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Clamp Cells for High Pressure Neutron Scattering at Low Temperatures and High Magnetic Fields at the MLZ

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To study the effect of high pressure on any sample property, suitable pressure devices are a fundamental requirement. Their design has to be tailored to the experimental demands regarding the intended pressure, the employed instrumentation and the expected scientific results. Our work presents the development of high pressure cells for neutron scattering on polycrystalline and single-crystalline samples at low temperatures and with applied magnetic fields.
One of the most common devices for high-pressure neutron experiments is the clamp cell [1], where the pressure is applied ex situ and which can be used independently in various setups. Our cell design [2] has been specifically developed for neutron scattering experiments at low temperatures in the closed-cycle cryostats on the instruments DNS (diffuse scattering neutron spectrometer), MIRA (cold three axes spectrometer), and POLI (polarized hot neutron diffractometer) at the Heinz Maier-Leibnitz Zentrum (MLZ) in Garching, Germany. The compact monobloc cell has been produced in two variants, the CuBe alloy and NiCrAl "Russian Alloy", working up to about 1.1 GPa and 1.5 GPa, respectively. The low paramagnetic moment of both alloys allows also measurements of magnetic properties.
First tests of the cell with neutron radiation were performed to calibrate the load/pressure-curve of the CuBe cell (up to 1.15 GPa), to estimate its neutron absorption and background, and to measure magnetic reflections. In addition, the thermal response in the instrument cryostat was measured and the experimental findings were complemented by simulations.
Ultimately, these cells are intended as standard cells for high pressure measurements on different instruments at MLZ suitable for all available magnets and cryostats down to 1.5 K. Further tests under various conditions (temperature, pressure, magnetic field) as well as simulations are planned for both cells. The results will help both to establish the present cells and to optimise the design of subsequent cells to achieve higher pressures, to fit into smaller cryostats and to enable neutron-independent pressure calibration.

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