron measurements when the reactor is restarted in early 2024.

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Session Classification: Poster Session MONDAY

Track Classification: Neutron Instrumentation, Optics, Sample Environment, Detectors, and Software