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Effects of the Back Reflector on the Optical Enhancement Factor and Quantum Efficiency of a-Si:H p-i-n Solar Cells

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Abstract: The effect of tin oxide (SnO_2) texture and back reflector (BR) on optical enhancement factor has been extensively investigated in a series of 4 a-Si:H p-i-n solar cells. The internal quantum efficiency QE in the wavelength range 550--750 nm has been analyzed using an optical model. The optical enhancement factor m, which is a wavelength-dependent fitting parameter, represents the increase in optical pathlength relative to the i-layer thickness. Our solar cells, at low or high haze SnO_2 with an Al BR, have negligible optical enhancement, m < 1.5, representing failure to obtain multiple reflections. This is consistent with large parasitic absorption at the Al/Si interface. Our solar cells at high haze SnO_2 with ZnO/Al or ZnO/Ag BRs have peak values of m \sim 3-4, with ZnO/Ag having slightly larger values than ZnO/Al. The maximum values of m , and thus the QE increase with reflectivity of the BR, indicates that efficient light trapping needs a very reflective BR to minimize parasitic absorption losses with each pass.

Key Words: amorphous (a-) Si:H p-i-n solar cells, back reflectors, light trapping, quantum efficiency.

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