

WILDE LAB.

Water and Ice at Interfaces



Department of Fundamental Engineering
Social Cooperation Program: Frost Protection Science

Surface Physical Chemistry

<http://oflab.iis.u-tokyo.ac.jp>

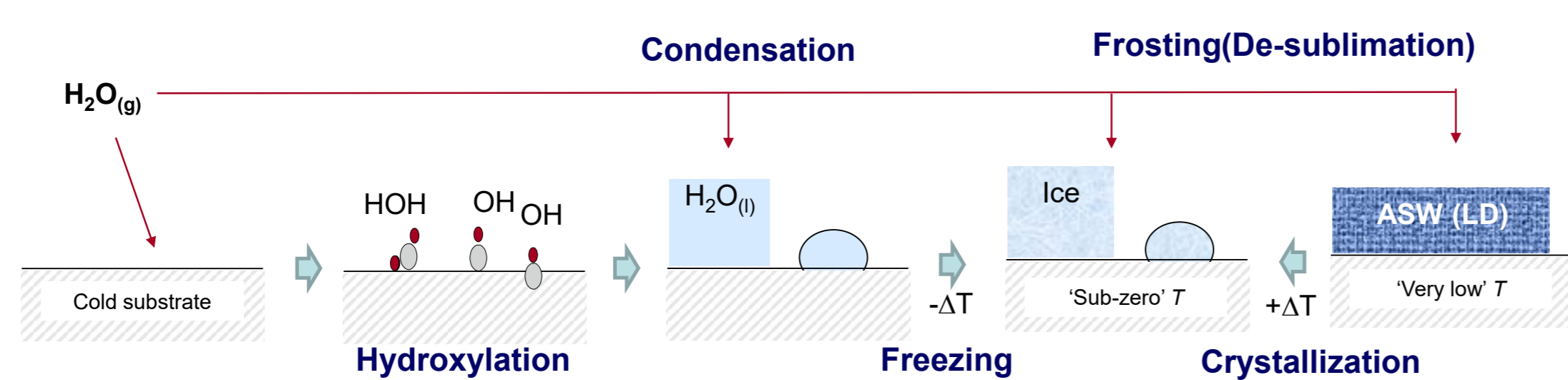
Molecular Perspective on Frost Formation on Cold Surfaces

Frost formation – the growth of ice films from water vapor on cold surfaces by de-sublimation – a daily life phenomenon that seriously obstructs heat transfer at refrigerated surfaces, is still not well understood at the molecular level. This laboratory employs (ultra)-high vacuum experimental techniques to reveal fundamental molecular interactions and (de-)sublimation dynamics in interfacial water and ice films on solid surfaces, especially of well-defined oxides as model systems for naturally oxidized metals. We aim at clarifying how the chemical constitution, atomic structure, and macroscopic wetting properties of the surface influence interfacial water-ice phase transitions and the crystallization kinetics of amorphous solid water films prepared at cryogenic temperatures.

