The Preconditioning Effect of Uncured EVA Rolls on the Long-Term UV Exposure of Glass/Glass Modules

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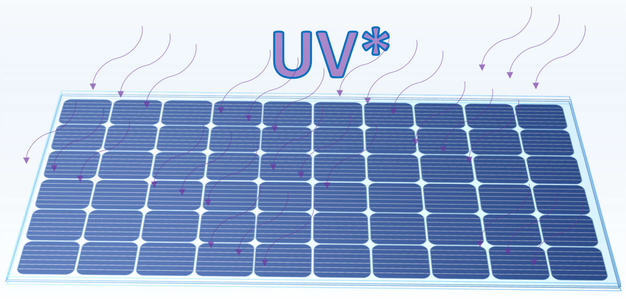
Motivation

- Material and process quality are critical to product quality and lifetime at all manufacturing stages, including before production.
- The use of *high quality materials* can improve the reliability of solar panles.
- In particular, we studied the impact of storage conditions - of uncured EVA rolls - on lamination quality and mid-term ultraviolet (UV) exposure of Glass-Glass PV modules.

Storage conditions of uncured EVA rolls

ID code	Temperature [°C]	Rel. Humidity [%]	Time [days]
EVA-30	20	30	5
EVA-65	30	65	5
EVA-100	20	soaked in water	5

Aging test conditions: ***IEC 62788-7-2,A3***



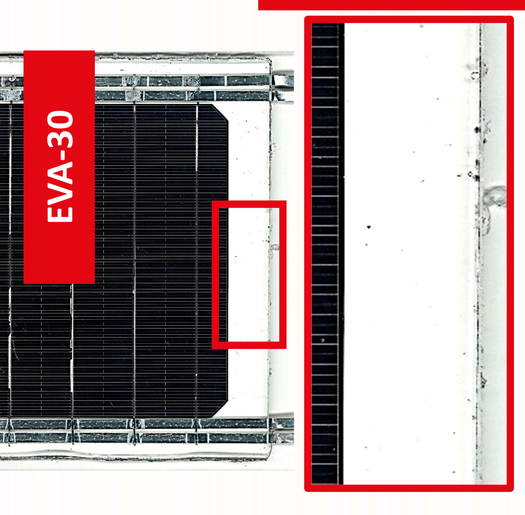
Air Temperature [°C]	Black panel Temperature [°C]	Relative Humidity [%]	UV intensity (@ 340 nm) [W/m^2]	Test duration
65	90	20	0.8	630 kWh/m^2

