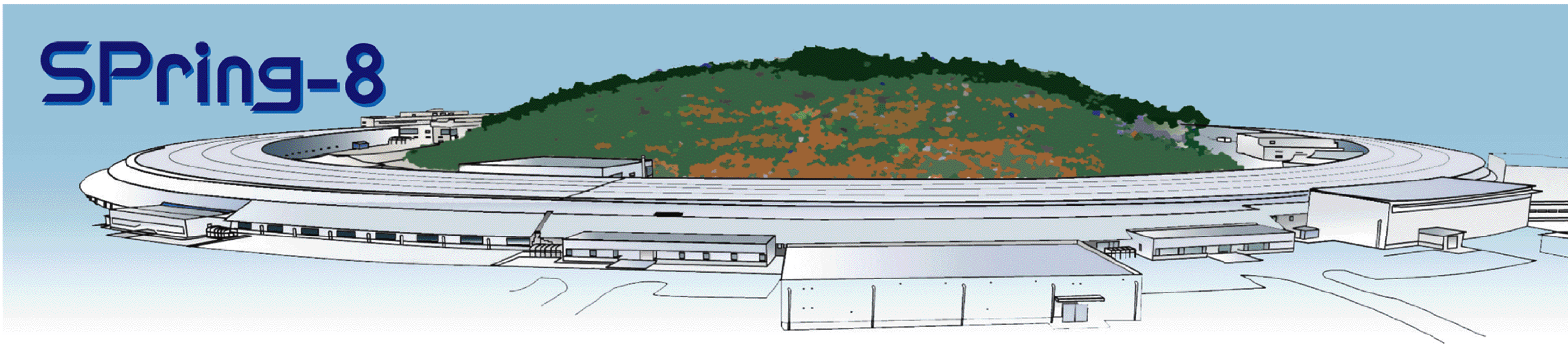

High-energy X-ray diffraction beamline BL04B2 for structural study on disordered materials

The high-energy X-ray diffraction beamline BL04B2 allows us to reveal the structure of glass, liquid, and amorphous materials by diffraction techniques. BL04B2 was designed for use in research on diffraction using high-brilliant and high-energy X-rays which are advantages of SPring-8. A two-axis diffractometer (Fig. 1) [1] has been installed to study the structures of oxide glass, metallic glass, metallic liquid, water, and ionic liquid. In particular, reverse Monte Carlo (RMC) simulation on diffraction data, the reliability of which is significantly improved by the top-up operation of the storage ring, can be used to visualize the 3-dimensional atomic configuration of disordered materials. The structural study on containerless high-temperature liquid, which is very important for the study of the nature of glass and amorphous formation, can be performed employing a levitation technique (Fig. 1) at temperatures of up to 2500 K. Recently, topical materials such as those used for DVR-RAM have become the research subject at BL04B2.

