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Published in: Proceedings of the 33rd European Photovoltaic Solar Energy Conference and Exhibition

Publication date: 2017

Document Version
Publisher's PDF, also known as Version of record

Citation (APA):

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INDOOR MEASUREMENT OF ANGLE RESOLVED LIGHT ABSORPTION BY ANTIREFLECTIVE GLASS IN SOLAR PANELS

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Introduction

The effect of the angle of incidence (AOI) on the optical properties of the cell is considerable for AOI larger than 45° and needs to be taken into account when assessing performance of solar cells, including the antireflective (AR) glass.

In this work, we normalize the relative short circuit current to a cosine response thereby isolating the optical effect of the glass-air interface. This form of data presentation is frequently described as the "incidence angle modifier" (IAM) and is used in PV modelling programs such as PVsyst.

Experimental Method

A laser driven light source (LDLS):
• Off-axis parabolic mirror for collimation
• Angular divergence of about 0.1°

Setup Top view Schematic

Setup Photography

Samples

Bare Cell Smooth Glass Diffuse Glass
Smallest AR structure Intermediated AR structure Biggest AR structure

Simulations

• IAM data were used to create unique PV module files in PVsyst.
• Energy production of a 10 kWpeak grid-tied system.
• The locations selected so as to span a variety of latitudes.
• PV balance of system (BOS) was also kept constant in all simulations.
• A fixed-tilt rack relative to a horizontal plane was equivalent to the location’s latitude.

Summary of monthly DC energy production estimates when the seven glass types are used across four locations.

Conclusions

• The results indicated that the different AR glasses present diverse optical effects from angles intervals between 0 – 45° and 60 – 90°.
• PVsyst simulations showed that Diffuse Glass sample can improve monthly yields by as much as 2% relative to Structured Glass 2 sample.
• Based on the PVsyst simulations, we consider the setup presented a valuable tool for indoor measurements of the IAM i.e. the angular performance on solar cells and mini modules.

References


Outlook

• Round Robin between other laboratories with AOI cell testing indoors and outdoors, for a comprehensive setup validation.
• Modelling of different glass types on BIPV systems, where the installed tilt angle does not allow for receiving the optimal amount of solar irradiance.