

Ice and Hydrate Study on Oak Ridge National Laboratory, Tennessee

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We measured neutron powder diffraction of ices doped with very small amounts of some catalysts using the wide-angle neutron diffractometer (WAND) at the High Flux Isotope Reactor (HFIR) in Oak Ridge, Tennessee. We succeeded in making ferroelectric ice, which prepared at high pressures (0.02 - 2.1 GPa), in a 60 to 75 K temperature range over tens hours. Neutron diffraction experiments confirmed the existence of a large ferroelectric structure in the sample. Therefore, thick surface (about 500 Km) of ferroelectric ice may exist on cold icy bodies, such as, Pluto and Kuiper Belt Objects (KBO). It suggests that about 70% of Pluto body is ferroelectric ice. Future telescope or planetary probe will be able to detect the huge ferroelectric-ice mass. A part of this work [1] is generating interests, and it was picked by the Science magazine editor in the Editors choice section and some Japanese daily newspapers [2]. We do experiments on ice prepared at much higher pressure conditions. We aim to observe the ferroelectric ice and hydrogen-ordered structures below 130 K using the WAND. We try to observe the phase transition from disordered phases to the ferroelectric ice or other ordered phases around 40-130 K (The value is the same as the temperature of Plutos surface and inner). The experiment will reveal the whole picture of low-temperature ice structures. In this meeting we report recent results at the HFIR and our future plan using higher intensity neutron beam.

References

- [1] H. Fukazawa et al., Astrophysical Journal Letters, 652, pp.L57-L60 (2006).
- [2] PhysOrg.com (<http://physorg.com/news83862687.html>); Editor's Choice, 2007, Science 315, 18; Asahi Daily Newspaper (2/2/07' in Japanese); Tokyo Daily Newspaper (7/10/07' in Japanese)