**Controllable Preparation of Monodispersed ZrO2 Nanocrystals Using High-Gravity Reactive Precipitation Combined with Solvothermal Treatment**

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**Abstract**

The controllable synthesis of monodisperse nanocrystals has attracted broad attentions because of their scientific and technological applications. In this study, a novel route was presented to controllably prepare transparent dispersions of monodispersed ZrO2 nanocrystals with inexpensive inorganic zirconium salt under an acid aqueous surrounding by using high-gravity reactive precipitation in a rotating packed bed reactor combined with solvothermal treatment. By altering reaction conditions, the controllability for the crystalline forms from monoclinic to tetragonal phases, the average particle size from 3 to 20 nm, the shapes of sphere, rice, spindle, rod, and cube can be achieved. The as-prepared monodispersed ZrO2 nanocrystals can be readily dispersed in many solvents including water, alcohols, esters, cycloalkanes, oils, etc, thereby forming highly-concentrated (>60 wt%), highly-stable (>18 months) and highly-transparent nanodispersions. Furthermore, highly transparent polyvinyl alcohol (PVA)/ZrO2 and polystyrene (PS)/ZrO2 nanocomposite films with high refractive index were conveniently prepared with a simple solution mixing route. The refractive index can be tuned from 1.53 to 1.75 (@ 589 nm) by changing the mass fraction (0-80 wt.%) of ZrO2 in transparent nanocomposite films. It could be envisioned that such highly dispersed ZrO2 nanocrystals would be potential in many areas including LED encapsulation, dental ceramics, solar cells, catalysts and so forth.