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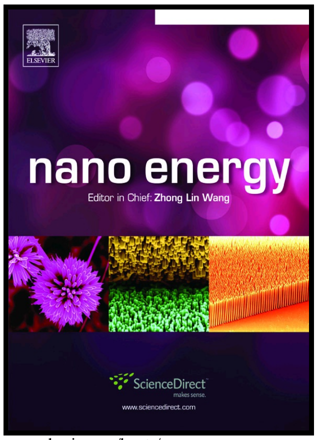

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Improved Amorphous Silicon Passivation Layer for Heterojunction Solar Cells with Post-Deposition Plasma Treatment

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Abstract

In numerous silicon semiconductor devices, an important task is to suppress charge carrier recombination at surface dangling bonds. In solar cell business, silicon heterojunction with intrinsic thin film (SHJ) solar cells is one of the major research topics to investigate and optimize such interface defect states. The aim of this work is to further optimize SHJ solar cells by post-deposition argon plasma treatment (APT) and to demonstrate the origin of material improvement compared to hydrogen plasma treatment (HPT). We analyze the influence of post-deposition APT and HPT on the surface of 10 nm thick intrinsic hydrogenated amorphous silicon (i-a-Si:H) layers and show the influence of this advanced post-deposition passivation technique on SHJ solar cells. For the first time a detailed study is presented here which could be also applied to several other techniques.
The results demonstrate that our approach of post-deposition plasma treatment distinctly optimizes the i-a-Si:H/c-Si interface by restructuring the i-a-Si:H layer itself. It is discussed that argon or hydrogen plasma treatment steps applied to a-Si:H/c-Si structures can lead to an improved chemical passivation. Other than expected, APT shows beneficial effects by increasing significantly the minority carrier lifetime, material compactness and the splitting of quasi-Fermi levels compared to HPT. We also discuss the origin of enhanced interface properties after post-deposition APT and fabricated 2×2 cm^2 lab cells with an outstanding increase in open-circuit voltage compared to reference cells without APT, to a maximum of 720.5 mV.

Keywords: a-Si, PECVD, interface, SHJ, argon, hydrogen

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