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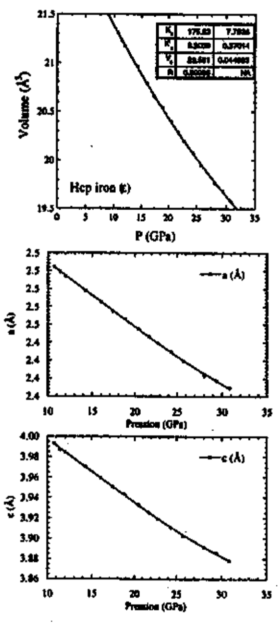
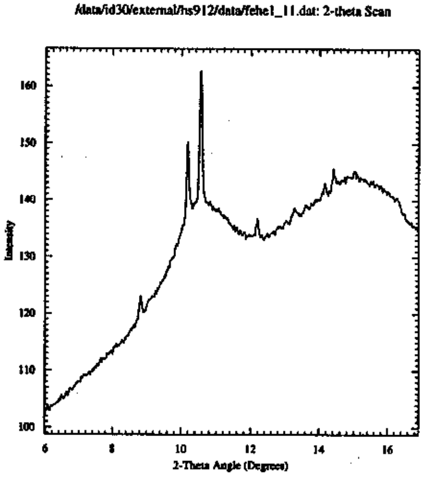
Report:

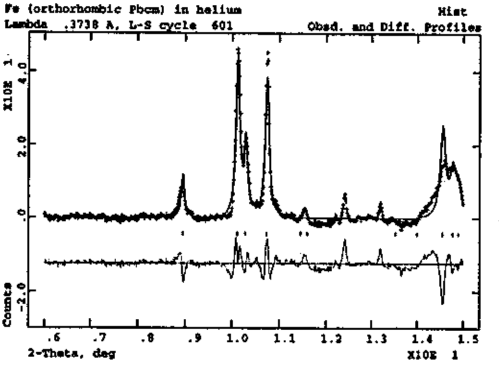
Angle dispersive X-ray diffraction patterns were recorded using imaging plates from a polycrystalline sample of iron (foil 10 μm thick) under pressure in a diamond-anvil cell coupled with an *in situ* laser heating technique. One series of experiment was carried out at to establish a room-temperature equation of state of the high-pressure phase of iron (phase ε with hcp structure). Helium was used as pressure transmitting medium to provide the most hydrostatic environment around the sample.

Results are presented in the following figures, where cell parameters as well as molar volume are reported against pressures. This study yields a bulk modulus of 175 (7) GPa and a first pressure derivative K'_0 of 3.2 (4). These results are in good agreement with the previous experimental study by Jephcoat et al. [1986] carried out in neon to 72 GPa, which reports a bulk modulus of 167 (27) GPa. Our experiment should have been extended to pressures higher than 32 GPa, at which one diamond anvil broke, thus prevailing any further pressure increase. Helium is indeed one of the most hydrostatic pressure transmitting medium, but it is also well known for interacting with small defects of diamond anvils, enhanced by diffusion of helium in those defects.



A second set of patterns were recorded at high pressure and high-temperature, to study any potential interaction between iron and helium. An example is given in the figure below, where a pattern of the high-pressure (hcp ε) of iron is shown at 37.3 GPa and 2800 K (on the left). The broad peaks at around 11.5 and 15 Å in 2-theta evidence a mixture of liquid and solid phases of iron (λ=0.3738 Å). At those P-T conditions, according to the phase diagram of helium, the pressure transmitting medium is molten, thus providing the optimal conditions for any chemical reactions.





The pattern plotted on the right was taken from the same sample quenched from high-temperature at high-pressure (37 GPa). According to Andrault et al. [1997], reflections corresponding to an orthorhombic phase of iron (phase β with Pbcm structure) can be recognised, whereas helium is hardly seen. Two reflections are unidentified, which might indicate the appearance of a new phase. A more detailed analysis is however needed to ascertain such a new compound. The pressure domain is also limited and such features need to be checked at higher pressures.

These preliminary results also show that laser heating experiments are feasible when helium is used as pressure transmitting medium, although the large diffusion of helium into diamond anvils or gasket material make these experiments also a matter of luck.