Abstract Submitted
for the MAR14 Meeting of
The American Physical Society

An integrated approach to realizing high-performance liquid-junction quantum dot sensitized solar cells HUNTER MCDANIEL, Los Alamos Natl Lab, NOBUHIRO FUKE, Materials & Energy Technology Laboratories, Corporate Research and Development Group, Sharp Corporation, NIKOLAY MAKAROV, JEFFREY PIETRYGA, VICTOR KLIMOV, Los Alamos Natl Lab — Solution processed semiconductor quantum dot solar cells offer a path towards both reduced fabrication cost and higher efficiency enabled by novel processes such as hot-electron extraction and carrier multiplication. Here we use a new class of low-cost, low-toxicity $CuInSe_xS_{2-x}$ quantum dots to demonstrate sensitized solar cells with certified efficiencies exceeding 5%. Among other material and device design improvements studied, use of a methanol-based polysulfide electrolyte results in a particularly dramatic enhancement in photocurrent and reduced series resistance. Despite the high vapor pressure of methanol, the solar cells are stable for months under ambient conditions, which is much longer than any previously reported quantum dot sensitized solar cell. A study of electron transfer QD/TiO2 interface reveals the process to be surprisingly slow and confirms that methanol does not act as a sacrificial donor. This study demonstrates the large potential of $CuInSe_xS_{2-x}$ quantum dots as active materials for the realization of low-cost, robust, and efficient photovoltaics as well as a platform for investigating various advanced concepts derived from the unique physics of the nanoscale size regime. This work was just accepted to Nature Communications.

Nikolay Makarov
Los Alamos Natl Lab

Date submitted: 14 Nov 2013 Electronic form version 1.4