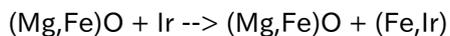


Probing the variation of the oxygen fugacity in diamond anvil cells using the Fe-Ir alloy as redox sensor

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Understanding the oxygen fugacity (f_{O_2}) in diamond anvil cells (DACs) is an important issue for many reasons, among them reconciling contradictory results that have been obtained for carbonate studies (Cerantola et al., 2017; Dorfman et al., 2018) that might be due to different redox conditions during the experiments. We therefore investigated the f_{O_2} conditions during DAC experiments using powder X-ray diffraction (beamlines ID15b and ID27) and energy-domain Synchrotron Mössbauer Source (SMS) spectroscopy (beamline ID18) at the European Synchrotron Radiation Facility (Grenoble, France). Double sided laser heating experiments (Aprilis et al., 2017) were carried out at high pressure and temperature using a mixture of synthetic ferropericlase ($Mg_{0.75}Fe_{0.25}O$) and pure iridium powder as a sliding redox sensor (Borisov and Palme, 2000; Swartzendruber, 1984; Taylor et al., 1992). The Fe content in the Fe-Ir alloy, together with the amount of FeO in ferropericlase, allows a calculation of f_{O_2} during the experiments (Stagno et al., 2011; Woodland and O'Neill, 1997). Preliminary results from powder X-ray diffraction data show that, after heating, an Fe-Ir metal alloy that can be indexed in the Fm-3m space group is formed by the reaction of pure Ir and Fe from ferropericlase according to the reaction:



The compressibility of the Fe-Ir alloy and ferropericlase was measured up to ~ 60 GPa and SMS data were collected before and after heating. X-ray diffraction results coupled with energy-dispersive X-ray spectroscopy (EDS) measurements and a simple thermodynamic model indicate that the redox conditions during the DAC experiments were close to the iron-wüstite (IW) buffer, although some inhomogeneity was observed. Further chemical analyses and additional experiments are ongoing to understand the variation of oxygen fugacity in a DAC during laser heating.

Keywords: oxygen fugacity , redox sensor, diamond anvil cell