Rheological properties and microstructural analysis of coating liquids composed of binary colloidal particles

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Coating fluids that include binary colloidal particles are widely used in many applications such as Li-ion batteries, multi-layer ceramic capacitors, and electrical conductors. In these liquids, the size and surface chemistry of the particles is very different; one is micron and the other nano-meter scale, for example. Because of distinctively different size of the particles, these bi-modal suspensions show different flow behavior compared to colloids of a single size. In this study, we investigated the effect of nano-particles on the microstructure formation and flow behavior in the bi-modal suspensions, which consists of sub-micron PS latex particles and nano-sized alumina-coated silica particles. The rheological properties were dramatically changed from viscous to gel-like depending on the surface potential and concentration of small particles. Scaling analysis and cryo-SEM distinguished the gel structures from which the phase diagram derived. Because this behavior is distinct from that of single sized nano-colloids as well as single sized micron-colloids, we conclude that there exists a special role of nano particles which facilitates to form a network structure in bi-modal suspensions.