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Measuring electron transport in nano-patterned films of PbS nanocrystals using a charge sensor TAMAR MENTZEL, Massachusetts Institute of Technology, Department of Physics, DARCY WANGER, Massachusetts Institute of Technology, Department of Chemistry, NIRAT RAY, Massachusetts Institute of Technology, Department of Physics, BRIAN WALKER, MOUNGI BAWENDI, Massachusetts Institute of Technology, Department of Chemistry, MARC KASTNER, Massachusetts Institute of Technology, Department of Physics
— The ability to form nanoscale patterns of semiconductor nanocrystal films and to align those patterns to a substrate with nanoscale precision opens the possibility of novel electronic measurements and optoelectronic devices. We demonstrate a novel method for patterning nanoscopic films of semiconductor nanocrystals with electron-beam lithography. The resulting films are ordered and do not suffer from the cracking that arises when annealing or exchanging the capping ligand of the film. The patterning method is effective for a wide range of nanocrystal materials and capping ligands. We pattern a film of PbS nanocrystals approximately 80 nm wide, and position it within 100 nm of charge sensors made from nanoscale metal-oxide-semiconductor field-effect transistors (MOSFETs). The charge sensors, which can measure the fluctuations of individual electrons in the nearby electrostatic environment, are used to measure electron transport in the films as a function of temperature and applied field.

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