

Observation of surface structure of amorphous solid water by atomic force microscope at low temperatures

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Amorphous solid water (ASW) is one of the important materials in space because it exists an abundant and effects to evolution of interstellar molecules. In molecular clouds, it is well known that chemical reactions on icy interstellar dust grains which consist of ASW mantle and mineral particle core are key processes in the formations of important organic molecules (ie. H₂CO, CH₃OH) and deuterium-enriched molecules. Although ASW surface play an important role as a field of chemical reactions, the surface structure of ASW has yet to be revealed.

Recently, we developed a low temperature atomic force microscope (AFM) for study of the surface structure of ASW. AFM is a powerful tool to study the surface structure of ASW because it can work even if the surface do not have a conductive property. In this presentation, we show AFM images of ASW surfaces which were formed at several conditions. ASW were formed on Si(111) 7×7 at 103-135 K with various deposition rate (0.08-0.8 nm/min) and various thickness(2.5-22 nm). From the observations of surface structure, we discuss the relation between the surface structure and the condition of ASW formation.

Keywords: amorphous ice, interstellar dust, molecular clouds, atomic force microscopy