IMPACT OF EXCESS CHARGE CARRIER CONCENTRATION ON EFFECTIVE SURFACE RECOMBINATION VELOCITY IN SILICON PHOTOVOLTAIC STRUCTURES

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S u m m a r y

Within the framework of a self-consistent approach, a special attention is paid to the impact of the density and polarity of a surface charge formed at the insulator-semiconductor interface on the effective surface recombination velocity S_{eff}. The parameters of surface recombination centers, as well as the concentrations of doping impurities and excess charge carriers in the emitter and base regions of a solar cell (SC), are taken into consideration. It is shown that the passivation of a rather weakly doped emitter or a base region by a dielectric film containing a built-in charge of the same polarity, as the polarity of majority charge carriers in the substrate, can result in a catastrophically high increase of surface recombination losses. At the same time, the formation of the accumulation or inversion layers at the surface essentially reduces the effective surface recombination velocity S_{eff} at low injection levels. The slope of $S_{\text{eff}}(\Delta n)$ curves can be both positive and negative depending on the density and polarity of a surface charge. However, in the region of very high injection levels, S_{eff} ceases to depend on the injection level and the SC design and is defined only by the parameters of surface recombination centers.