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Abstract for an Invited Paper
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Controlled assembly and electronics in semiconductor nanocrystal-based devices

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I will discuss the assembly of semiconductor nanocrystals (CdSe and PbSe) into electronic devices and the basic mechanisms of charge transport in nanocrystal arrays [1-4]. Spherical CdSe nanocrystals show robust memory effects that can be exploited for memory applications [1]. Nanocrystal memory can be erased electrically or optically and is rewritable. In PbSe nanocrystal arrays, as the interdot coupling is increased, the system evolves from an insulating regime dominated by Coulomb blockade to a semiconducting regime, where hopping conduction is the dominant transport mechanism [2]. Two-dimensional CdSe nanorod arrays show striking and anomalous transport properties, including strong and reproducible non-linearities and current oscillations with dc-voltage [4]. I will also discuss imaging of the charge transport in nanocrystal-based electronic devices. Nanocrystal arrays were investigated using electrostatic force microscopy (EFM) and transmission electron microscopy (TEM) [3]. Changes in lattice and transport properties upon annealing in vacuum were revealed. Local charge transport was directly imaged by EFM and correlated to nanopatterns observed with TEM. This work shows how charge transport in complex nanocrystal networks can be identified with nm resolution [3]. This work was supported by the ONR grant N000140410489, the NSF grants DMR-0449553 and MRSEC DMR00-79909, and the ACS PRF grant 41256-G10.

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