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.

Results
After \( I_{SC} - AOI \) measured:
- Area correction for angles >±75°
- Normalized to AOI = 0°

Since we used a collimated light source, we neglected the diffuse component.

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.

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.

References