ABSTRACT

This project represents a continuation and offshoot of the Multi-Anvil Cell Assembly Development project in COMPRES. The new project will adjust the focus from working with all multi-anvil cell development, to enhanced development of those assemblies used at synchrotron beam lines.

The first task is to lay out what aspects of synchrotron large-volume high pressure research is in need of improvements in materials and techniques. There is now a wider variety of needs than what existed previously. One new focus has been on attaining higher pressures using highly aligned multi-anvils with very small assemblies (such as the FORCE initiative). The previous COMPRES project provided some assistance with this but there were two major areas that need more development: micro-machining to make the smaller parts, and the fabrication of complex small parts to form the pieces of the specialized assemblies. The goal is for users to reach higher pressures – 40 GPa or more – in large-volume internally heated assemblies, that are available to all users and are readily assembled with high success rates. This will be one focus of the new project. (GSECARS, others).

Complex shapes for Paris-Edinburgh cells, Drickamer cells, and the layered assemblies used in Kawai cells in Japan, will be pursued. New machining companies will need to be identified since our existing sources have declined to do some of this work due to it being outside of their current capabilities.

Recently NSLS II has come online and the beam line MAXPD has been using monochromatic light to illuminate its samples in large-volume high pressure apparatus. This creates a host of new challenges in terms of what materials to use in the assemblies, because the diffraction from assembly elements appears in the patterns. Many of the ceramics developed for the COMPRES project are not favorable for this because they have complex diffraction (mullite, alumina, MgO+spinel, etc). This is going to require the development of new assemblies from simpler materials (pure and doped MgO, BN, graphite etc). The diffraction signal will be a more critical element of these designs than it was for the previous experiments using well-collimated energy dispersive XRD.

Along with the pursuit of higher pressures and monochromatic capabilities, lower pressures are another target area for development. Our field has been guilty of developing the advanced synchrotron capabilities only for pressures above 2 or 3 Gigapascals. This has left out the entire Earth's crust from consideration with our capabilities. We will seek to work on providing capabilities for lower pressure using the appropriate methods (piston-cylinder, gas vessel). The initial challenge with these is creating a way to introduce an x-ray beam into these highly shielded tools. After that the introduction of x-ray translucent windows into the assemblies will be needed.

We will also work with non-high pressure synchrotron groups that are included in the project, when our capabilities are useful to them. We expect these connections to develop as the project proceeds.