New interlay heated diamond anvil cell for fast heating and cooling rates at high pressure

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Now days, fast heating and cooling rates (in milliseconds or even less) at static high pressure (HP) is possible using pulsed laser heated diamond anvil cells . However, such experiments are usually limited for measurements above 1000K [1]. High temperature (HT) experiments with diamond anvil cells in the moderate temperature range (up to 1500 K) is usually realized using internal or external resistive heaters, but performming fast heating cycles with such heaters is difficult due to important limitations introduced by cell stability at HT [2].

Recently, we developed a new HT diamond anvil cell allowing for combined x-ray absorption (XAS) and diffraction measurements (XRD) in a wide range of temperature and pressures. The cell is heated resistively using a self-heating gasket, and allows fast heating and cooling rates at HP, thus suitable for studying melting/crystallization dynamics when coupled with time resolved XAS setup (second and sub-second ranges). The temperature and its distribution inside the sample are evaluated by analyzing the black-body radiation signal, showing insignificant temperature gradients.

Initial test measurements were carried out recently on elemental Germanium using the available setup at the ODE (optic dispersive EXAFS) beamline of synchrotron SOLEIL[3,4]. Results show successful fast melting (see Fig. 1) and cooling of Ge at several pressure points up to 15 GPa.

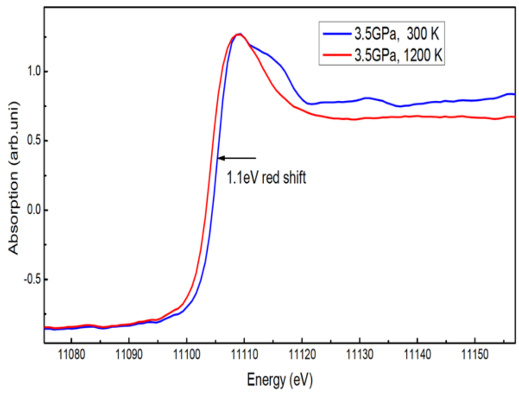

Figure 1. Example XAS data measured at 300K and 1200 K. The well known shape change and red shift of XAS spectra shows successful melting of Ge at 3.5 GPa.

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