On sputter damage of silicon heterojunction solar cells and its recovery by illuminated annealing

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Mechanisms of plasma damage caused by sputtering of transparent conductive oxide (TCO) layers in silicon heterojunction (SHJ) solar cells have been investigated. It is shown that a buffer layer at the amorphous/crystalline silicon (*a*-Si/*c*-Si) interface can play an essential role in mitigating the sputter damage. More than $9\%_{abs.}$ loss in the conversion efficiency is observed for rear emitter SHJ cells with nanocrystalline silicon *n*-layer when the underlying buffer layer changes from amorphous silicon carbide to amorphous silicon. It is revealed that the anomalous efficiency loss is mostly related to breaking Si-H bonds by NUV photons at the *a*-Si/*c*-Si interface during the TCO sputtering. Illuminated annealing of these cells at elevated temperature using a distributed light source based on light emitting diodes (LEDs) recovers the anomalous efficiency loss by more than $7\%_{abs.}$ Other possible mechanisms of sputter damage and mitigation strategies are also discussed.

Keywords: magnetron sputtering, transparent conductive oxide, *a*-Si/*c*-Si interface, surface passivation, conversion efficiency.

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