A Real-Time Event Monitoring System for Deriving Equation of State of a High Pressure Sample with a Dynamic Diamond Anvil Cell

Yun-Hee Lee[1, S], Minju Kim[1], Jin Kyun Kim[1], Yong Chan Cho[1] and Geun Woo Lee[1, C]

[1]*Korea Research Institute of Standards and Science (KRISS), Daejeon, Korea*
gwlee@kriss.re.kr

Pressure is one of thermodynamic parameters which can govern state and structure (or phase) of a material. Recently, the dynamic diamond anvil cell (dDAC) technique bridging static pressure and dynamic shock studies has been highlighted because it possibly provides fast, repeatable, and controllable pressurization under isothermal condition. It means that the dDAC can be used for establishing an isothermal equation of state for a sample under dynamic compression if thermodynamic parameters such as pressure and volume are simultaneously measured at ambient temperature. Here, we report the development of a real-time event monitoring (RTEM) system with dDAC, which can simultaneously record the volume, pressure, optical image, and structure of materials during dynamic compression runs. In particular, the volume measurement using both Fabry-Pérot interferogram and optical images facilitates the construction of an equation of state (EoS) using the dDAC in an in-house laboratory. We also developed an in-line ruby pressure measurement (IRPM) system for a synchrotron X-ray facility. This system provides simultaneous measurements of pressure and X-ray diffraction in low and narrow pressure ranges. The EoSs of ice VI obtained from the RTEM and the X-ray diffraction data with the IRPM are consistent with each other. The complementarity of both RTEM and IRPM systems will provide a great opportunity to scrutinize the detailed kinetic pathways of phase transitions using dDAC.