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Segregation of ions in deliquesced droplets of alkali halide nano-crystals on SiO₂

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A nion concentrations at the air/water interface of saline droplets are important in atmospheric and environmental chemistry, because gaseous halogens emitted from the droplet surface mediate various key tropospheric chemical processes. The purpose of this study is to reveal the ion segregation in deliquesced droplets of alkali halide nano-crystals on SiO₂; noted that SiO₂ was chosen as a model substrate for dust particles. First, the adsorption of water on alkali halide nano-crystals (KBr, KCl, KF, NaCl) on SiO₂ was in-situ investigated by noncontact atomic force microscopy (AFM) in an amplitude-modulation mode with electrostatic forces. For KBr, KCl and NaCl, deliquesced droplets show negative surface potentials relative to the surrounding region, indicating the preferential segregation of Br⁻ and Cl⁻ anions to the air/solution interface, even in the presence of a liquid/solid interface located a few nanometers away. This trend is more drastic for larger anions, meaning that heterogeneous reactions of gas-phase molecules with saline droplets to emit gaseous halogens can be more significant with larger anions. Secondly, I used ambient-pressure X-ray photoelectron spectroscopy (XPS). In-situ XPS spectra of a deliquesced droplet of KBr on SiO₂ demonstrate that Br⁻ ions are segregated at the air/droplet interface, which agrees with the AFM results. Thirdly, I introduce our recent challenge to fabricate a transistor with a gate insulator of SiO₂. The point of this transistor is a water droplet acting as a gate material instead of metals. After showing its design and device process, I present some results of electrical characteristics of the water-droplet/SiO₂/Si transistor.

Biography

Kenta Arima is an Associate Professor in the Department of Precision Science and Technology in the Graduate School of Engineering in Osaka University, Japan. In 2000, he received his PhD in Precision Science and Technology from Osaka University. In 1997-2000, he was a Junior Research Associate at RIKEN. He became an Assistant Professor in 2000 and has been an Associate Professor since 2009 at Osaka University. In 2007-2008, he was a visiting scholar in Materials Sciences Division in Lawrence Berkeley National Laboratory (USA). He is a member of four academic societies including Materials Research Society.

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