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Hybrid passivated colloidal quantum dot solids for photovoltaics<sup>1</sup> SUSANNA M. THON, ALEXANDER H. IP, SJOERD HOOGLAND, OLEK-SANDR VOZNYY, DAVID ZHITOMIRSKY, RATAN DEBNATH, LARISSA LEV-INA, LISA R. ROLLNY, GRAHAM H. CAREY, ARMIN FISCHER, KYLE W. KEMP, ILLAN J. KRAMER, ZHIJUN NING, ANDRÉ J. LABELLE, Department of Electrical and Computer Engineering, University of Toronto, KANG WEI CHOU, ARAM AMASSIAN, Physical Sciences and Engineering Division, King Abdullah University of Science and Technology (KAUST), EDWARD H. SARGENT, Department of Electrical and Computer Engineering, University of Toronto — Colloidal quantum dot (CQD) films are an attractive photovoltaic material due to their largearea-compatible solution processing and bandgap tuning through the quantum size effect. However, the large internal surface areas make CQD films prone to high trap state densities, leading to recombination of charge carriers. We quantify the density of midgap trap states in PbS CQD solids and show that the current photovoltaic performance is limited by these states. We develop a robust hybrid passivation scheme that involves introducing halide anions during the end stages of the synthesis process, which can passivate trap sites that are inaccessible to much larger standard organic ligands, and combine this with an organic crosslinking strategy to form the film. We use our hybrid passivated CQD solid to fabricate a solar cell with a certified efficiency of 7.0%, which is a record for a CQD photovoltaic device.

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