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Three-Step Water Sorption of Thin Nafion Films DAISUKE KAWAGUCHI, Education Center for Global Leaders in Molecular Systems for Devices, Kyushu University, YUDAI OGATA, Department of Applied Chemistry, Kyushu University, Japan, NORIFUMI YAMADA, Neutron Science Laboratory, High Energy Accelerator Research Organization, Japan, KEIJI TANAKA, Department of Applied Chemistry, Kyushu University, Japan — Nafion has been widely used as a proton exchange film in polymer electrolyte fuel cell (PEFC). Although downsizing PEFC is one of the interesting developments in the near future, it appears that most studies conducted so far are limited to bulk systems. Here we examined water sorption behavior in thin Nafion films based on optical and neutron reflectivity measurements. Nafion films were prepared on silver and silicon oxide substrates. It was found that the thicknesses of Nafion thin films increased with time after contacting water in three steps. The asymptotic swelling ratios in regimes I, II and III were 1.05, 1.26 and 1.41, respectively. These values were in-dependent of the substrate species, and were coincident with the transition points of different hydration states in the bulk Nafion; water binding to sulfonic acid groups, the formation of sphere-like ionic clusters, and bridge formation between clusters. The swelling was much slower in thin films than in the bulk due to the mobility restriction of Nafion near the substrate.

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