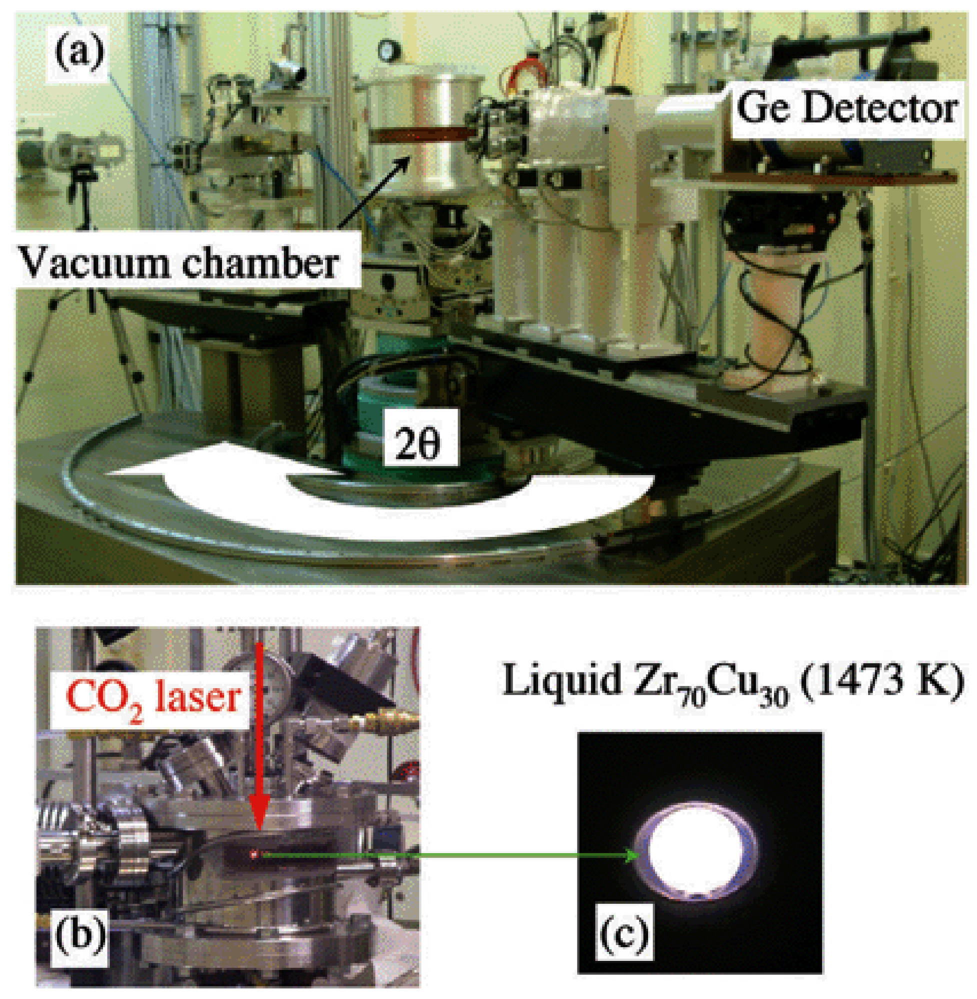

Fig. 1 Photographs of (a) two-axis diffractometer installed for the study of glass, liquid, and amorphous materials, (b) conical nozzle levitation furnace [2], and (c) levitated liquid.

Structural basis for fast phase change of DVD-RAM

A combination of high-energy X-ray diffraction and RMC simulation has revealed the key structure of DVD-RAM [3], which has strongly contributed to the improvement of the phase-change speed of DVD-RAMs. On the basis of the obtained structure, the mechanisms of the fast crystal-liquid-amorphous (record) and amorphous-crystal (erase) phase changes in $Ge_2Sb_2Te_5$ are proposed by the schematic presentation shown in Fig. 2. In the crystal-liquid phase-change process (stage I), the atomic configuration is disordered in the liquid phase. However, in the liquid-amorphous phase-change process (stage II), only even-numbered rings are constructed in amorphous $Ge_2Sb_2Te_5$ (a-$Ge_2Sb_2Te_5$). In the amorphous-crystal phase-change process (stage III), a-$Ge_2Sb_2Te_5$ transforms to the crystal phase via the transformation of only the large even-numbered rings into the crystal structure (mainly 4-fold rings), whereas the recombination of the various-size rings is required in stage III of GeTe, since both odd- and even-numbered rings are formed in stage II of GeTe. Thus, the construction of odd-numbered rings in a-GeTe disturbs the fast crystallization of the amorphous phase. We believe such unusual ring statistics of a-$Ge_2Sb_2Te_5$ is the key in achieving a high crystallization speed of the material.

This work was supported by CREST" X-ray pinpoint structural measurement project - development of the spatial- and time-resolved structural study for nanomaterials and devices -" from the Japan Science and Technology Agency (JST).

