

Hidden pathways of water freezing and ice melting under dynamic (de)compression

Yong-Jae Kim¹, Yun-Hee Lee^{1,2}, Soohyong Lee^{1,2}, Geun Woo Lee^{1,2*}

¹Frontier in Extreme Physics, Korea Research Institute of Standards and Science, Daejeon 34113, Republic of Korea

²Department of Nano Science, University of Science and Technology (UST), Daejeon 34113, Republic of Korea

Supercompressed water can transform into ice VI phase through metastable ice VII phase [1]. Moreover, the supercompressed water may be able to transform into high density amorphous phase [2]. Here, we report that there is more pathways of water freezing and ice melting under dynamic compression and decompression, which has been veiled. Using dynamic diamond anvil cell (dDAC) that is newly developed in Korea Research Institute of Standards and Science (KRISS), we can measure pressure

and image within microsecond level so that we can reveal hidden crystallization and melting pathways of the supercompressed water and ice. We find five different ways for crystallization and melting which are identified by in-situ real time micro-Raman and X-ray scattering experiment. We will discuss the mechanism of multiple pathways in solidification of supercompressed water by calculating driving force and interfacial free energy and comparing structure of supercompressed water and stable and metastable solids.