Report HS4752

Melting of iron alloys at Earth's core pressures

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 up to 150 GPa for different compositions: Fe-10 %wtO; Fe-5%wtS and Fe-1.5wt%C. These samples were homogeneously synthesized under inert conditions at ambient pressure and high temperature (except for Fe-10wt% O that was mixture of Fe and FeO powders sintered using piston cylinder apparatus). 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.

The procedure is similar to previous experiment (HS4073 and HS4488), which gave accurate melting temperature and density for Fe, Fe-S and Fe-Si alloys up to 100 GPa. These results are described in recent publications (Anzellini et al., 2013; Morard et al., 2011; Morard et al., 2013a; Morard et al., 2013b). In the experiment HS4752, we studied different systems relevant for planetary cores (Fe-O and Fe-C systems) up to 140 GPa (Figure 1). We found melting temperatures in good agreement with previous studies (Lord et al., 2009; Seagle et al., 2008) and we extended the pressure range investigated by these studies. Densities of liquid alloys have been also extracted for these different compositions.

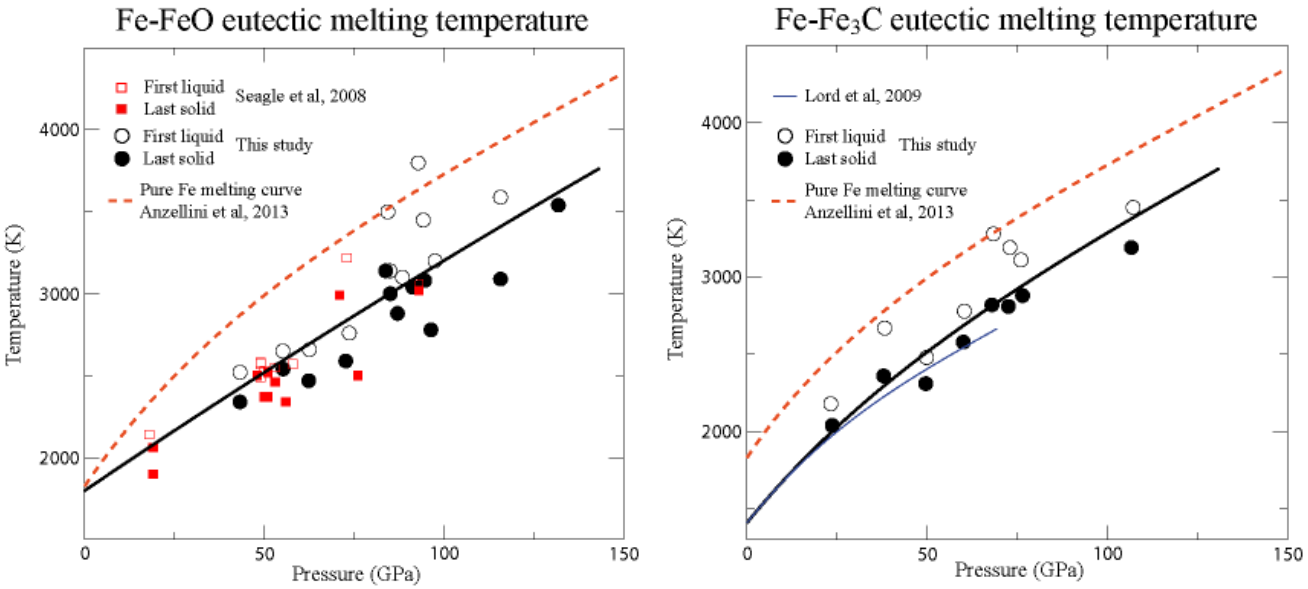

Figure 1: *Eutectic melting temperature of Fe-O and Fe-C systems measured during HS4752 beamtime compared with previous studies (Lord et al., 2009; Seagle et al., 2008) and pure Fe melting curve (Anzellini et al., 2013).*

Following a method described in previous publications (Morard et al., 2013a; Morard et al., 2013b), density has been extracted from the analysis of the liquid diffuse scattering signal for Fe-5wt%S and Fe-12wt%S alloys. Density as a function of S content has been measured, enabling us to deduce pure liquid Fe density and volume change upon

crystallization. This has strong implications for density difference between solid inner core and liquid outer core measured in the Earth's core.

References

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