Abstract Submitted
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Design, fabrication and characterization of rugged, high-performance quantum dot photocathodes[1] JEFFREY PIETRYGA, ISTVAN ROBEL, NIKOLAY MAKAROV, JAEHOON LIM, QIANGLU LIN, JOHN LEWELLEN, NATHAN MOODY, Los Alamos National Laboratory — Semiconductor nanocrystal quantum dots (QDs) are bright, tunable fluorophores used as, e.g., biolabels and downcoverting phosphors. Such applications make use of over three decades in advances in techniques for overcoming the natural tendency of these materials toward losing photoexcited carriers to surface defect states or to ionization. Ironically, QDs first gained attention as a material class for use in photocatalysis, which uses QD photoionization to drive redox reactions. Here, we explore the use of QDs in an alternative application that also exploits photoionization, namely within photocathodes for the electron guns that will enable next-generation light sources. We evaluate the efficiency of electron photoemission of conductive, solution-cast QD films of a variety of compositions in a typical electron gun configuration. By quantifying photocurrent as a function of excitation photon energy, excitation intensity and pulse duration, we demonstrate efficiencies superior to standard copper cathodes in films that are more robust against oxidation. Finally, we establish the dominant mechanism responsible for electron emission in the multi-photon excitation regime, which suggests numerous pathways for further enhancements.

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