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The Potential for Hot Carrier Collection from an Amorphous Semiconductor[1] REUBEN COLLINS, Colorado School of Mines, KRISTIN KIRILUK, Abengoa Solar, JEREMY FIELDS, BRIAN SIMONDS, LEVI MILLER, YU-PAN PAI, Colorado School of Mines, TINING SU, BAOJIE YAN, JEFFREY YANG, SUBHENDU GUHA, United Solar Ovonic, LLC, ARUN MADAN, MVSystems, Inc., CRAIG TAYLOR, Colorado School of Mines — The quest for clean, inexpensive sources of energy has produced intense interest in low-cost methods for dramatically increasing the efficiencies of solar cells. One such method is to collect carriers before they lose energy to heat. Here we present strong evidence for such hot carrier transfer in an unlikely place, between the amorphous and crystalline regions of nanocrystalline Si. Nanocrystalline Si is a thin film photovoltaic material formed of Si nanocrystallites imbedded in a hydrogenated amorphous Si matrix. Using a combination of photoluminescence quenching and electron spin resonance measurements as a function of nanocrystalline fraction, we observe clear evidence that above a critical fraction carriers excited in the amorphous region transfer to the nanocrystals rather than relaxing to band tail states of the amorphous silicon matrix. The average nanocrystallite spacing is consistent with estimates of the distance hot carriers can transfer in amorphous silicon before thermalization. This result has implications that extend from improving the stability of amorphous silicon under optical illumination to the development of a new paradigm in solar cell design using nanostructured amorphous absorbers.

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