



## ENVR 23: Acceleration of amorphous solid water crystallization by acidic impurities

### Details

---

**Session:** ENVR: Water in the Solid State: Reactions & Interactions with Impurities (/acs\_sd2019/event/7dcbe902994c7947c52c4210b0336eba)

**Location:** Room 28C, San Diego Convention Center  
(/acs\_sd2019/place/31abfb4c4291cea2049e9ca02bcc8f13?booth=18b8143339a4525e62d5f65183aa7ac3)

**Date & Time:** Sunday, Aug 25 9:55 AM

**Duration:** 20 minutes

### Authors

---

#### Presenter

Dr. Du Hyeong Lee  
Korea Polar Research Institute  
(/acs\_sd2019/speaker/285efb1e81423867d7c4d6eb348ab824)

### Abstracts

---



ENVR 23: Acceleration of amorphous solid water crystallization by acidic impurities

(/acs\_sd2019/abstract/036e379e-39dd-4c8c-8662-763fd61fe79a)

## Fall 2019 ACS National Meeting in San Diego, CA

## View Abstract

**ABSTRACT SYMPOSIUM NAME:** Water in the Solid State: Reactions & Interactions with Impurities

**ABSTRACT SYMPOSIUM PROGRAM AREA NAME:** ENVR

**CONTROL ID:** 3198585

**PRESENTATION TYPE:** Oral Preferred : Do not consider for Sci-Mix

**TITLE:** Acceleration of Amorphous Solid Water Crystallization by Acidic Impurities

**AUTHORS (FIRST NAME, LAST NAME):** [Du Hyeong Lee](#)<sup>1, 2</sup>, Heon Kang<sup>2</sup>

**INSTITUTIONS (ALL):** 1. Korea Polar Research Institute, Incheon, Korea (the Republic of).

2. Department of Chemistry, Seoul National University, Seoul, Korea (the Republic of).

**ABSTRACT BODY:**

**Abstract:** It is well known that impurities usually retard crystallization of solutions. However, amorphous solid water (ASW) with acidic impurities showed an opposite phenomenon; protons from hydrogen chloride (HCl) accelerates the crystallization of ASW. ASW is a solid form of water and has similarities to supercooled liquid water. ASW is metastable, so it transforms into crystalline ice (CI) at temperatures higher than ~135 K. In this study, we investigated the crystallization of ASW thin films affected by dissociated acid molecules. ASW film samples with excess protons from dissociated HCl were prepared by vapor deposition onto a Pt(111) single crystal in an ultrahigh vacuum chamber. After the film preparation, crystallization kinetics in isothermal conditions were measured using O-H stretch peak changes by reflection-absorption infrared spectroscopy (RAIRS). Rapid phase transition observed in HCl-doped ASW films, but not in NaCl-doped films indicated that the excess protons promoted the crystallization of ASW. The apparent activation energy of the ASW crystallization was lowered from 63.4 kJ/mol without HCl to 48.5 kJ/mol with 0.1 ML HCl. This acid-promoted crystallization started near the location where the acid was injected, regardless of the film surface or interior. These results suggest that the excess protons from dissociated HCl accelerated the nucleation step of the crystallization process. A possible acceleration mechanism for this process is discussed based on the configurational entropy of excess protons. This study, crystallization of ASW with acidic impurities, would be helpful to understand the unique phenomenon of protons in water and ice, and the behavior of low-temperature water in interstellar clouds.

(No Image Selected)

ACS MAPS Environment. Copyright © 2019 American Chemical Society. All rights reserved.

[Terms of Use](#) | [Privacy](#) | [ACS Homepage](#)

© Clarivate Analytics | © ScholarOne, Inc., 2019. All Rights Reserved.

ScholarOne Abstracts and ScholarOne are registered trademarks of ScholarOne, Inc.

ScholarOne Abstracts Patents #7,257,767 and #7,263,655.

[@ScholarOneNews](#) | [System Requirements](#) | [Privacy Statement](#) | [Terms of Use](#)

Product version number 4.16.0 (Build 83). Build date Wed Apr 24 13:34:59 EDT 2019. Server ip-10-236-28-210