
Study of a Commercial SiO₂ Sol and Gel by Small Angle X-ray Scattering: Effect of Sample Thickness and Interpretation by Means of Smoluchowski Scheme

Yingnian Xu¹, Pang L. Hiew¹, Matthew Akira Klippenstein¹ and Yoshikata Koga^{2, †}

¹ Department of Chemistry, The University of British Columbia, Vancouver, B. C., Canada V6T 1Z1

² Center for Ceramics Research, Research Laboratory of Engineering Materials, Tokyo Institute of Technology Nagatsuta, Midori-ku, Yokohama, 227 Japan

† Permanent address: Department of Chemistry, The University of British Columbia, 2036 Main Mall, Vancouver, B.C., Canada V6T 1Z1.

Abstract: Ludox HS SiO₂ sols at high concentrations show a peak in small angle x-ray scattering (SAXS) reminiscent to a " structure." The appearance of such a peak was found to depend crucially on the thickness of the sample cell used for SAXS measurements. The thinner the cell used, the more prominent the peak. When the thickness was larger than 2 mm, it was no longer observable. When sols were treated with activated charcoal powders (in order to remove a surfactant) the peak became less prominent.

For the cases where clear features for structure were absent (thick sample regime), the Smoluchowski scheme was utilized to study the nature of sols. Namely, the distribution of the Smoluchowski species were estimated by numerically calculating the size distribution of particles directly from SAXS data. The distribution was found basically bimodal, and the main distribution peak, particularly for dilute sols (less than 5 wt%), was consistent with primary particles of SiO₂. The second distribution peak was strongly dependent on the concentration of SiO₂ particles. The observed trend was that the higher the concentration of SiO₂ particles, the more prominent the second distribution peak and the locus of the maximum tended to move toward a smaller value in diameter. This behavior of the second distribution peak of the Smoluchowski species is no doubt a manifestation of the interparticle correlation. The observation of such behavior may provide a convenient means to characterize sols with interparticle correlation. This method was also applied for characterizing gels formed when the pH values were altered.

Key Words: Dependence of Sample Thickness • Ludox HS SiO₂ • SAXS • Smoluchowski Scheme • Structure in sol

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