Abstract Submitted
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Progress Developing Hybrid Silicon Quantum Dot/Amorphous Silicon Thin Films for Photovoltaics Application[1] TIANYUAN GUAN, JEREMY FIELDS, GRANT KLAFEHN, CHITO KENDRICK, ROBERT LOCHNER, ZAHRA NOURBAKHSH, MARK LUSK, Colorado School of Mines, PAUL STRADINS, National Renewable Energy Laboratory, CRAIG TAYLOR, REUBEN COLLINS, Colorado School of Mines — Quantum confined (QC) nanostructures exhibit novel, size tunable, quantum mechanical phenomena and their use in solar cell architectures may yield significant efficiency gains. We demonstrate QC hybrid silicon nanocrystal(nc-Si:H) – hydrogenated amorphous silicon (a-Si:H) structures, which can potentially serve as photo-stable, thin film silicon, solar cell materials and provide higher open-circuit voltage compared to conventional materials. We deposit a/nc-Si:H films sequentially, where nc-Si:H and a-Si:H are grown layer-by-layer using separate plasma reactors in a common deposition chamber. X-ray diffraction, Raman spectroscopy, and electron microscopy results confirm the nanoparticles are the appropriate size to achieve QC (3-7nm). Photoluminescence spectroscopy reveals the QC. Co-planar electrical probe experiments investigate carrier transport in a/nc-Si:H, which could be limited by defects accompanying plasma interruption in the sequential deposition process. Defect spectroscopies, such as electron paramagnetic resonance and photothermal deflection spectroscopy are used to study this relationship. These studies reveal material quality limitations to be addressed for realizing film silicon materials that harvest QC to enhance PV device performance.

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