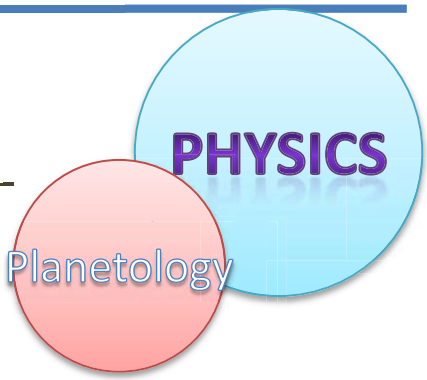
HAMAYA, Nozomu

Graduate School of Humanities and Sciences / Department of Physics



■ Researcher information

Contact

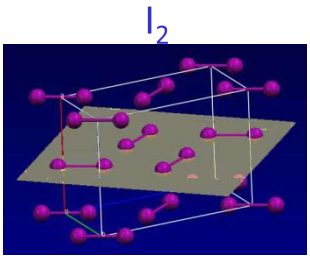
Email: hamaya.nozomu@ocha.ac.jp ／TEL: 03-5978-5319 ／FAX: 03-5978-5329

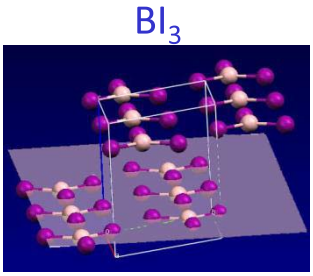
Major

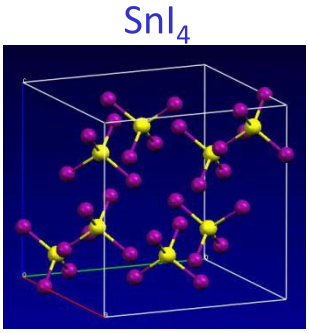
Material sciences under high pressure by physical and chemical approaches

■ Research topics

Study of molecular materials under ultrahigh pressure







Keywords

Molecular materials, High pressure, Phase transition, Novel structure and function, Synchrotron radiation X-ray diffraction experiment

Contents

■ Overview

Compression of molecular materials induces changes in a variety of physical and chemical properties. These are crystal structures with new arrangement of molecules and resulted from dissociation of molecules, stabilization of amorphous structure, and appearance of novel functions such as metallization, superconductivity. Studying the effect of pressure on molecular liquids and solids and knowing nature of chemical bond and electronic structure will lead to the developments of new materials with novel functions.

■ Case study

1) Iodine (I_2) is the simplest molecule with two atoms, analogous to hydrogen (H_2). Compression of I_2 yields dissociation of the molecules at the second phase transition and ultimately the fifth crystalline phase to be 'atomic'.

2) Boron triiodide (BI_3) is a triangular planer molecule. The crystal structure shown in Fig.(middle) transforms at ~6 GPa or ~60000 atm. Recent studies have revealed that molecules are dimerized in a new phase and this is the first pure dimer molecular crystal in boron halides.

3) Tin tetraiodide (SnI_4) molecule has a regular tetrahedral shape. It is interesting in that the normal crystal structure shown in Fig.(bottom) once becomes amorphous by compression and then recrystallizes into the other form at higher pressure. More interestingly this substance was recently found to have different two liquid states at high pressure and high temperature. A new phenomenon of phase transition between two liquid states attracts extensive researchers' attention.

All of these three molecular materials become metallic and superconductive under high pressures.

■ Applications

Knowledge of materials under ultrahigh pressure is crucial to planetary sciences and is used to develop new materials with novel functions.

Intellectual properties

「5th ed. Jikkenkagakukouza **6** Ondo, Netsu, Atsuryoku」 ed. M. Kotani *et al*. 435-444 (Maruzen, 2005).
「Kouatsuryokukagaku handbook」 ed. N.Mohri *et al*., 160-168 (Maruzen, 2007).

Potential of social/industrial contribution

■ Joint research and technical consulting

We are ready to collaborate in performing high pressure experiments with those who are interested in compressing materials. We have special skill in high-pressure technique and x-ray diffraction technique using synchrotron radiation light source.