Abstract Submitted
for the MAR15 Meeting of
The American Physical Society

Visualization of Exciton Transport in Molecular and Quantum Dot Solids GLEB AKSELROD, PARAG DEOTARE, FERRY PRINS, NICHOLAS THOMPSON, LISA POULIKAKOS, ELIZABETH LEE, MARK WEIDMAN, JOLENE MORK, JIYE LEE, ADAM WILLARD, MARC BALDO, Center for Excitonics, Massachusetts Institute of Technology, VINOD MENON, City College of New York, WILLIAM TISDALE, VLADIMIR BULOVIC, Center for Excitonics, Massachusetts Institute of Technology — Transport of nanoscale energy in the form excitons is at the core of the operation of a wide range of nanostructured optoelectronic devices such as solar cells, light emitting diodes and excitonic transistors. Particularly important is the relationship between exciton transport and nanoscale disorder, the defining characteristic of molecular and nanostructured materials. Here we report a spatial, temporal, and spectral visualization of exciton transport in molecular crystals and quantum dot solids. Using tetracene as an archetype molecular crystal, the imaging reveals that exciton transport occurs by random walk diffusion, with a transition to subdiffusion as excitons become trapped. By controlling the morphology of tetracene, we show that the transition to subdiffusive transport occurs at earlier times as disorder is increased. In colloidal quantum dot films, we show that diffusion does not occur by a random-walk process; instead, energetic disorder causes the exciton diffusivity to decrease over time. Our findings demonstrate that the mechanism of exciton transport depends strongly on the nanoscale morphology and disorder.

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Date submitted: 14 Nov 2014 Electronic form version 1.4