Amorphous and liquid samples structure and density measurements at high pressure – high temperature using diffraction and imaging techniques

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Abstract

Determination of the density and structure of liquids such as iron alloys, silicates and carbonates is a key to understand deep Earth structure and dynamics. X-ray diffraction provided by large synchrotron facilities gives excellent results as long as the signal scattered from the sample can be isolated from its environment. Different techniques already exist; we present here the implementation and the first results given by the combined angle- and energy-dispersive structural analysis and refinement (CAESAR) technique introduced by Wang et al. in 2004, that has never been used in this context. It has several advantages in the study of liquids: 1/ the standard energy-dispersive technique (EDX), fast and compatible with large multi-anvil presses frames, is used for fast analysis free of signal pollution from the sample environment 2/ limitations of the EDX technique (homogeneity of the sample, low resolution) are irrelevant in the case of liquid signals, others (wrong intensities, escape peaks artifacts, background subtraction) are solved by the CAESAR technique 3/ high Q data (up to 15 A-1 and more) can be obtained in a few hours (usually less than 2). We present here the facilities available on the PSICHE beamline (SOLEIL synchrotron, France) and a few results obtained using a Paris-Edinburgh (PE) press and a 1200 tons load capacity multi-anvil press with a (100) DIA compression module.

X-ray microtomography, used in conjunction with a PE press featuring rotating anvils (RotoPEc, Philippe et al., 2013) is also very effective, by simply measuring the 3D volume of

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glass or liquid spheres at HPHT, thus providing density. This can be done in conjunction with the CAESAR technique and we illustrate this point. Finally, absorption profiles can be obtained via imaging techniques, providing another independent way to measure the density of these materials.

References

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