Report HC1307

Melts properties of Fe-Si alloys under high pressure by Fe K-edge XANES and EXAFS

High pressure-high temperature experiments have been performed on the ID24 beamline using the recently available laser heating diamond anvil cell (LH-DAC) experimental set-up. The aim of this experiment was to test the melting signature on the Fe XANES and EXAFS signals in iron alloys in LH-DAC, and to correlate short-range information of XANES and EXAFS with that from x-ray scattering obtained recently on ID27 (Morard et al., 2011; Morard et al., 2013; Morard et al., 2014).

Several type of Fe-alloys have been investigated (Fe-10wt%O, Fe-1.5wt%C, Fe-15wt%Si and Fe-12wt%S) in the 20-70 GPa pressure range, and up to temperature of ~4000K. Conventional Le Toullec type DAC were used with Boehler Almax diamonds of 250 µm culets. Based on our previous experience, KCl will be used as pressure medium and thermal insulator. The experimental procedure was the following: X-ray absorption spectra acquisitions were synchronized with the laser heating, with one second exposure time (10 spectra of 100ms). Laser beam was switched off after each acquisition, in order to reduce potential reaction between diamonds and liquid iron alloys. Temperature was increased by steps of ~100K.

Unfortunately, nanodiamond anvils expected for this experiment (manufactured by Ehime University in Japan) were finally not available, and glitches due to diffraction peaks of the diamond anvils monocrystal were often present and limited the range in energy to perform accurate EXAFS analysis of liquid and solid spectra.

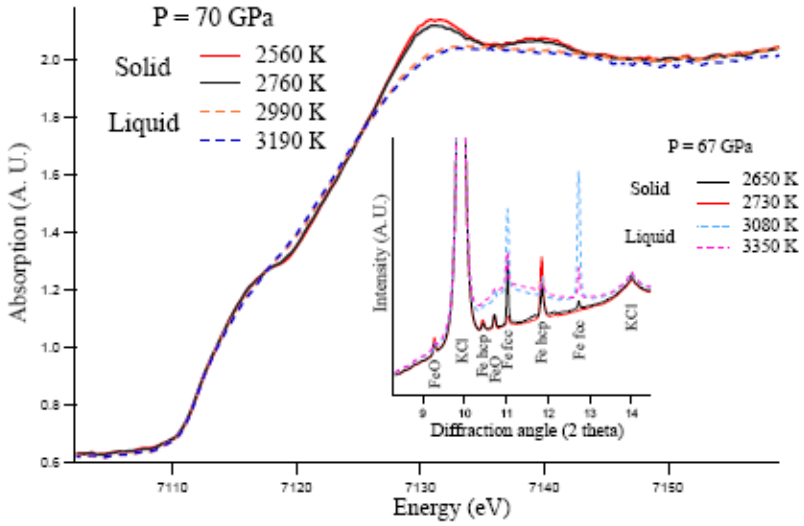

Figure 1: *XANES (beamline ID24) and XRD (beamline ID27) measurements on Fe-10wt%O alloys using Laser-Heated Diamond anvil cell. The solid-liquid transition is clear on both diagnostics, and in good agreement.*

Melting signature on XANES depends upon the Fe-X system. Here we present the Fe-O system (Fe-10wt% O) (**Figure 1**), where we could observe a clear loss of structure in the slope of the k-edge upon melting and also a decrease of the structure just after the edge. This melting signature is in good agreement with expected results for pure iron calculated numerically (Mazevet et al., 2014). The analysis of the other Fe-X system is ongoing, and we also expect to obtain structural information on the liquid properties with EXAFS analysis.

References

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