# Intensity dependence of quantum efficiency and photo-gating effects in thin film silicon solar cells

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**Abstract**

Steady-state photoconductivity measurements have been carried out on thin-film silicon pin structures of i-layer thickness typically 4 mu m, where crystalline composition has been varied by adjustment of the silane concentration in the process gas. In amorphous and low-crystallinity cells, strongly-absorbed light incident from the p-side at photon fluxes in excess of 10(14) cm(-2) s(-1) produces strongly sub-linear intensity dependence, 'S' shaped reverse current-voltage curves and amplification of a second weakly-absorbed beam, termed photogating. These effects are linked to the formation of space charge and attendant low-field region close to the p-i interface, as confirmed by computer simulation. More crystalline devices exhibit little or no such behaviour. At lower intensities of strongly-absorbed light there is a markedly steeper increase in reverse current vs. voltage in low-crystalline when compared to amorphous cells, particularly with light incident from the n-side. This suggests the mobility-lifetime product for holes is much larger in the former case, consistent with the higher hole mobilities reported in time of flight studies. Thus the prospect of composition-dependent changes in mobility as well as defect density should be borne in mind when developing materials for application in microcrystalline silicon solar cells.

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