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Light-induced thermodynamic metastability in amorphous silicon
DANIEL QUEEN, JULIE KAREL, FRANCES HELLMAN, University of California, Berkeley, QI WANG, RICHARD CRANDALL, EUGENE IWANICZKO, National Renewable Energy Lab — The efficiency of amorphous silicon photovoltaics is limited due to the generation of dangling bond defects upon light soaking which leads to a decrease in their efficiency known as the Staebler-Wronski Effect. These defects act as recombination centers for photoexcited electron-hole pairs and can be reversibly removed by annealing above 150 $^\circ$C. The electrical properties of these defects are well documented but the mechanism that gives rise to them is still an open question. It is known that hydrogen plays a crucial role in their formation and recovery but it is not clear if hydrogen participates in the defect formation. We present heat capacity data for a-Si:H films grown by the Hot-Wire CVD (HWCVD) technique and a-Si films grown by e-beam evaporationand measured using our MEMS based nanocalorimeter. Both materials have an excess heat capacity observed upon light soaking that is reversibly removed by annealing at 200 $^\circ$C. This excess is found to be independent of H content in the HWCVD films and is present but at a smaller magnitude in the e-beam evaporated a-Si. The lack of dependence on H content and the presence in the e-beam films indicates the light induced metastability is intrinsic to the amorphous silicon matrix.

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