Synthesis and characterization of surface modification metal oxide nanoparticles by organic ligands using supercritical methanol in a continuous system

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Surface-modified ceria oxide (CeO2) and zinc oxide (ZnO) nanoparticles were synthesized rapidly and continuously in supercritical methanol at 400 oC, 30 MPa and a residence time of ~ 40s by using a flow type reactor system. Oleic acid and decanoic acid were used to modify surface. The usage of supercritical methanol and the addition of the organic modifiers into the reaction system have a significant effect on the particle size, morphology and the dispersion of nanoparticles. Fourier transform infrared (FT-IR) and thermogravimetric analysis (TGA) indicated that aliphatic, carboxylate and hydroxyl groups were chemically bounded on the surface of metal oxide nanoparticles. The surface modified nanoparticles showed a very high surface area compared with unmodified particles. Scanning electron microscopy (SEM) and transmission electron microscopy (TEM) images showed that the organic modification inhibited crystal growth of the nanoparticles. Dispersion test indicated that the addition of organic modifier into the reaction system significantly affected the dispersion stability of nanoparticles.