The 480th Geodynamics Seminar

Point defects in iron at inner core conditions

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Abstract

Seismic observations provide strong evidence that the Earth's inner core exhibits a global anisotropy (Deuss, 2014). This anisotropy is typically assumed to be the result of the collective alignment of iron crystals. So far, the main mechanism which is responsible for this crystal alignment remains unclear. One of the possible mechanisms is plastic deformation (Yoshida et al., 1996; Karato, 1999; Wenk et al. 2001; Deguen, 2012). In this study we focus on atomic self-diffusion which provide a direct link between plastic deformation and the mechanical properties of the Earth's inner core stable iron phase(s). We use first-principles calculations to study the conjugate effect of pressure and chemistry on vacancy diffusion in hcp-, bcc-, and fcc-iron by taking into account potential light alloying elements. Our results show that inner core pressure strongly suppress defect concentration rather than to alter the mobility of defects. Moreover, we found light elements to be able to influence metallic bonding. This allows for extrinsic diffusion mechanisms in iron under inner core conditions. We will discuss how inner core chemistry can influence the rheological properties of iron alloys.

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