

W0365

Structure of Core-Shell and Alloyed Binary Nanoparticles Studied With X-ray Absorption Fine Structure.

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We report XAFS, optical, and TEM studies of Au-Ag, Pt-Ag, and Pd-Ag bimetallic nanoparticle structure as a function of size and growth conditions. The 2-20nm particles were synthesized radiolytically, and depending on the initial parameters, they assume spherical or cylindrical morphologies. In the Au-Ag nanoparticles, interdiffusion alloying was observed to be a strong function of total particle radius. For smaller particles, the diffusion is much greater than expected from either bulk or size-scaled thermodynamics and a defect-mediated model will be presented. For Pt-Ag and Pd-Ag nanoparticles of the same size, the metals retain their bulk alloying characteristics. Pt and Ag segregate, indicating that strain effects overcome the excess surface free energy in the small particles. The structure of Pd-Ag bimetallic nanowires was also determined, and contrary to the Pt-Ag system they are shown to alloy similar to spherical particles of similar diameter and composition.