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Kinetics-Limited Composition Profile of Semiconductor Alloy Quantum Dots[1] XIAOBIN NIU, GERALD STRINGFELLOW, FENG LIU, Department of Materials Science and Engineering, University of Utah — Semiconductor alloy quantum dots (QDs) with controlled composition profile are promising nanoscale building blocks for modern nanophotonic and nanoelectronic devices. The overall composition profile of such low-dimensional nanostructures is usually far from equilibrium, because bulk diffusion is negligible at typical growth conditions. However, local equilibrium may be established in the surface regions via surface diffusion. Consequently, the kinetic growth mode, which dictates the way of surface mass transport and alloy mixing in the growth fronts, becomes a key factor in determining the kinetics-limited composition profile. In this talk, we report our recent discovery of a striking correlation between the composition profiles of the strained semiconductor alloy QDs and their growth modes, based on atomistic-strain-model Monte Carlo simulations of InGaN (GeSi) QDs. The layer-by-layer growth forms core-shell structures with the core-rich unstrained component; while the faceted growth forms the core-rich strained component. Our findings suggest a promising method for the control of composition profile of semiconductor alloy QDs by selecting the growth mode.

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