QUANTITATIVE MEASUREMENT OF NANOPARTICLE HALO FORMATION AROUND COLLOIDAL MICROSPHERES IN BINARY MIXTURES USING SMALL-ANGLE X-RAY SCATTERING

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A new colloidal stabilization mechanism, known as nanoparticle "haloing", has been predicted theoretically and inferred experimentally in microsphere-nanoparticle mixtures that possess high charge and size asymmetry. The term "halo" implies the existence of a non-zero separation distance between the highly charged nanoparticles and the negligibly charged microspheres that they surround. For the first time, we quantify this interparticle separation distance, which we found is similar to the Debye screening length of the solution. We also quantify the average number of nanoparticles associated with each microsphere and the spatial arrangement of the nanoparticles in the halo. Our observations based on ultra-small-angle X-ray scattering measurements reveal the magnitude of the haloing effect, and show that the nanoparticles are not strongly adsorbed to the surface of the microspheres.