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NON-CONFIDENTIAL DISCLOSURE

NSi NewSouth Innovations

Novel polycrystalline silicon thin-film solar cell technology on glass (ALICE)

Background:

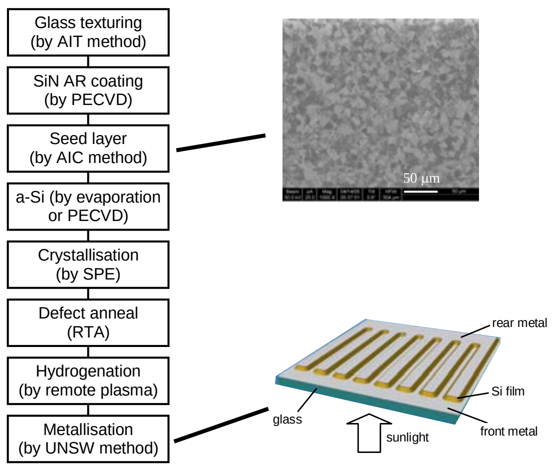
Polycrystalline silicon (poly-Si) thin-film solar cells on glass are attractive because they have the potential to merge the strengths of silicon wafer based PV technologies (efficiency, long-term stability) with the cost advantages of thin-film technologies (large-area processing, monolithic construction), thereby lowering the cost of PV electricity. Recent years have seen excellent progress with poly-Si thin-film solar cells on glass, and the first commercial modules are now made by CSG Solar. The CSG technology uses solid phase crystallisation (SPC) of PECVD-deposited a-Si and achieves mini-module efficiencies of over 9%. The estimated manufacturing costs of large-area CSG modules are about 1.5 €/Watt.

What is the ALICE technology?

To further improve the efficiency and cost-effectiveness of poly-Si thin-film solar cells on glass, the electronic quality and the grain size of the poly-Si material needs to be enhanced. To this end, we have developed and patented a novel thin-film solar cell technology (ALICE). **The key feature of ALICE solar cells is a thin (~100 nm), large-grained (> 10 μm) poly-Si seed layer fabricated on glass by means of the AIC (aluminium-induced crystallisation) method.** In the AIC method, an a-Si/Al bilayer on a SiN-coated glass sheet is heat treated at 500°C. The thin a-Si layer is formed by dc magnetron sputtering or PECVD. Due to the presence of Al in the crystallisation process, these AIC seed layers are large-grained and of p-type conductance. Compared to AIC films reported in the literature, our research has led to AIC films with greatly superior surface finish, crystal quality, and density of pinholes and Al inclusions. A microscope image (plan view) of an AIC seed layer fabricated by us on planar glass is shown in the graph.

The seed layer then serves as the foundation for the fabrication of the remaining parts of the solar cell. These are fabricated by depositing a 1-5 μm thick amorphous silicon precursor diode (for instance p^+nn^+) onto the AIC seed layer, followed by crystallisation of the a-Si by **solid-phase epitaxy (SPE)**, post-deposition treatment of the samples (defect anneal, hydrogenation), and metallisation. The entire process sequence of ALICE poly-Si thin-film solar cells on glass is listed in the graph. The substrates are commercially available borosilicate glass sheets. They are textured on the Si-facing surface of the glass to reduce reflection losses and improve light trapping in the silicon film. The texture is realized with our patented AIT method (aluminium induced texture) and consists of a random array of sub-micron sized dimples. Contacting of the solar cells is realised with a metallisation method developed and patented by us. The thickness of the silicon film in ALICE solar cells is in the range 1-5 μm. Silicon deposition occurs with PECVD or, preferably, electron-beam evaporation. The latter is attractive due to the very high silicon deposition rate, enabling an in-line deposition tool.

Process sequence ALICE



Commercial opportunity:

Research at UNSW on ALICE has progressed to the proof-of-concept stage for the individual fabrication steps of the new solar cell technology, with voltages now approaching 500 mV. The time has come where the individual steps need to be combined, optimised, and evaluated. This is best performed in a **pilot line facility** where a reasonable number of mini-modules are produced and tested each week. The goal would be to realise mini-modules with efficiency of over 10%. NewSouth Innovations is seeking a partner who is interested in undertaking collaborative research to develop this advanced thin-film PV technology to the point of large-scale industrial manufacturability.

Further Information:

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