Quantitative and qualitative high pressure calorimetry for in situ studies

Alexandre Courac (Sorbonne université, FRANCE),
Andrea Gauzzi (Sorbonne université, FRANCE)
Yann LE GODEC (CNRS, FRANCE)

Abstract

High pressure, high temperature calorimetry is a vast field that can include numerous measurements, most of which include implicit or explicit temperature measurements while heating, compressions or both. Historically, experimental calorimetry gave solid background not only in applied metallurgy, but also to numerous idea in fundamental physics, such as quantum theory of solids, superfluidity and superconductivity ; and in petrology, where calorimetry on silicates has provided useful inputs for modelling magmatic processes.

At present time, qualitative and quantitative high-pressure calorimetry remains a big challenge to petrology and fundamental physics aiming room-temperature superconductivity. Probing the chemical interactions and phase transformations would also be a big deal, since even qualitative calorimetric data would be an in house alternative to highly costly synchrotron in situ probing.

High pressure, high temperature conditions are typically attained in high pressure cells with cylindrical space [1] to be filled with sample, thermocouples, oven, etc. Adapted AC method [2] can be employed along with DTA variations [3, 4]. A number of successful applications related to Si materials will be presented and discussed [4, 5].

In the proposed poster we will highlight a number of examples of accomplished or preliminary calorimetric studies of light element compounds (Si, Na-Si) using various temperature and power regimes.

1. Y. Le Godec and A. Courac, Materials 14 (15), 4245 (2021).
2. Z. M. Geballe, V. V. Struzhkin, A. Townley and R. Jeanloz, Journal of Applied Physics 121 (14), 145903 (2017).
3. A. Lazicki, Y. Fei and R. J. Hemley, Solid State Communications 150 (13), 625-627 (2010).
4. A. Courac, Y. Le Godec, C. Renero-Lecuna, H. Moutaabbid, R. Kumar, C. Coelho-Diogo, C. Gervais and D. Portehault, Inorganic Chemistry 58 (16), 10822-10828 (2019).
5. A. Courac and Y. Le Godec, Acta Crystallogr. B B82, https://doi.org/10.1107/S2052520626004026 (2026).