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Study of liquid iron alloys at high temperature and high pressure by X-ray scattering using the double sided laser heated diamond anvil cell

In this study, we have done a structural investigation of the Fe-FeS system in the solid and in the liquid state at high pressures and high temperatures up to 80 GPa and 3000 K. We also measured the melting relationship and the structures of the phases present at the solidus.

The working energy was 47 keV (Sm K edge). X-ray beam was focused to a size of 3 microns horizontally and 6 microns vertically. Temperature was monitored using a CCD spectrometer and the pressure was monitored using the ruby fluorescence method and equation of state of stishovite [1] or of pure Fe [2].

We have done melting experiments on the Fe-FeS system. The starting sample was a finely grinded mixture of Fe-15%wt S. It corresponds to the eutectic composition measured at 23 GPa [3]. This mixture was loaded into SiO2 powder pressure medium. During the melting in eutectic system, melt and solid metal coexist. This permits to maintain the liquid in the hottest part of the laser spot, by entrapping it in solid metal. Then diffraction patterns of the eutectic liquid could be done. We could also determine the eutectic temperature. Four different pressures were investigated: 23 GPa, 45 GPa, 53 GPa and 80 GPa. Liquid diffraction patterns have been recovered at these four different pressures. We also gathered diffraction patterns of the solid phases before melting and coexisting with liquid. The high temperature range where diffraction patterns have been obtained is going from 1400 K up to 3000 K at each pressure.

In order to obtain the structure factor of the liquid, the data treatment will be done by subtracting the background signal (Compton from the diamonds and the pressure medium) to the rough signal. Background signal will be obtained by fitting it in the signal of the quenched sample.

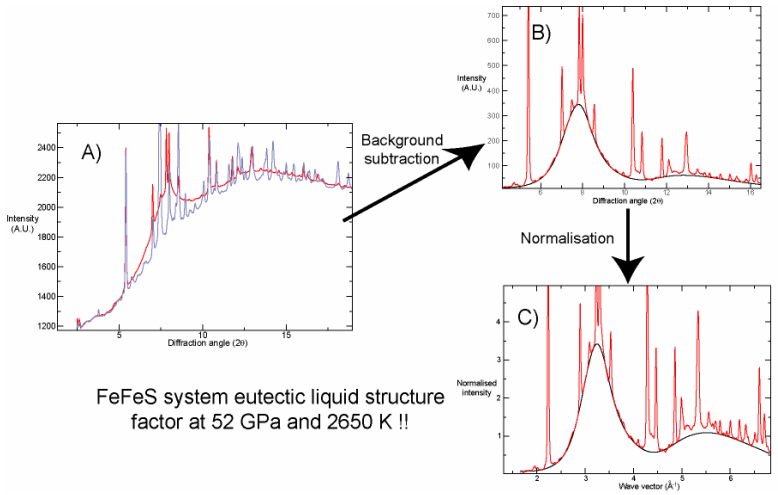

Figure 1 :A) Diffraction patterns of Fe-FeS eutectic liquid at 52 GPa and 2650 K and of the following quenched solid. SiO_2 is used as pressure medium. B) Liquid diffraction pattern after subtraction of the background fitted on the solid. C) Structure factor of the liquid after normalisation using the Krogh-Moe Norman method.

References

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