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

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The fundamental requirement to study high-pressure effects is the availability of suitable pressure devices. 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**]. Its characteristic feature is the application and fixation of the pressure *ex situ*, before the cell is transferred to the experimental setup. While the pressure can thus not be changed *in situ*, the advantage of this design is the liberty to use the cell 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 (a diffuse scattering neutron time-of-flight spectrometer), MIRA (a cold three axes spectrometer), and POLI (a polarized hot neutron diffractometer) at the Heinz Maier-Leibnitz Zentrum (MLZ) in Garching, Germany. The compact monobloc cell (*Fig. 1*) has been produced in two variants, one made from CuBe and one made from NiCrAl "Russian Alloy", working up to about 1.1 GPa and 1.5 GPa, respectively. Since both CuBe and NiCrAl have a very low paramagnetic moment, the cells have low magnetic background, allowing also measurements of magnetic properties.

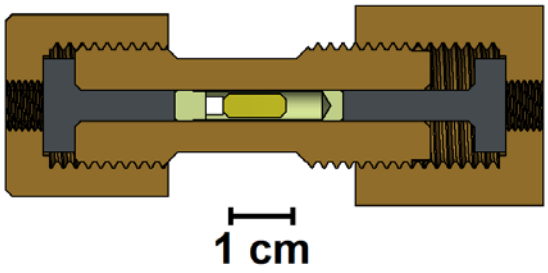

Figure 1: Schematic drawing of the clamp cell.

First tests of the cell with neutron radiation have been performed to calibrate the load/pressure-curve of the CuBe cell (up to 1.15 GPa), to estimate cell attenuation and background, and to measure magnetic reflections. In addition, the thermal response in the instrument cryostat has been measured and simulations have been performed to complement the experimental findings. The experiments and simulations are in good agreement and confirm the suitability of the cells with regard to the geometrical and material requirements.

Ultimately, these cells are intended as standard cell 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 which are in development to reach higher pressures, to fit into smaller cryostat and to enable neutron-independent pressure calibration.

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