THE GEODYNAMICS SEMINAR № 627

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Venue: Meeting Room #486

Science Research Bldg. 1, 4th floor.
Ehime Univ.

Keywords:
1. Toroidal-type diamond anvil cell (t-DAC)
2. Equation of state (EoS)
3. Pressure scale

Equations of state at extreme pressure

The equation of state used to determine pressure in a static compression experiment is called the pressure scale. Many primary pressure scales for various materials have been proposed based on shock experiments, ultrasonic and/or Brillouin scattering measurements, and ab initio calculations. Mutual consistency of these scales of different materials can be confirmed by the static compression experiment. Simultaneous static compression experiment of two or three materials combining with the X-ray diffraction (XRD) measurements give us an information on the volume-volume (V-V) (or density-density, ρ-ρ) relationship of the sample. The V-V data can be used to check the consistency of each EoS and calibrate a new EoS with respect to a given primary scale. At pressures up to 100~250 GPa, many efforts have been made to construct the internally consistent scales through simultaneous compression for metals, oxides, alkali-halides, and noble gas. However, even these internally consistent equations of state become inconsistent when extrapolated beyond the pressure range of the experiment. Especially, at extreme pressure conditions such as above the Earth's center pressure, the discrepancy is quite large. Recently proposed pressure scales (Fe, Cu, Pt, Au) based on ramp compression are expected to be consistent with each other in wide pressure range reaching tera-pascal (TPa), but their consistency should be confirmed by simultaneous static compression experiments. Here I report the internally consistent equations of state for several materials including platinum, gold, etc., based on the copper scale and the result of static compression experiments extreme pressure condition using the toroidal type of diamond anvil cell (t-DAC) and the laser-heated DAC (LHDAC). These EoSs provide the V-V relationships among these materials, and it allow various pressure scales to be compared with each other, and to assess whether discussions in condensed matter physics and earth and planetary sciences are valid from the perspective of pressure values.

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