Influence of Organic Capping Ligands on the Growth Kinetics of ZnO Nanoparticles


The growth of ZnO nanoparticles from zinc acetate in propanol proceeds by coarsening. Coarsening processes involve the growth of larger particles at the expense of smaller particles, and are governed by capillary effects. Since the chemical potential of a particle increases with decreasing particle size, the equilibrium solute concentration for a small particle is much higher than for a large particle, as described by the Gibbs-Thompson equation. The resulting concentration gradients lead to the transport of solute (e.g., metal ions) from the small particles to the large particles.

In this report, we demonstrate that the growth rate, and hence particle size, can be controlled by injection of capping ligands that adsorb onto the particle surface. Both thiols and phosphonic acids are shown to slow the growth rate of ZnO nanoparticles, indicating that they adsorb onto the particle surface and provide a barrier to further transport of metal ions from the small particles to the large particles.

This work demonstrates a practical method to control the particle size of nanoparticulate ZnO, a semiconductor material widely used in various applications.

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