Facile Grown Oxide Based Passivation for Silicon Heterojunction PV Cells

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High efficiency (~25%) hydrogenated amorphous silicon (aSi:H) - crystalline silicon (cSi) heterojunction photovoltaic (PV) devices have been fabricated using all low temperature processing. The low thermal budget based fabrication process is deemed suitable for ultra-thin silicon wafers which would further reduce the material cost and potentially make this technology a subsidy free energy resource. Nevertheless, the passivating hydrogenated amorphous silicon layers deposited on cSi surfaces are a source of parasitic optical absorption loss and do exhibit light induced degradation.

We have recently developed alternative low temperature passivation and fabrication schemes based on facile grown oxide and PECVD silicon nitride dual layers. Specifically, we have attained a surface recombination velocity as low as 8 cm/sec which is comparable to state-of-the-art passivation schemes used for crystalline silicon. We have successfully implemented the new passivation scheme in aSi:H-cSi heterojunction devices. A maximum cell efficiency of 16.7% has been achieved for proof-of-concept cells using untextured crystalline silicon under AM 1.5 solar irradiation.

The paper will be present a detailed study of the passivation characteristics as a function of the passivation material parameters. Also, various techniques that can be used to equivalently produce high quality facile grown oxide based passivation will be discussed. Experimental results on the stability of the passivation materials against light exposure will be reported.

Keywords: Passivation, Amorphous silicon, Crystalline silicon, Native oxide, PECVD Silicon nitride