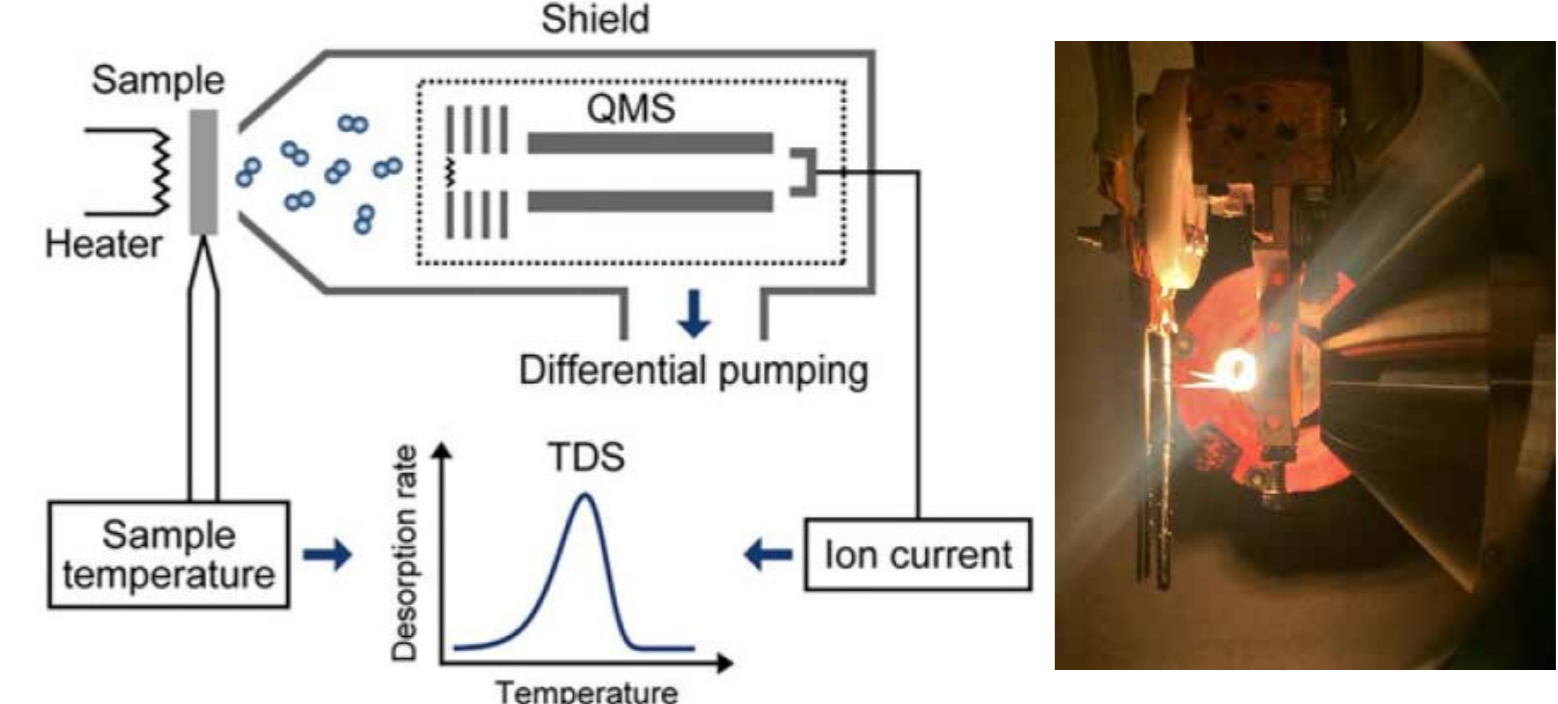
◆ Key Experimental Techniques & Information Gain

- ✓ *Low Energy Electron Diffraction (LEED)*: → Atomic Surface Structure (Periodicity) of Substrate and Thin Ice Films
- ✓ *Thermal Desorption Spectroscopy (TDS)*: → H₂O Sublimation/De-sublimation Kinetics ▪ Energies of Desorption and Intermolecular Interactions between H₂O molecules in Interfacial Water/Ice Layers
- ✓ *IsoThermal Desorption Analysis (ITDA)*: → Crystallization Kinetics of Amorphous Solid Water Films
- ✓ *Nuclear Reaction Analysis (NRA)*: → Hydrogen Depth Profiling with Nanometer Resolution ▪ Quantification of Surface Hydroxyl (OH) Coverages ▪ Thermal Stability, Depth Distribution and Diffusion of (O)H in Surface Oxide Layers