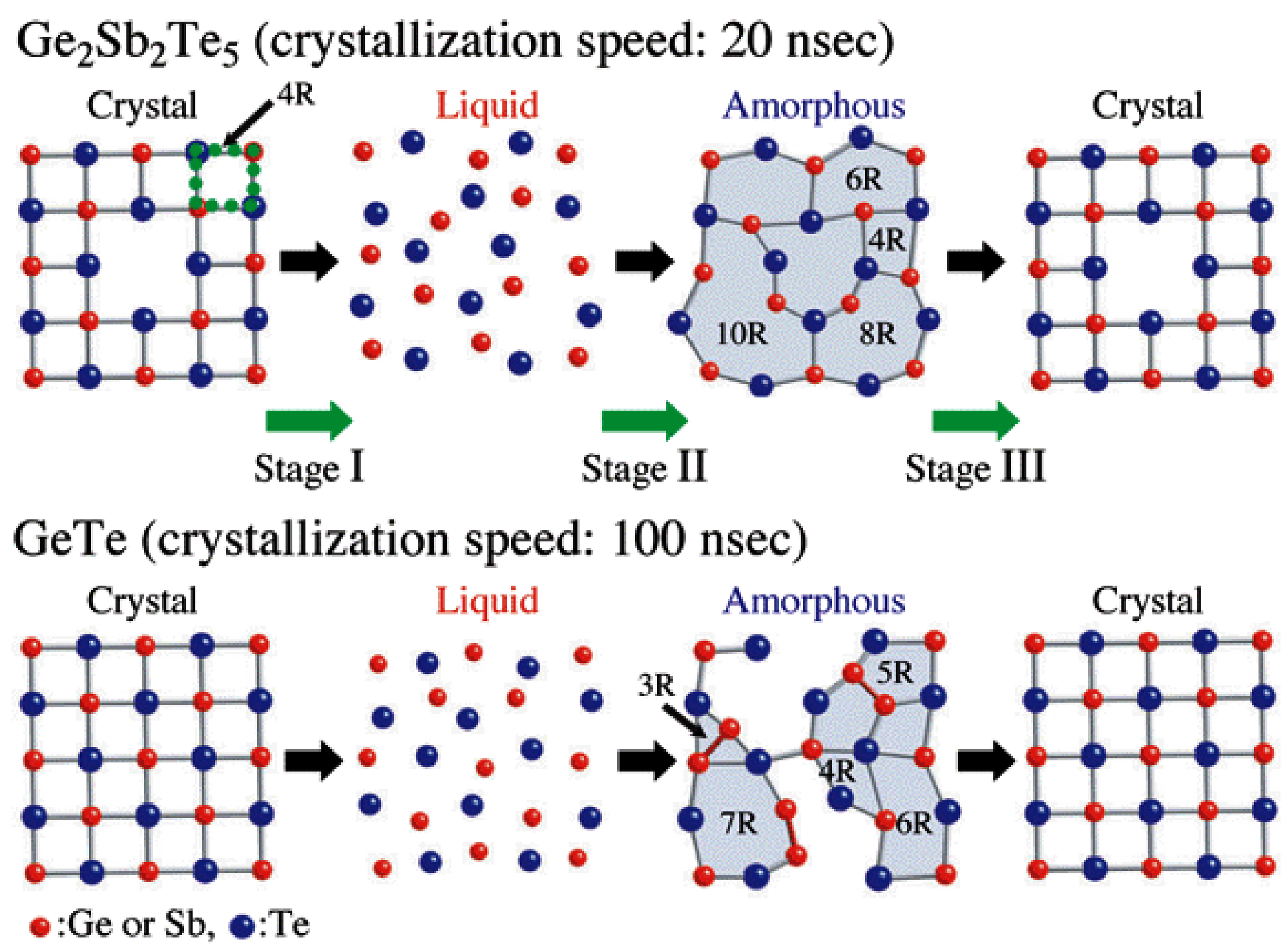

Fig. 2 Schematic presentation of possible ring size transformation in crystal-liquid-amorphous phase change (record) and amorphous-crystal phase change (erase) in $Ge_2Sb_2Te_5$ and GeTe. Stages I and II: recording process, stage III: erasing process.

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IXS2007

The 6th International Conference on Inelastic X-ray Scattering (IXS2007) will be held at Awaji Yumebutai, Awaji City, Hyogo, Japan, from May 7 to 11, 2007.

http://ixs2007.spring8.or.jp/

WIRMS2007

International Workshop on Infrared Microscopy and Spectroscopy with Accelerator Based Sources (WIRMS2007) will be held at Awaji Yumebutai, Awaji City, Hyogo, Japan, from September 25 to 29, 2007.

http://www.uvsor.ims.ac.jp/WIRMS2007/index.htm

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