IN-005 <Invited Talk>

Structural Control of Single-Crystalline Metal Oxide Surfaces toward Bioapplications

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Well-defined surfaces of single-crystalline solid materials are starting points of self-organizationof nanostructures and chemical reactions controlled in nanoscale. Although highly ordered atomicarrangement can be obtained on semiconductor surfaces, they can be maintained only in vacuumand not in air or in aqueous environment. Since single-crystalline metal oxide surfaces arechemically stable and no further oxidation occurs, their atomic structures can be utilized fornanofabrication in liquid processes, nanoelectrochemistry and nanobiotechnology. Sapphire is oneof the most stable metal oxides and its crystalline quality is excellent, as can be applied to electronicdevices that require ultralow defect densities. We recently found that chemical phase separationoccurs on sapphire surfaces by annealing processes and the formed nanodomains exhibit specificproperties in air and in water [1,2]. In our experiments, highly selective and controllable adsorptionof various protein molecules is observed on the phase-separated surfaces though the materials andcrystallographic orientations are identical [3,4]. Planar lipid bilayers supported on thephase-separated sapphire surface also exhibit a specific formation site selectivity [5]. Chemicalnanodomains appear on other metal-oxide surfaces, such as well-ordered titania surfaces. Wedemonstrate that surface chemistry of the nanodomains can be characterized in aqueousenvironment using atomic force microscopy equipped with colloidal tips and then show adsorptionand desorption behaviors of various proteins on the phase-separated surfaces.

References

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