***CUMULATIVE UV dose ≈ 10 years outdoor exposure in a mid-latitude country**

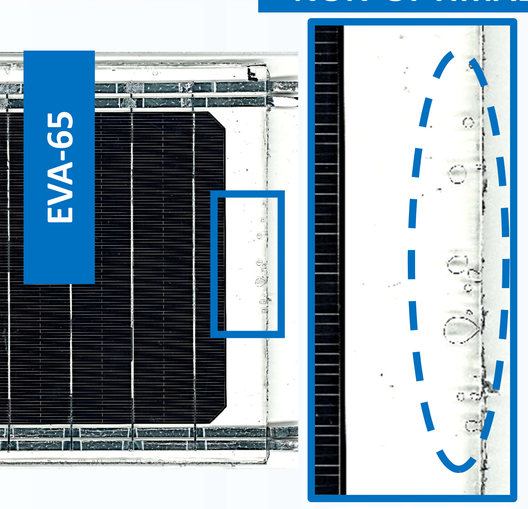
AFTER LAMINATION

Quality check of 1-cell modules

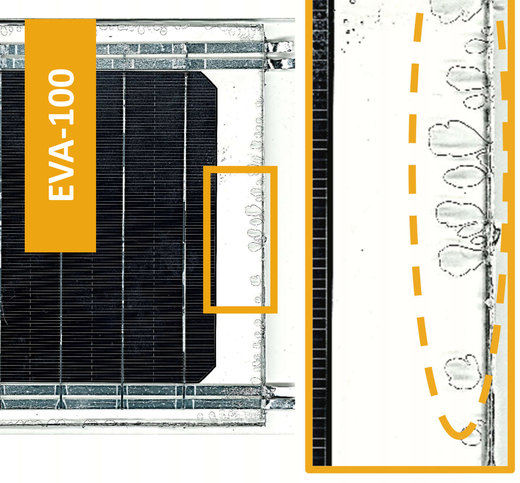
OPTIMALLY STORED EVA



NON-OPTIMALLY STORED EVA

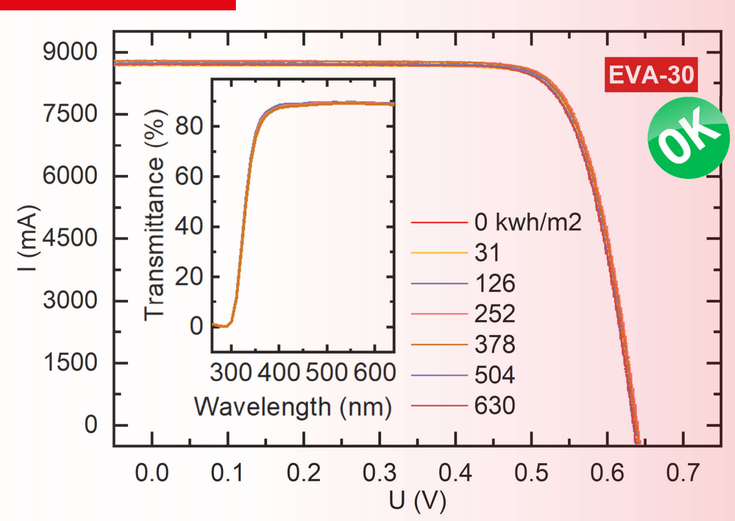


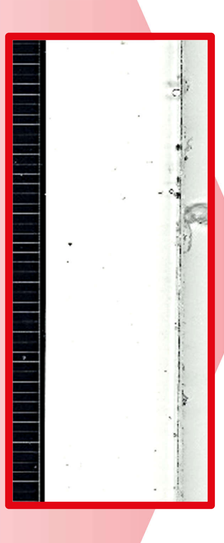
EXTRIMELY POORLY STORED EVA

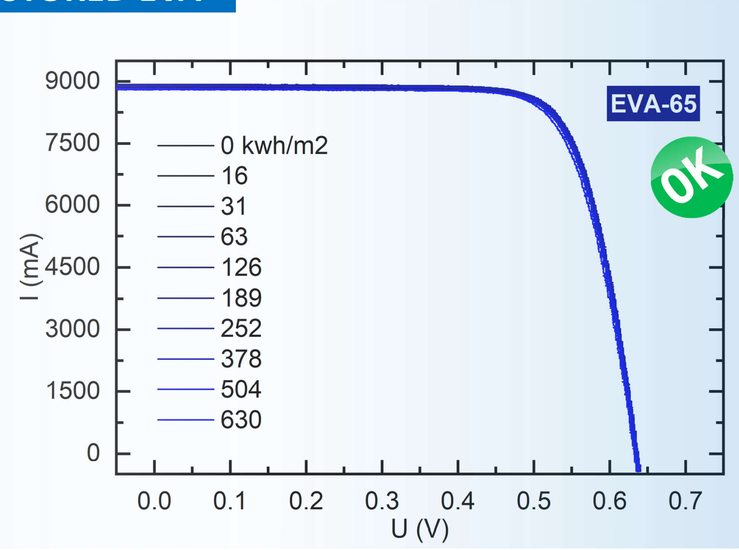


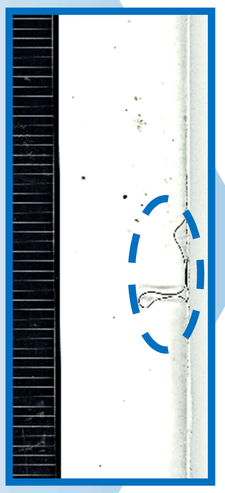
DURING INDOOR UV AGING TEST

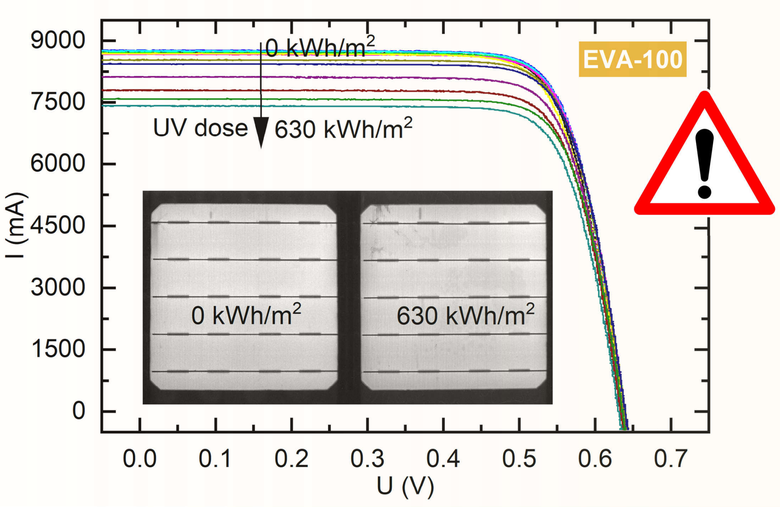
Characteristic I-V curves (@ STC), and quality check of 1-cell modules











AFTER THE LAMINATION

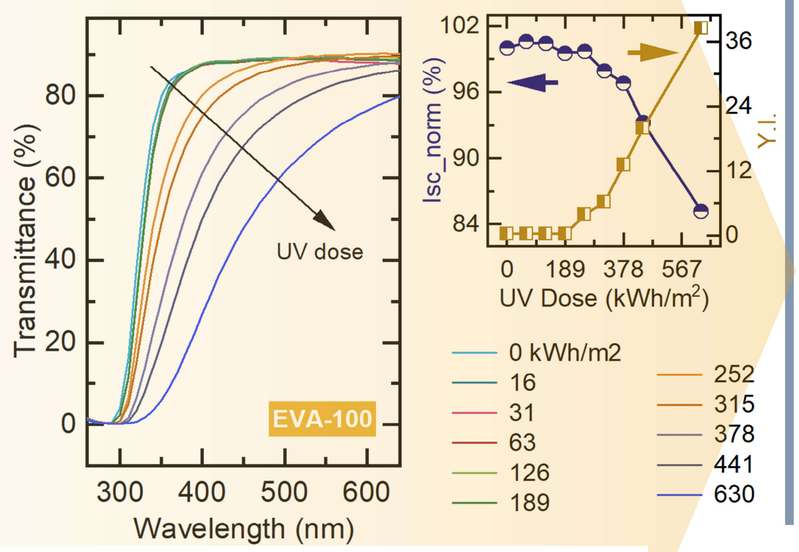
- Only **minor aesthetic defects** (bubbles along the edges) in the modules encapsulated with a poorly stored EVA (i.e. EVA-65 and EVA-100).

DURING UV EXPOSURE

- Both modules encapsulated with the optimally stored EVA (EVA-30) and the poorly stored EVA (EVA-65) showed **no signs of degradation.**
- In EVA-65 the temperature inside the climatic chamber (i.e. 65°C) allows to **partially outgas the residual moisture** and the EVA can rearrange its crystal morphology to a more stable one (DSC results not shown here).
- When the storage conditions are extremely poor (i.e. EVA-100) we observed a constant **reduction of the** current **Isc** due to **EVA yellowing** (EL images shows that the **BSF cell** is not degraded) starting from a UV dose of 200 kWh/m^2 (i.e. **3 years of outdoor exposure**).

CORRELATION BETWEEN ↓ Isc and ↑ Yellowing

Transmittance measurementes and correlation between module current (Isc) and EVA-100 Yellowing Index (Y.I).



Conclusion

- Assumed awless modules after the production, could instead rapidly degrade after installation because of poor material quality.
- If **good polymer storage and handling practices** are carefully respected, the results tend to suggest that **EVA can still be a viable solution to encapsulate G-G PV modules**, for deployment in geographical zones where the humidity levels are not so high during the year (i.e. temperate climates).
- If these conditions are not observed, or in the event of module operating in a hot-humid climate, we believe that this may affect the long-term performance of G-G modules encapsulated with EVA.

Acknowledgments

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