Effect of Zeta Potential and Particle Size on the Stability of SiO₂ Nanospheres as Carrier for Ultrasound Imaging Contrast Agents

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A series of SiO₂ nanospheres (NPs) and amino-functionalized SiO₂ NPs were synthesized through a modified Stöber method and eventually used as the model of SiO₂ carrier for ultrasound imaging contrast agents loading. The physicochemical properties of these materials were characterized by X-ray diffractometry (XRD), transmission electron microscopy (TEM) and Fourier transform infrared detector (FT-IR). Also, the zeta potential and diameter of the as-prepared SiO₂ NPs was measured and compared. It can be observed that the particle size of obtained SiO₂ spheres are controllable from 100 nm to 800 nm by adjusting the synthetic condition. SiO₂ NPs size 200 nm and 400 nm exhibit remarkable uniformity, while the morphology of ~800 SiO₂ spheres turns to irregular. The zeta potential of the unmodified SiO₂ NPs was much higher than conventional carriers of ultrasound imaging contrast agents, indicating that the monodisperse stability of small SiO₂ NPs was superior. After amino-function, SiO₂ NPs size ~400 nm show the highest zeta potential of -45.5 mV, which will benefit the carrier transportation when it pass though the endothelial barriers of tumour tissue. The excellent stability and unique surface groups of amino-modified SiO₂ NPs will significantly benefit the loading of drugs and biological ligands, thus show insight for its future applications of nanomedicine and clinical ultrasound imaging beyond blood vessel.

Keywords: Ultrasound imaging contrast agents, SiO₂, Zeta potential, Size control