PASSIVATED MOLYBDENUM OXIDE CONTACTS FOR CRYSTALLINE SILICON SOLAR CELLS

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Wide bandgap semiconducting metal oxide as a full-area rear-contact offers a great potential to further increase the efficiency of c-Si solar cells. This type of the contact can potentially remove individual recombination that contributes from the metal or diffused region in direct contact with c-Si, producing higher open-circuit voltage ($V_{oc}$) in Si solar cells. In this work, we examine MoOₓ films via thermal evaporation as a full-area rear contact to crystalline p-type Si solar cells for efficient hole-selective contacts. Prior to front- and rear-metallization, the implied open-circuit voltage (i$V_{oc}$) is evaluated to be 646 mV with an implied fill factor (iFF) of 82.5% for the tunnel SiOₓ/MoOₓ rear contacted cell structure with the passivated emitter on the textured surface, showing it is possible to achieve an implied one-sun efficiency of 20.8%. Numerical simulation reveals that the electron affinity ($\chi$) of the MoOₓ material strongly influences the performance of the MoOₓ contacted p-Si cell. Simulated band diagrams show that the values in $\chi$ of the MoOₓ layer must be sufficiently high in order to lower junction recombination, indicating that the highest efficiency of 21.1% is achievable for a high $\chi$ of 5.6 eV of MoOₓ films and back surface recombination velocity of <100 cm/s at p-Si/MoOₓ. For the p-Si solar cell featuring passivated emitter and MoOₓ/Al rear-contact, the cell $V_{oc}$ and $J_{sc}$ were measured at 606 mV and 37 mA/cm² under AM1.5G (100 mW/cm²). An enhancement in cell performance will be presented for the p-Si cell with MoOₓ/Al rear contact using electroplated Cu front metallization.