Microscopic study using XANES diagnostic of laser shocked MgO

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The high-pressure behavior of MgO is of critical importance to planetary science as magnesium and oxygen are thought to be the two most abundant elements in the Earth's mantle and generally in terrestrial planets. More in particular, the knowledge of ionic and electronic structural changes of MgO in the Warm Dense regime has important repercussions for planet modeling [1]. We present here the first MgO study at multi-Mbar pressures using X-ray Absorption Near Edge Spectroscopy (XANES). The results were obtained on the LULI2000 at the Ecole Polytechnique using the nanosecond beam to compress a sandwiched CH/MgO/C/CH target and the picosecond beam to generate the X-ray source. With an approach previously tested on aluminum [2] and SiO_2 [3], we obtained XANES data at a wide range of temperature and density conditions. Ab initio simulations are used to support the interpretation of the experimental spectra. The main conclusions are that MgO transforms from an isolant to a semi-conductor and that MgO melts in a molecular unstructured liquid. This work has been supported by ANR Planetlab.

References

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