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Structural Evolution of Nanocrystalline Silicon in Hydrogenated Nanocrystalline Silicon Solar Cells

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Abstract

We deposited hydrogenated nanocrystalline silicon (nc-Si:H) thin films and n-i-p solar cells onto flexible stainless steel substrates through the plasma-enhanced chemical vapor deposition (PECVD) method to investigate the effects of n-doped layers with different crystallinity on the structural evolution of the subsequent intrinsic nc-Si:H layers. The n-doped layers with various crystalline volume fractions were formed by changing the hydrogen dilution ratios. The structural characteristics of the nc-Si:H thin films were tested using transmission electron microscopy (TEM) and Raman scattering measurements. Intrinsic nc-Si:H layers, with an incubation layer up to 200 nm, were observed deposited on low crystallinity n-doped layers during the initial growth stage. Increasing the crystallinity of n-doped layers helps reduce the thickness of the incubation layers at the n/i interface and improves the microstructure homogeneity of i-layers. The experimental results demonstrate that the short circuit current density and fill factors of solar cells can be greatly improved by