Desorption-induced evolution of cubic and hexagonal ices in an ultrahigh vacuum and cryogenic temperatures

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The existence of water in diverse environments, as exotic as in space, is well known. While amorphous solid water (ASW) is the predominant form of water in the interstellar medium, crystalline ice has also been detected within many astrophysical environments.[1,2] Reflection absorption infrared spectroscopic investigations of multilayer films of acetonitrile (ACN) and water in an ultrahigh vacuum under isothermal conditions showed the emergence of cubic (ice I_c) and hexagonal (ice I_h) ices depending on the composition of the film. The experiments were conducted with a mixed film of 300 monolayers in thickness and the ACN : H_2O monolayer ratios were varied from 1 : 5 to 5 : 1. Mixed films were deposited at 10 K and warmed to 130–135 K, where ACN desorbed subsequently and IR spectral evolution was monitored continuously. While the emergence of ice I_c at 130 K has been reported, the occurrence of ice I_h at this temperature was seen for the first time. Detailed investigations showed that ice I_h can form at 125 K as well. Crystallization kinetics and activation energy (E_a) for the emergence of ice I_h were evaluated using the Avrami equation.

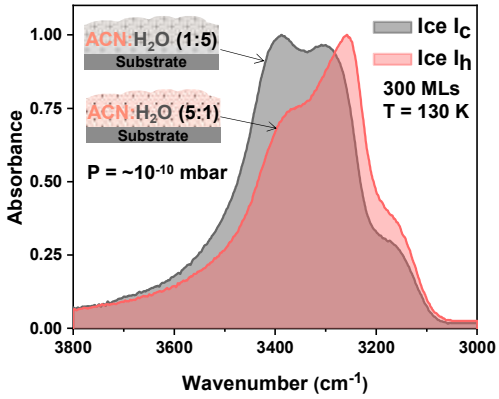

Figure 1. Acetonitrile desorption-induced emergence of cubic and hexagonal ices.

(1) Jewitt, D. C.; Luu, J. Crystalline Water Ice on the Kuiper Belt Object (50000) Quaoar. *Nat. 2004 4327018* **2004**, *432* (7018), 731–733.
(2) Merlin, F.; Guilbert, A.; Dumas, C.; Barucci, M. A.; De Bergh, C.; Vernazza, P. Properties of the Icy Surface of the TNO 136108 (2003 EL). *Astron. Astrophys.* **2007**, *466* (3), 1185–1188.

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