

Flexible Lightweight Advanced Materials In Next Generation Of PV

Publieke samenvatting / Public summary

Aanleiding

Flexible and lightweight thin film Si photovoltaics (PV) offer new application possibilities in BIPV products such as roofing membranes, corrugated plates, and façade elements, as well as in large scale utility power plants especially in floating applications. Additional product benefits, easy sizing in length of the module as well better energy yield compared to c-Si are unique selling points. Furthermore, lightweight and flexible PV products allow for completely different system designs and thereby much lower balance of system cost than higher efficiency c-Si modules, resulting in highly competitive system prices, even at an extrapolated c-Si module price of 0.24 €/Wp. The use of moisture resistant materials such as SnO₂:F and silicon itself result in good reliability. The fact that no moisture barrier is needed in the encapsulation materials is key in achieving low material costs. HyET Solar wants to achieve module efficiencies of $\approx 12\%$ in production and demonstrate low-cost, roll-to-roll manufacturing on a 37.5 MWp/yr scale in the Netherlands in preparation of -multiple - 300 MWp/yr production factories world-wide. Beyond the 1 GWp/yr production costs are below 0.20 €/Wp.

Doelstelling

In the development of the HyET Solar technology many Dutch universities (TU Delft, TU/e, UU) and research institutes as TNO and ECN were and are involved. The unique production sequence and IP portfolio makes it unlikely that this technology will be copied.. The goal of FlamingoPV is to increase

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the module efficiency of HyET Solar from 10% in a 330 mm wide product to above 12% in a 1300 mm wide product on a commercial interesting production scale of 37.5 MWp/yr in the Netherlands, thereby decreasing turnkey PV system costs. The product energy yield and reliability will be extensively tested to convincingly. As energy yield and product reliability are key to investors, the long lifetime must be convincingly shown for this next generation PV product, especially in view of its use in BIPV. The production capacity will be limited by the PECVD tool that deposits the bottom cell. The design of a next machine generation is required for the future expansion of the production capacity to 300 MWp/yr. The targeted record efficiencies on lab scale of 13% for dual junction modules and 14% for triple junctions will allow to further improve the module efficiencies in the future.

Korte omschrijving

Inspired by micromorph cells record efficiencies achieved at TU Delft on glass substrates, the micro-texture of the temporary aluminum foil used as substrate in the HyET Solar production line is optimized, enabling the realization of modulated surface texture (MST) front electrodes. The efficiency of HyET modules is further enhanced by targeted improvements of the transparent conductive oxide layer and p-doped Si window layer. In order to achieve higher stabilized performance and better spectrum utilization, amorphous silicon (a-Si:H)/nano-crystalline silicon (nc-Si:H)/nc-Si:H triple junction will be developed. After testing & characterization on lab-scale at TU Delft, processing is upscaled at HyET Solar and the MST and triple junction configuration is integrated. The mechanisms & kinetics of module degradations in accelerated lifetime tests and outdoor conditions is compared and used to predict the product energy yield over lifetime by TU Delft & HyET Solar. Finally, the existing PECVD bottom cell deposition tool design is reviewed and modified for series production at lower investment costs by HyET Solar as it is the most expensive machine.

Resultaat

The deliverables of FlamingoPV are: • WP1: Lab-scale flexible a-Si:H/nc-Si:H PV cell (5 cm²) and module (5×5 cm²) with 13% stabilized module efficiency. • WP2: Roll-to-roll produced modules of 30x30 cm² of 12% aperture area stabilized efficiency with 80% production yield • WP3: Industry standard lifetime (>80% initial performance) convincingly proven for lifetime > 35 years. • WP4: Design and cost model for bottom cell PECVD tool with CAPEX < 0.2 MEuro/MWp. • WP5: Lab-scale flexible a-Si:H/nc-Si:H/nc-Si:H PV cell (5 cm²) and module (5×5 cm²) with 14% stabilized module efficiency. The combination of these deliverables will result in a PV product that will be competitive with state-of-the-art c-Si modules for large scale power plants and will have the potential to dominate the BIPV market. Parallel to this project and on commercial basis, the improved products will be used for market development projects with key customers. Names of these customers are available upon request.

De data in deze applicatie is afkomstig van de Rijksdienst voor Ondernemend Nederland (RVO) en wordt in samenwerking met de Topsector Energie ontsloten.

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