Surface modification of metal oxide nanoparticles by organic ligands using supercritical methanol for highly stabilized nanofluids

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A preparation method of surface-modified ceria oxide (CeO2) and zinc oxide (ZnO) nanoparticles for highly stabilized nanofluids was established in a flow type reactor system by using supercritical methanol at 400 oC, 30 MPa and a residence time of ~ 40s. 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. SEM and TEM images showed that the organic modification inhibited crystal growth of the 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. Dispersion test in water, ethylene glycol and transformer oil indicated that the addition of organic modifier into the reaction system significantly affected the dispersion stability of nanoparticles.