

Abstract Submitted
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How different is water crystallization from polymer crystallization under confinement? GEORGE FLOUDAS, University of Ioannina, YASUHITO SUZUKI, Max Planck Institute for Polymer Research, HATICE DURAN, TOBB University of Economics and Technology, MARTIN STEINHART, University of Osnabrueck, HANS-JUERGEN BUTT, Max Planck Institute for Polymer Research — The freezing mechanism of water under confinement can be fundamentally different from the bulk. Despite fundamental importance, the lack of well-defined confining media precluded a systematic investigation. Herein we employ self-ordered nanoporous aluminum oxide (AAO) which contains arrays of discrete, parallel and cylindrical nanopores with uniform pore length and diameter to study the effect of confinement on water crystallization. By varying different parameters such as pore size, temperature and cooling rate, the respective conditions under which the hexagonal form (I_h) and the less common form of cubic ice (I_c) could be studied. We found a transition from heterogeneous nucleation of I_h to homogeneous nucleation of predominantly I_c with decreasing pore diameter. Furthermore, the monotropic $I_c \rightarrow I_h$ transition commonly observed upon heating is suppressed inside pores having diameters ≤ 35 nm. These findings lead to the phase diagram of water under confinement. It contains a predominant cubic form, a form known to exist only in the upper atmosphere. There are many similarities between the freezing of water and the crystallization of polymers under confinement.

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