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Ehime Univ.

**Keywords**
1. Amonia dihydrate
2. Disordered molecular alloy
3. Ice VII



# Stability and Compression Behavior of High-Pressure Ice Phases in the $H_2O$–$NH_3$ System of Icy Body Interiors

Water and ammonia are major constituents of icy bodies, such as giant ice planets and icy moons. In the $H_2O$–$NH_3$ system, several stoichiometric hydrate phases such as AMH, AHH, and ADH have been reported (Loveday and Nelmes, 2004). In room-temperature compression experiments on AMH and ADH, these phases are known to decompose to AHH-II and Ice VII at pressures of approximately 4 GPa or higher. In contrast, low-temperature compression experiments have reported the existence of a solid-solution phase referred to as a disordered molecular alloy (DMA), in which water and ammonia molecules mutually substitute for one another (Wilson et al., 2015).

This study focused on the possibility that ammonia molecules form a DMA like solid solution with the Ice VII phase produced by room-temperature compression and investigated its stability at high temperatures. Compression experiments on pure water and ammonia water (28 wt.%, $NH_3$:$H_2O$ = 1:2.4) were conducted using a diamond anvil cell (DAC), followed by in-situ room/high-temperature X-ray diffraction measurements at SPring-8 BL10XU.

XRD measurements of the ammonia water sample confirmed a volume expansion of approximately 3.6 % in the "Ice VII" phase during compression experiments at room temperature, suggesting the formation of an Ammonia containing Ice VII phase (Am-Ice VII). In the in-situ high-temperature experiments, AHH-II and Am-Ice VII phases were observed coexisting with pure ice VII at approximately 11.7 GPa and 513 K. As the temperature increased, the diffraction peak intensity of Am-Ice VII decreased, while that of pure Ice VII increased, suggesting that the ammonia component may have been released as the temperature increased.

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