High Speed X-ray imaging for studying behavior of liquids at high pressures and high temperatures

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Abstract

In situ characterization of materials under conditions of high pressure and high temperature (HP-HT) are of great interest in planetary and materials sciences as well as physics and chemistry. Upon the last decade, many efforts have focused on the development of *in situ* three-dimensional (3D) tomographic imaging at HP-HT, which enable nondestructive investigations of heterogeneous structures of materials [e.g. Wang et al. 2005, Philippe et al. 2016]. X-ray imaging is one of the most powerful tools for investigating the behavior and properties of liquids (i.e. viscosity, surface tension on a liquid-liquid interface or immiscibility of liquids). A critical parameter for the accurate characterization of these properties in liquids is the time resolution (e.g. acquisition time) at which changes can be observed, detected and/or measured [e.g. Kono et al 2015]. We have implemented high speed X-ray tomography at HP-HT on the Psiché Beamline at Soleil Synchrotron (France). Using pink beam through a Paris-Edinburgh Press, we were able to increase the speed by 100 compared to the current state of art (i.e. from 15 min to $<$ 10 s). In complementary, high speed 3D tomography can be integrated with combined angle- and energy-dispersive structural analysis and refinement acquisitions [CAESAR, Wang et al. 2004], offering the possibility to study material/liquids structures at the micro and atomic scales. Here, we will present first measurements of silicate melt propagation through a solid silicate matrix at HP-HT and discuss its applications in Earth sciences as well as further developments for higher speed acquisition ($<$ 1s) in the near future on Psiché Beamline.

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