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Optimizing Dynamic Light Scattering for the Analysis of Anisotropic Nanoparticles in Solution

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Abstract

To further understanding of light scattering on solution of anisotropic hard-to-image soft particles such as elastin-like polypeptide micelles the light scattering characterization of anisotropic easy-to-image inorganic gold nanoparticles was undertaken. We used Depolarized Dynamic Light Scattering (DDLS) and Scanning Electron Microscopy (SEM) to study commercial gold nanoparticles: nanospheres, nanorods with aspect-ratio=3, and nanorods with aspect ratio=7. According to SEM particles appeared to be larger than manufacturer specs, namely 2R=18.9±1.3nm, (26.1±4.1)x(65.5±9.5)nm, and (16.3±2.2)x(103.6±16.7)nm, respectively. DDLS on nanospheres showed no rotational diffusion (VH) signal, q dependence of decay rate consistent with that of spherical particles, no concentration dependence of translational diffusion coef- ficient (DVV), no absorption change under incident laser light, and a hydrodynamic radius Rh=12.2±0.4nm, largely consistent with SEM-measured size. The aspect-ratio=3 rods also revealed no VH signal, sphere- like q-dependence of decay rate, no concentration dependence of DVV, and apparent Rh=20.9±0.5nm. These samples also revealed unexpected change of absorption and color under incident laser light. However, the absorption change didn't affect particle diffusion. In other words, DDLS on 26x66nm nanorods yielded apparent diffusion properties of 41.8nm diameter spherical particles! DDLS on aspect-ratio=7 rods revealed noticeable VH signal and significant change in absorption altering diffusion properties under the laser light. The absorption change might have been caused by plasmon resonance, which greatly alters the particles' absorption. It was also found that, after certain "exposure" to the laser beam 16x104nm particles became stable and showed diffusion properties consistent with diffusion of cylinders.