Australian Government
Australian Renewable Energy Agency

ARENA

Lessons Learnt

Lessons Learnt Report: *Impact of the optical properties of a backsheet material on the power output of a solar module*

Project Name: *Photovoltaic Modules for the Australian Environment (PV-MATE)*

Knowledge Category:	Technical
Knowledge Type:	Technology
Technology Type:	Solar PV
State/Territory:	Canberra ACT, Adelaide ACT

Key learning

We developed a method to determine the angular reflection of backsheet materials after being laminated in a module compound. We found the backsheets to reflect the light close to lambertian. We calculated the impact of lambertian vs direct reflecting backsheets to have a maximum impact on the STC power output of 0.7%.

Implications for future projects

The generated data can be used as input for optical simulation modules to determine the impact of module embedding on the overall power output of a module.

Knowledge gap

We proofed that the backsheets keep their lambertian light distribution after being laminated into a module. The optical properties of backsheets were only known being surrounded by air which is unrealistic since backsheets are part of a module laminate. We the method we developed we found a way to directly measure the reflectance distribution.

Background

Objectives or project requirements

We have investigated a variety of different backsheet material according to their total and angular reflectance inside a module compound. Based on this we determined the impact on the internal light recycling in a module.

Process undertaken

We used a semi-circle glass cylinder on which we laminated the backsheet materials. This semi-circle cylinder allowed us to directly measure the distribution of reflected light on the rear side of a layer structure.

Supporting information

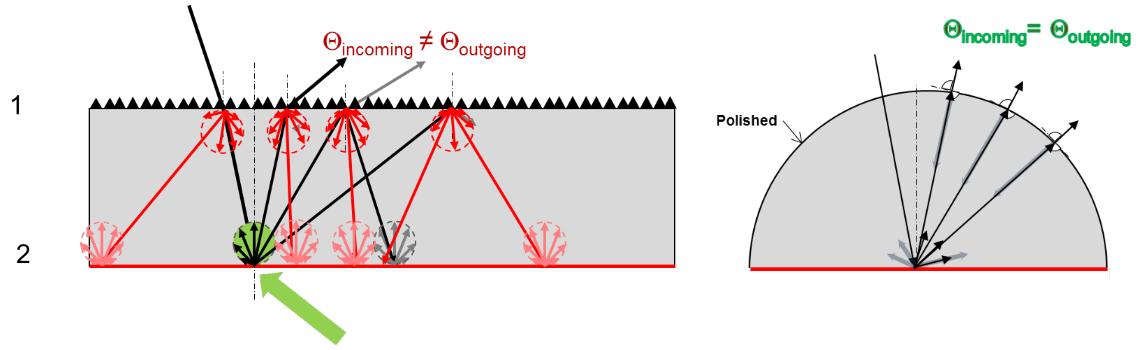


Fig. 1: Illustration of a light ray reflected at the backside of a plane-parallel laminate (left) and a semi-circle glass laminate (right). Whereas the latter guides the reflected light out of the glass/air interface without changing the angle, the plane-parallel laminate causes multiple internal reflections and modifies the outgoing angle.

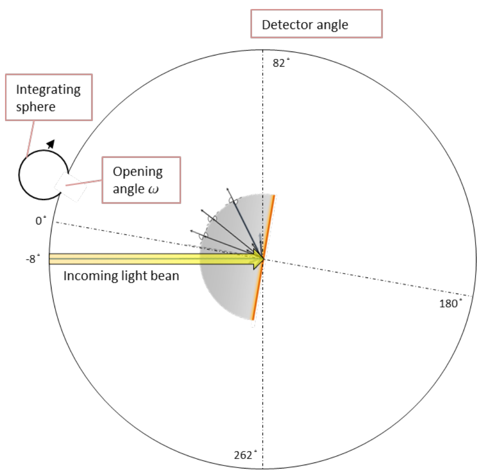


Fig. 2: Automated reflectance/transmittance analyser (ARTA) which consists of a directional moving integrating sphere embedded in a spectrophotometer setup. The sample is placed in the centre and is rotated by 8° to allow detection of specular reflected light.

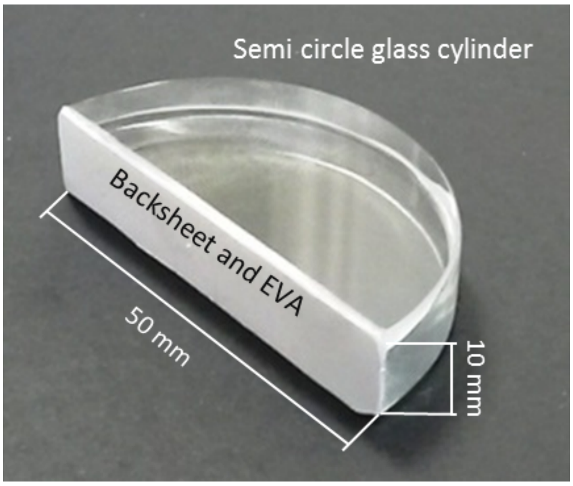
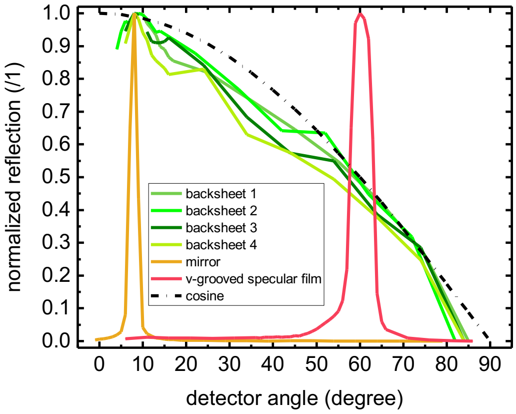


Figure 3: Photograph of the semi-circle glass cylinder with a white backsheet laminated on the flat side of the sample and including relevant dimensions.



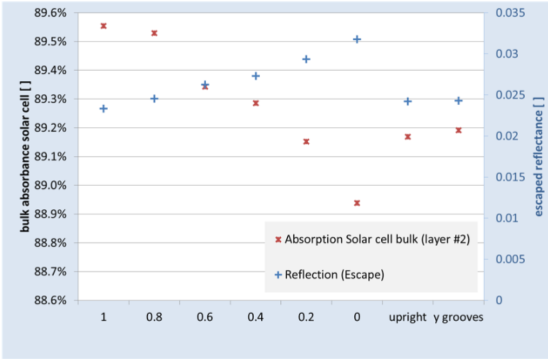


Fig. 1. Normalised angular reflectance of four different backsheet types, one mirror and a light redirecting v-grooved ribbon. Whereas the backsheets show a nearly Lambertian scattering (compare against dashed cosine reference curve) the mirrors reflect the light predominantly specular.

Fig. 2. Absorption of a solar cell for a backsheet with a fully lambertian light distribution (x value =1) and a fully direct reflection (x value =0) and for a v grooved and pyramidal textured backsheet. We calculated the impact of lambertian vs direct reflecting backsheets to have a maximum impact on the STC power output of 0.7%.