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## Complementary Photogating Effect in Microcrystalline Silicon n-i-p Structures

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**Abstract:** Spectral responses above the unity at short wavelengths have not been yet reported in  $\mu\text{c-Si:H}$  based n-i-p devices illuminated with a red bias light. In solar cells this effect is known as the Complementary Photo-Gating Effect. After calibrating the input parameters of our computer code by matching experimental output device characteristics, the necessary conditions to predict these anomalous responses at short wavelengths were explored. In order to obtain SR higher than unity at short wavelengths in  $\mu\text{c-Si:H}$  n-i-p devices under red bias illumination a highly defective buffer layer must be present at p/i interface. The short wavelength a.c. probe beam modulates the carrier concentration trapped at the gap states of the defective interface strengthen the electrical field in the intrinsic layer and weaken the electrical field inside the p-doped and p/i buffer layers. The short wavelength a.c. probe beam reduces the total recombination loss inside the intrinsic layer with respect to its counterpart under only red bias light illumination generating a net gain and spectral responses over unity. This phenomenon is predicted in devices with either high or low mobility (p)-layers, such as (p)-a-SiC:H and (p)- $\mu\text{c-Si:H}$  respectively, that are not very efficiently doped with boron. Spectral responses higher than one are very sensitive to the electrical parameters of the p/i defective buffer such as mobility gap, thickness, density of defects, mobilities, capture cross sections of donor traps, and to the Boron density present in the p-layer and to the spectral content of the red bias light.

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