1 µm-thin crystalline silicon solar cells with amorphous-ordered nanotextures (PhotoNVoltaics project)

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Thin film crystalline silicon solar cells have drawn attention in the last years as they enable drastic reduction of material usage and global cost reduction. As the absorber layer thickness is reduced, advanced light-trapping schemes are required to enhance light absorption in ultrathin solar cells. As an alternative to periodic approaches and conventional random pyramid texturing, amorphous nanostructures with a short-range order have been studied and shown to combine efficient light-trapping and wide-angle broadband absorption. Here we present the integration of amorphous nanotextures in micron-thin crystalline silicon solar cells on glass using large-area and industry-compatible processes.

Our approach relies on the combination of (i) an amorphous-ordered photonic texture on the front side obtained combining colloidal lithography with dry etch [1,2] and (ii) a microcrystalline silicon oxide layer to ensure passivation of the rear contact of the cell [3]. The 1 µm-thin crystalline silicon absorber layer is fabricated with the « epifree » process and then transferred to a glass substrate. We demonstrate both enhanced light absorption and better electrical properties than the flat reference cell. We report a record conversion efficiency of 8.6 % for a nanostructured cell with a final effective thickness below 1 µm.

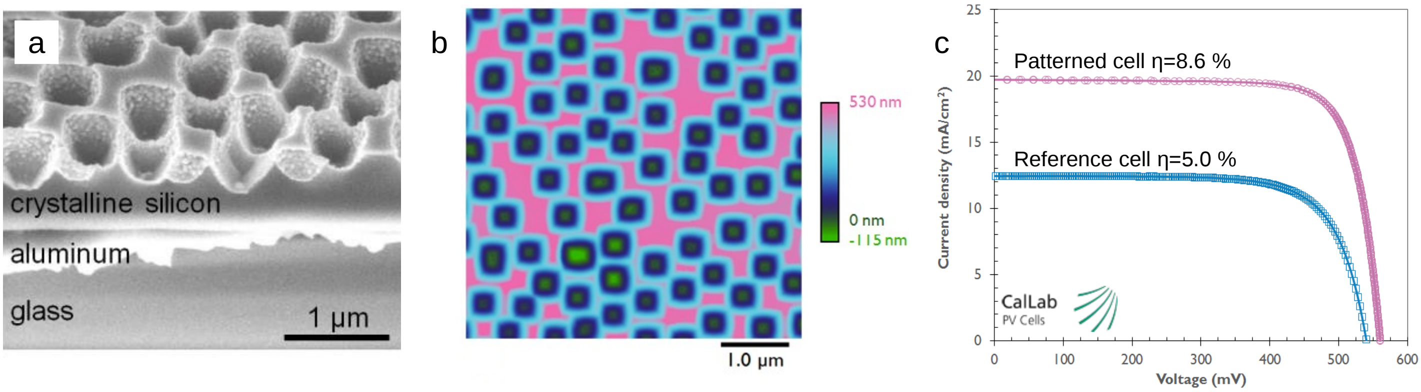

Figure 1: a) SEM image of the nanostructured cell cross-section. b) Top-view of the amorphous-ordered nanotexture (AFM, height profile). c) J-V characteristics of the best nanotextured cell (confirmed by ISE CalLab) vs the best reference flat cell.

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References

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