OR0401

Plasma-technological barrier layers for flexible thin film solar modules

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The aggressive pricing on the world market opposes the production of photovoltaic (PV) applications in Europe - and especially in Germany – facing the challenge of producing cheaper products. Novel PV concepts based on solar modules with copper indium gallium di-selenide (CIGS) technology manufactured on flexible and cost effective substrates such as metal foils with functional barriers can withstand the pressure of the market due to the technological lead. Plasma-technological processes for cleaning, activation and coating in particular contribute to this success. Nonetheless, the need to stay ahead of the competition by continuous innovations is evident.

A plasma-technological high-rate coating process of insulating SiO_x layers on metal foils is presented. This incremental step in CIGS solar module production could be an important contribution for further cost reduction. The challenge of the plasma-based layer is to electrically insulate the metal foil, and to protect the sensitive CIGS absorber layer against the diffusion of iron from the substrate, while maintaining the full flexibility of the solar module. In addition, the layers must withstand process temperatures of up to 650 °C during the subsequent CIGS deposition. Finally, the dielectric should not be affected by the laser scribes needed to fabricate monolithically integrated modules.

The insulating SiO_x layers are deposited from hexamethyldisiloxane (HMDSO) via a low-pressure chemical vapour deposition process fed by a microwave plasma (MW-PECVD). The plasma source used is the Duo-Plasmaline which generates a homogeneous plasma within an array configuration. The high rate deposition of up to 60 µm/min keeps the process times very short and is therefore suited for industrial applications.

Efficient insulation layers on steel foils of an area of 7 x 9 cm² were already deposited and a monolithically integrated CIGS module with a conversion efficiency of up to 10.2 % could be achieved so far.

Keywords
high rate deposition
microwave plasma
Duo-Plasmaline