Specialty Sample Mounting for CCRs at NCNR

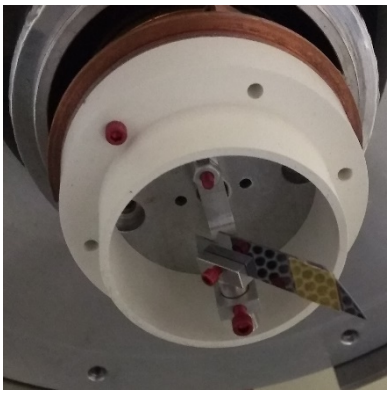
Tanya Dax, Sample Environment.

March 10, 2020

Neutron Shielding at High Temperature

For safety reasons, cadmium cannot be used in CCRs above 420 Kelvin. For high temperature sample mounting, boronated aluminum and boron nitride are good options for neutron masks and sample holders.

Low Background Thin Film Sample Holder -Prototype



This sample holder consists of a boronated aluminum base plate and clamps, a 6061 aluminum tee, and a boron nitride shell. This allows measurement of substrates at SPINS, BT4, and BT7 up to 800 Kelvin. There are tradeoffs to this method of sample mounting. The sample's thermal connection to the heater block is poor when compared to mounting within a sealed sample container or when using the inner and outer heat shields. For samples where the signal is small and the temperature behavior is well understood, this tradeoff is worthwhile. Sample alignment is more challenging as there is not a goniometer on this setup.

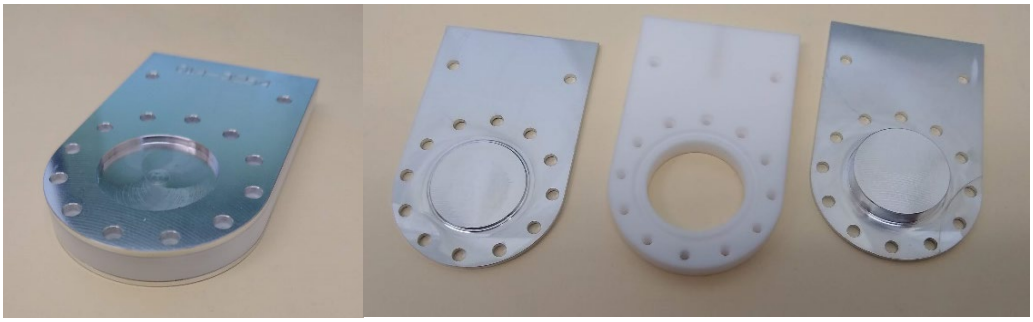
This sample holder is a prototype developed with Colin Heikes and Alex Grutter and they have successfully tested it at SPINS and BT4. Future iterations will have more fine alignment capability and variable height shells.

Titanium Annular Cans with Gold Seal

These are exact copies of the aluminum HFBS/NSE annular cans for use in top-loading CCRs. There are two applications for this. For high temperature measurements where the sample is either air sensitive or has poor physical contact with the walls of the sample container, a sealed helium atmosphere is possible using the gold gasket instead of indium. It is vital that the sample is well characterized offline so it is known that it will not decompose at experiment temperatures for this to be a viable option. The other application is for samples that corrode aluminum, and again the sample has to be well understood offline to know that it will not also react with titanium across the full temperature range. These cans also have boron nitride shells designed by Antonio Faraone.

Flat Plate Electric Field Sample Holder for Powders up to 5kV -Prototype

This untested prototype was designed for the HFBS top-loading CCR. There are two 6061 aluminum plates with a PTFE spacer, to be sealed with indium wire. The sample volume is 1 mm thick and 30 mm diameter, and there are positions on either plate for wiring in the high voltage circuit. Maximum temperature is limited to 420 Kelvin due to the use of indium and 475 Kelvin due to the PTFE.

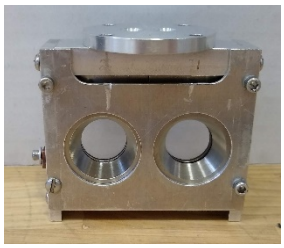


Electromagnets and CCRs

The reflectometry and SANS instruments have a variety of small electromagnets and one superconducting magnet with room temperature bores suitable for use with bottom-loading CCRs. Each has a different pole spacing, and the reflectometry instruments run in a horizontal configuration. The narrow bores require long sample rods and narrow vacuum tailpieces, and each is unique to the magnet it is designed for. Alan Ye has worked extensively to optimize these tailpieces, and the latest version includes cylindrical single crystal silicon vacuum tails.

SANS cell mounting on CCRs

The standard SANS titanium cells were not originally designed to be run in a CCR. Cedric Gagnon designed a frame that holds two cells side by side to mount onto the CCR sample block, with an optional cadmium or boronated aluminum mask. The cells were also modified to be sealed with either PTFE or indium on both the windows and the fill port and the height is modified to fit the frame.



To accompany this, we have a specialty vacuum can with 5-inch silicon windows and a frame for installing the CCR at the SANS instruments in a way that allows sample changes without disturbing the sample alignment.