Abstract Submitted
for the MAR14 Meeting of
The American Physical Society

The influence of Auger recombination on the performance of quantum-dot light-emitting diodes[1] JEFFREY PIETRYGA, Los Alamos National Laboratory, WAN KI BAE, Korea Institute of Science and Technology, YOUNG-SHIN PARK, ISTVAN ROBEL, VICTOR KLIMOV, Los Alamos National Laboratory — Colloidal quantum dots are the subject of intense research as fluorophores for light-emitting diodes (LEDs) due to properties such as spectrally narrow, tunable emission and facile processibility via solution-based methods. Continued improvement of LEDs based on quantum dots is restricted by an incomplete understanding of the physics underlying current performance limitations. More specifically, little is known about the influence of multi-carrier processes on overall LED efficiency, and on the reduction of efficiency at high currents (known as efficiency roll-off, or droop). Here, we present an investigation of this issue involving studies that correlate the excited state dynamics of structurally engineered quantum dots with their emissive performance within LEDs. We find that because of significant charging of quantum dots with extra electrons, multi-carrier Auger recombination greatly impacts both LED efficiency and the onset of efficiency roll-off at high currents. We conclude by examining two specific approaches for mitigating this problem using heterostructured quantum dots that either suppress Auger recombination, or that directly address the problem of charge-injection imbalance.

[1]This work was supported by the Chemical Sciences, Biosciences and Geosciences Division of Office of Science, Office of Basic Energy Sciences, US Department of Energy.

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Date submitted: 13 Nov 2013 Electronic form version 1.4