Report HS4073

Determination of melting of iron alloys by *in situ* X-ray diffraction using the double-sided laser heated diamond anvil cell.

High pressure-high temperature experiments have been performed on the ID27 beamline using the available laser heating diamond anvil cell experimental set-up. Melting properties have been investigated from 25 to 110 GPa for different compositions: Fe-5%wtNi-12%wtS; Fe-5%wtNi-15%wtSi; Fe-10%wtO; Fe-2%wtC. The first two samples were homogeneously synthesized under inert conditions at ambient pressure and high temperature; the last two were powder mixtures. In the diamond anvil cell pressure chamber, thin metallic sample sheets were insulated from the diamond using dry KCl as pressure medium. Then, in-situ X-ray diffraction patterns of 30s or 10s were acquired while the temperature was increased using the double-sided laser heating system.

Melting temperature is detected during the first appearance in diffuse background liquid signal. This data set (Figure 1A), covering all the most studied light elements present in planetary cores (Poirier, 1994), is in good agreement with previously studied melting temperatures (Asanuma et al., 2010; Campbell et al., 2007; Lord et al., 2009; Seagle et al., 2008), and increase the pressure range above 100 GPa, that is to say up to the conditions of the Earth’s outer core. Two conclusions could be derived from this data set. First, the melting depression strongly depends on the nature of the light element. This could be used to discriminate between the different geochemical models of the Earth’s core. Secondly, melting temperature of iron at megabar conditions could not be close to the data presented by Boehler (Boehler, 1993), as alloys present higher melting temperature. The iron melting curve should be closer to the theoretical melting curve presented by Alfe (Alfè et al., 2002).

Liquid signal could be extracted from the diffraction pattern by subtracting the background signal (Morard et al., 2008). Then, the radial distribution function g(r) could be obtained (Figure 1B). Furthermore, using a technique applied on liquid water in diamond anvil cell (Eggert et al., 2002), the density could be extracted during the analysis of the liquid. Density could be measured as a function of the light element, pressure and temperature.

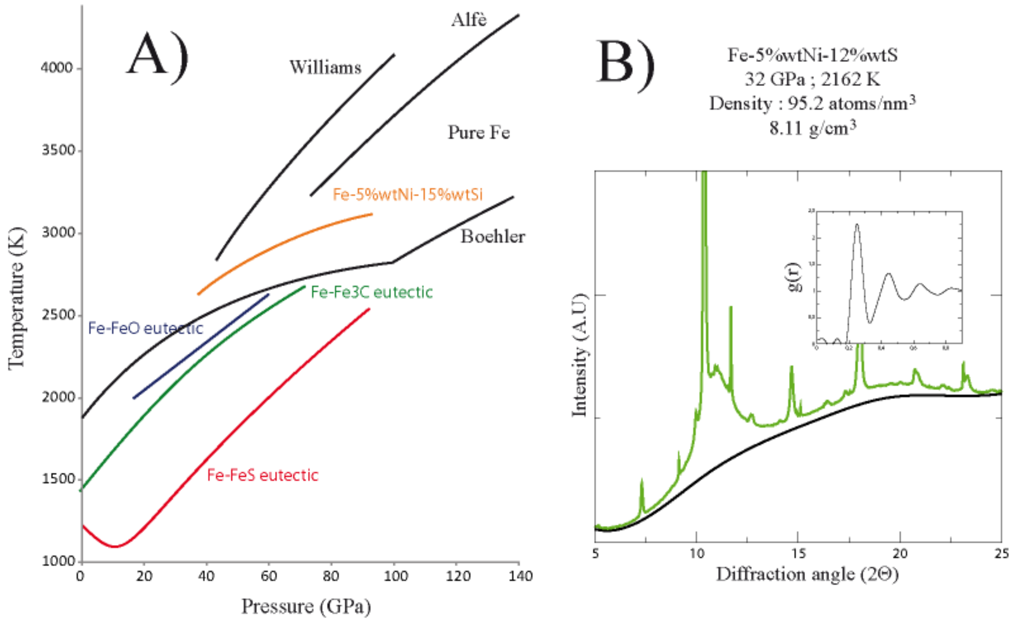

Figure 1: *A) Melting curve measured during experiment HS4073 compared with melting of pure iron from experimental work (Boehler, 1993; Williams et al., 1991) and ab-initio calculations (Alfè et al., 2002). B) Liquid diffraction signal compared to the background signal, fitted on solid signal. The radial distribution function g(r) extracted from this signal is shown in the inset. Density has been calculated using the method from (Eggert et al., 2002).*

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