H₂O Adsorption, Surface Hydroxylation, Freezing and Frosting on Cold Surfaces

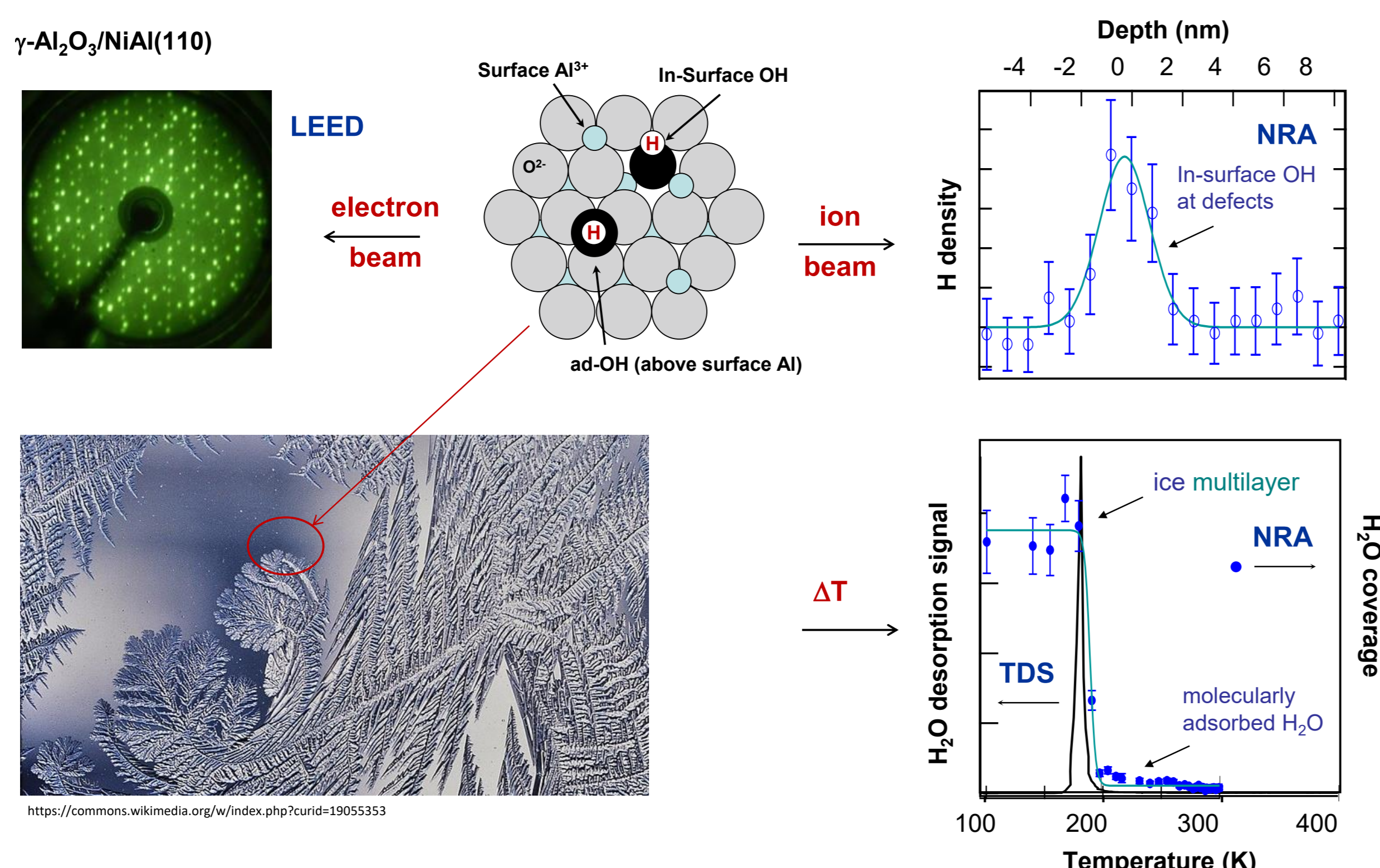


Thermal Desorption Spectroscopy (TDS)

