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

Mekbib W. Amdemeskel¹, Gisele A. dos Reis Benatto¹, Nicholas Riedel¹, Beniamino Iandolo², Rasmus S. Davidsen², Ole Hansen², Peter B. Poulsen¹, Sune Thorsteinsson¹, Anders Thorseth¹, Carsten Dam-Hansen¹

¹Department of Photonics Engineering, Technical University of Denmark, Frederiksborgvej 399, 4000 Roskilde, Denmark
²Department of Micro- and Nanotechnology, Technical University of Denmark, Ørsteds Pl., 2800 Kongens Lyngby, Denmark

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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 anti-reflective (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.

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**Experimental Method**

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

**Setup Top view Schematic**

- Sample holder stepper motor
- Short circuit current ($I_{sc}$) measuring transducer

**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.**

- **Copenhagen (55.7°N)**
- **Rome (41.8°N)**
- **Miami (25.8°N)**
- **Nairobi (1.3°S)**

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**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.

**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.

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**References**