MS16-1-3 Novel in situ powder neutron diffraction setups – the creation of a modern magnetic compound #MS16-1-3

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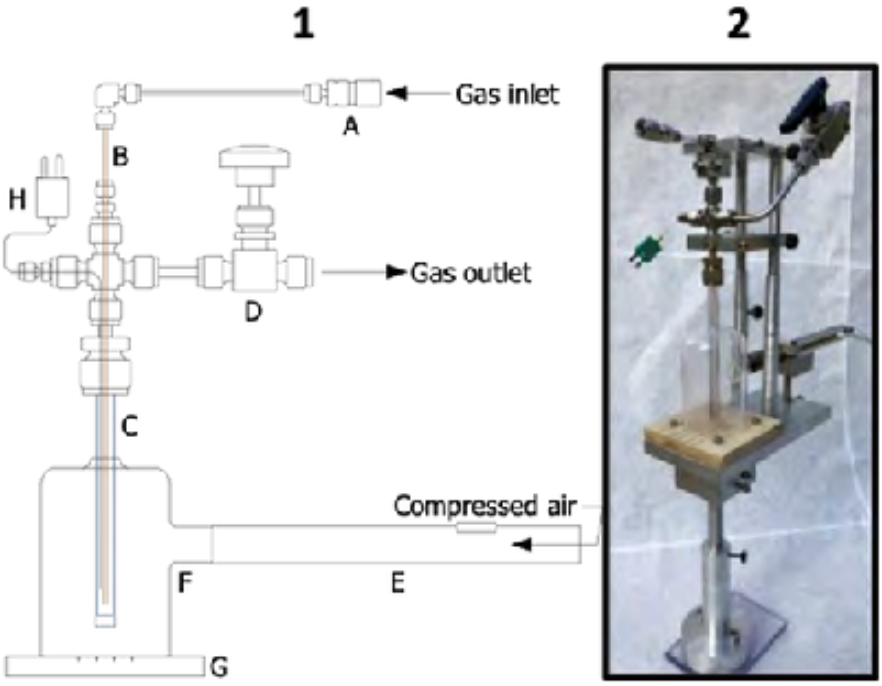
Abstract
In order to take full advantage of the significantly increased data collection rates expected at the European Spallation Source (ESS), it is paramount that new sample environments are developed to match the performance of the coming instruments. Here, we present two newly developed sample environments for neutron powder diffraction:
1. A single crystal Sapphire Air gun Heater Setup (SAHS), specially designed for solid-gas in situ angular dispersive neutron powder diffraction, has been developed [1] (Fig 1.1 and 1.2). Heating is provided by an air gun heater, allowing the sample to reach temperatures of up to 700 °C within less than 5 minutes. The setup is based on a single crystal sapphire tube, which offers a very low and smooth background. Fig. 1.1-2 shows: Schematic and picture of the SAHS. Gas flows through the system in the following order: A Quick fit connector, B Fused silica tube, C SCS sample container, D Outlet valve. The heater airflow goes through: E Hi-Heater airgun, F heat confinement quartz dome, G Ceramic insulator with air outlet grooves. H Thermocouple.
2. An induction furnace has been developed in a collaboration with: Chalmers University in Sweden, ISIS at the Rutherford Appleton Laboratory in England, the ESS in Sweden and Aarhus University in Denmark (Fig 1.3, 1.4 and 1.5). A fully functioning prototype has been built for the Time of Flight (ToF) diffractometer POLARIS at ISIS and will lead to a second version for the diffractometer/Small Angle Neutron Scattering (SANS) instrument HEIMDAHL at the ESS. The heating is based on an induction element, which allows an extremely fast and efficient way of heating and can reach temperatures of up to 1600 °C in less than 5 minutes. Furthermore, the setup works both in vacuum and under ambient conditions and requires no heat shielding, thus reducing the beam attenuation and lowering the level of background scattering. Fig. 2 shows: 1-2 The induction furnace heat element. 3 The full induction furnace setup.
Both setups offer: high temperatures, fast temperature stability, large sample volumes, and offer a very low attenuation of the beam. The setups have proven to be ideal for carrying out investigations of advanced materials under realistic conditions [2]. The ability to investigate real materials, in real time under realistic conditions, is a huge advantage for scientific investigations as well as for industrial applications.

References
[1] Ahlburg, J. V., et.al., J. Appl. Cryst. (2019), 52, 761-768, [2] Ahlburg. J.V., et.al., Nanoscale, Bind 12, Nr. 17, 2020, s. 9440-9451.

Reduction setup



Induction furnace