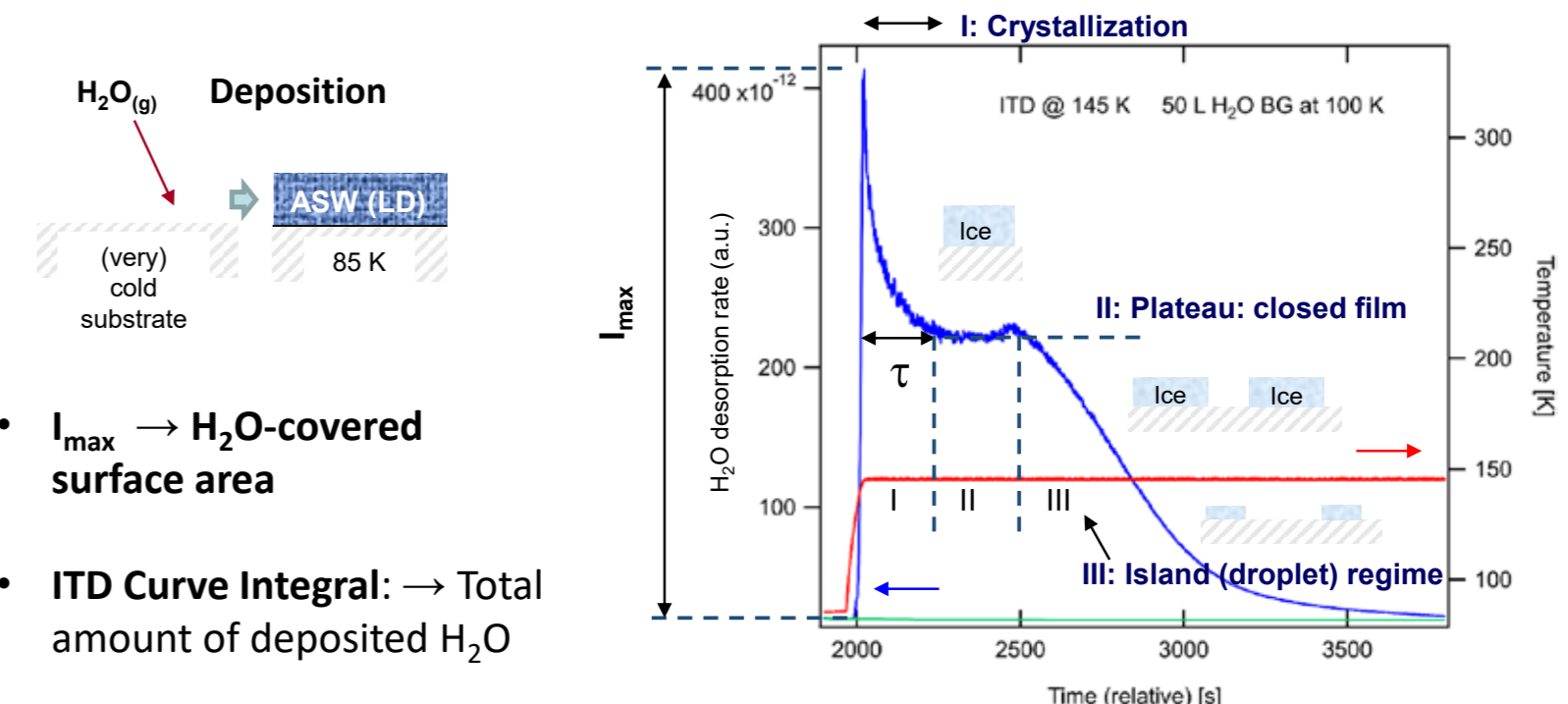


S. Ogura, Compendium of Surface & Interface Analysis, p. 719-724, Springer, 2018.

Structure and Dynamics of interfacial H₂O/ice films on well-defined Al₂O₃ surfaces



Isothermal Desorption Analysis (ITDA)



Resonant Nuclear Reaction Analysis (NRA)

