Glassy Behavior of a Tin Dioxide Nanoparticle Suspension

Atsumi Wakabayashi,[†] Tatsuhiko Goto,[‡] Toshiaki Dobashi,[‡] Yasuyuki Maki[*‡]

[†]*Advanced Materials Division, Sumitomo Osaka Cement Company, Ltd., Funabashi, Chiba 274-8601, Japan*

[‡]*Division of Molecular Science, Faculty of Science and Technology, Gunma University, Kiryu, Gunma 376-8515, Japan*

email: maki@gunma-u.ac.jp

SUPPORTING INFORMATION

Transmission Electron Microscope (TEM) Observation. Transmission electron micrographs were recorded with a JEOL JEM-2010 transmission electron microscope (TEM) (Figure S1). Samples for the TEM observation were prepared by spotting grids with a SnO_2 suspension with a concentration of 0.1 wt% ($\varphi = 1.4 \times 10^{-4}$) and letting the spots dry.

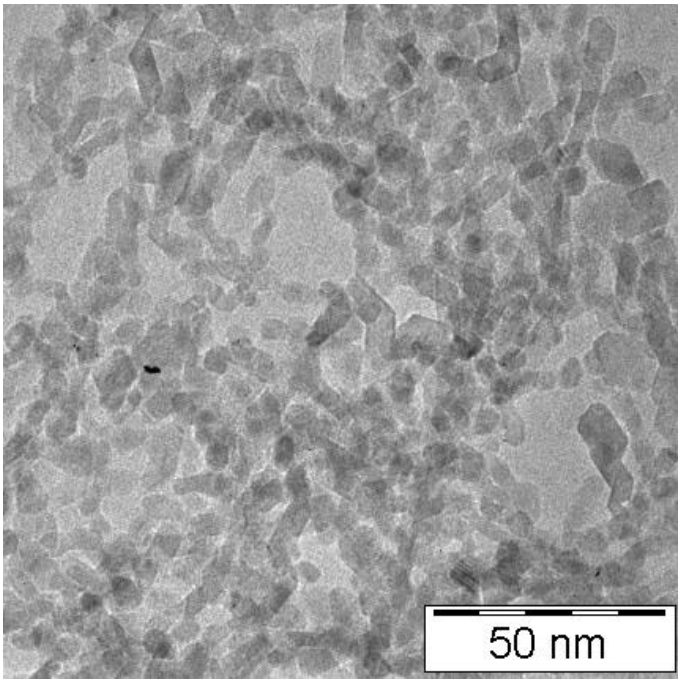

Figure S1. TEM image of SnO_2 nanoparticles.

Estimation of the Debye Length from the Conductivity Experiment. The Debye length κ^{-1} is represented as

$$\kappa^{-1} = \sqrt{\frac{\varepsilon kT}{2N_A e^2 I}}.$$

Here, ε, N_A, and I are the dielectric constant of the medium, Avogadro's number, and the ionic strength, respectively. The ionic strength is defined as $I = (1/2) \sum Z_i^2 n_i$, where Z_i and n_i are the valence and molar concentration of ith ion, respectively. The concentration n_i of ith ion in colloidal suspensions can be estimated from the conductivity σ by use of the equation $\sigma = \sum \mu_i Z_i n_i e$, where μ_i is the mobility of ith ion. For the SnO_2 nanoparticle suspension of 1.0 wt% ($\varphi = 1.4 \times 10^{-3}$), σ was measured to be 2.5 mS/m. Assuming that the mobile ions in the suspension are residual ammonium ions and chloride ions, and using $\mu_{NH_4} = 7.63 \times 10^{-8}$ $m^2 s^{-1} V^{-1}$ and $\mu_{Cl} = 7.91 \times 10^{-8}$ $m^2 s^{-1} V^{-1}$, κ^{-1} was calculated to be approximately 5 nm for the suspension with a concentration of 25 wt% ($\varphi = 0.045$).