EARTH & PLANETARY

"Noibara"- *Multiflora rose*

SCIENCE

Synchrotron radiation X-rays have spawned a new phase of *in situ* observation of materials subjected to extreme conditions, leading to a greater understanding of the Earth's and planetary deep interiors. Constantly evolving synchrotron-based and static high-pressure techniques, since the beginning of public use in 1997, increasingly enhance the high-pressure research program for Earth and Planetary Science. In recent years, the combined techniques of X-ray diffraction with synchrotron or non-synchrotron spectroscopy, which allow multiple measurements to be performed on the same samples under high-pressure and high-temperature conditions, have provided complementary information of material properties. This chapter provides an overview of selected challenges in high-pressure Earth and Planetary Science in 2012.

To simulate the behavior of liquid iron alloy in the early Earth magma ocean, Terasaki investigated the interfacial tension of liquid iron alloy droplets in silicate melt under high pressure and high temperature by X-ray radiography, and discussed the effect of the presence of light elements on liquid pure iron. Shibazaki *et al*. determined the phonon dispersion and volume compression of iron hydride by high-pressure inelastic X-ray scattering and X-ray diffraction. On the basis of geophysical observations of sound velocity and density distributions, they constrained the hydrogen concentration in the Earth's inner core.

Murakami and Ohta experimentally determined the properties of the Earth's lower mantle minerals under the relevant high-pressure conditions using a diamond-anvil cell technique in combination with X-ray diffraction and Brillouin scattering or thermoreflectance, respectively. The former, based on reliable shear velocity and density data, suggested that the composition of the lower mantle is compatible with that in the chondritic model, being different from that of the upper mantle. The latter found that the conventionally assumed thermal conductivity in the bulk lower mantle was reasonable, and the core-mantle boundary heat flow could be fully explained by new data concerning the thermal conductivity of silicates. Tange precisely determined the equation of state of $MgSiO_3$ perovskite, the primary mineral of the lower mantle, and MgO under high-pressure and high-temperature conditions relevant to the lower mantle, in order to apply it to a mineralogical model of the Earth's lower mantle.

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