Size-dependent physicochemical and optical properties of silica nanoparticles

Abstract

The size-dependent physicochemical and optical properties of silica nanoparticles have been studied. Significant increase in the specific surface area (SSA), concentration of silanol groups (δOH) and apparent density (Da) were observed as the particle size reduced from ~130 to ~7 nm. The decrease in the silanol number (αOH) and Si–O–Si bond angle in smaller particle size suggest that the silica structure, especially the surface has been significantly altered at nanoscale. This finding is supported by the presence of defect sites such as E′ centers and oxygen deficient centers (OCD). The stability of E′ centers (UV–vis analysis) increase linearly with the increase in particle size. The increase in the intensity of blue and green bands (PL analysis) with the decrease in the particle size are attributed to the higher silanol concentration and increased in the number of self-trapped exciton (STE)/OCD, respectively. The green band was blue-shifted with the decrease in the particle size. Overall, the silica nanoparticles have shown distinctive properties relative to the bulk silica.