Large self-assembled quantum dot arrays: Fabrication strategies and tunneling transport properties

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The first part of this talk discusses new strategies for the self-assembly of compact, macroscopic monolayers of ligand-coated metal nanocrystals. In close collaboration with Xiao-Min Lin at Argonne, our group has developed drop casting techniques that can produce extended mono- and multi-layers with very low defect density and high degree of long-range ordering. The nanoparticle layers form at the surface of an evaporating drop of colloidal solution and drape themselves over the substrate upon drying. I will present a phase diagram that delineates three different growth regimes, as observed by tracking with video microscopy. The second part focuses on the electronic transport properties which are controlled by the interplay of strong Coulomb charging effects and spatial fluctuations in the position of the local Fermi level. I will discuss our experimental results in light of recent models for both the shape of the resulting current-voltage characteristics at large bias and for the temperature dependence of the zero-bias conductivity (the latter was developed in collaboration with Igor Beloborodov and Valerii Vinokur at Argonne).

refs:
* Klara Elteto, Eduard G. Antonyan, T.T. Nguyen, and Heinrich M. Jaeger , "A model for the onset of transport in systems with distributed thresholds for conduction", Phys. Rev. **B 71**, 064206 (2005)
* T. B. Tran, I. S. Beloborodov, X.-M. Lin, V. M. Vinokur, and H. M. Jaeger, "Multiple Cotunneling in Large Quantum Dot Arrays", Phys. Rev. Lett. **95**, 076806 (2005).