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PV MODULE LIFE TIME FORECAST AND EVALUATION

Accelerated ageing of encapsulant materials for PV applications: effects on stability

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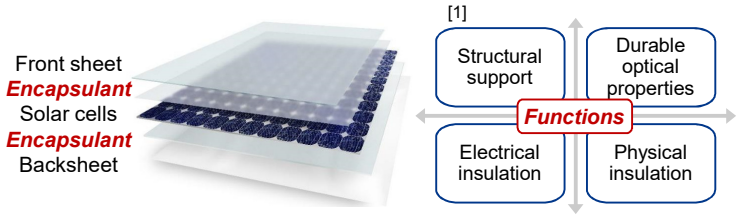
INTRODUCTION AND MOTIVATION



- Degradation of encapsulant materials can lead to *degradation modes* such as yellowing and delamination.
- Therefore, it is very important to analyze *stability* of different encapsulant materials after accelerated ageing test to simulate what happen during operation and to obtain a deep understanding of *degradation mechanisms*.

EXPERIMENTAL APPROACH

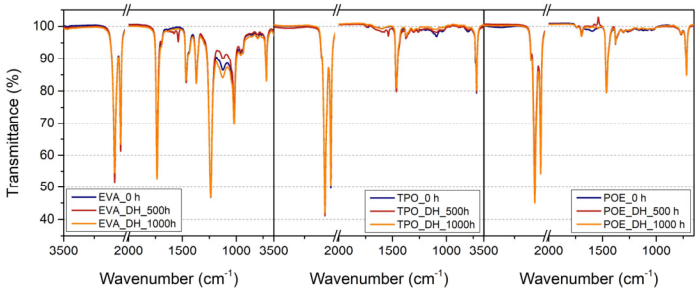
- Eight different *laminated films* of encapsulant materials:
  - 2 *EVA* (ethylene vinyl acetate),
  - 4 *POE* (polyolefin elastomer),
  - 2 *TPO* (thermoplastic polyolefin),
- *Damp Heat* test (85°C and 85% R.H.) for 1000 hours.
- *Optical properties* determined by means of UV-Vis-NIR Spectroscopy.
- Changes in *chemical composition* at the surface measured by means of Fourier-Transform Infrared Spectroscopy.
- Fluorescence behavior analyzed with Fluorescence Spectroscopy.

- *Results of one encapsulant for each material category are shown.*

RESULTS

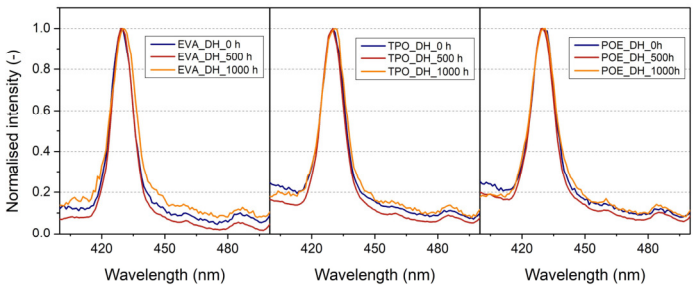
FT-IR Spectroscopy

- *No significant changes* due to ageing under DH test.



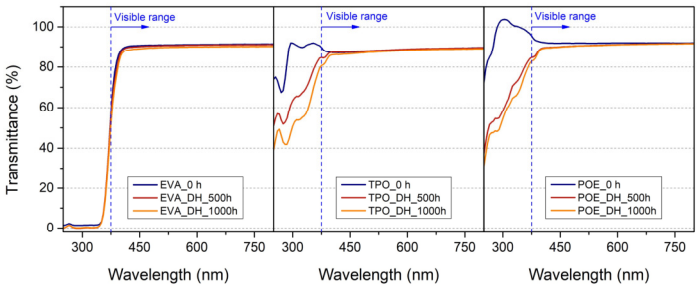
Fluorescence Spectroscopy

- Fluorescence emission spectra of material recorded using an excitation wavelength of 370 nm
- Main emission peak at 430 nm, smaller peaks are present at 460 and 485 nm
- *No significant changes* have been recorded between the encapsulant at the current ageing time



UV-Vis-NIR Spectroscopy, Hemispherical Transmittance

- Slight decrease of hemispherical transmittance in the visible range for all the aged encapsulants with respect to the non aged, due to *slight yellowing*.
- Strong decrease of transmittance in UV range for TPO and POE.
- Slight decrease of hemispherical transmittance between aged and non aged encapsulants in NIR region (not showed).



CONCLUSIONS AND OUTLOOK

- Damp Heat test has been performed on different encapsulant materials (EVA, TPO, POE).
- *No significant differences* between aged and not aged materials have been detected after 1000 hours of testing, resulting in *good stability* up to 1000 hours of DH test.
- Results of UV-Vis-NIR spectroscopy have shown a decrease of hemispherical transmittance in the UV range of the spectrum.
- *Additional ageing time* is needed to better evaluate stability of materials.
- Comparisons with samples laminated in a "mini-module" configuration will help in understanding the influence of microclimatic conditions on polymer degradation.

References
[1] Czanderna, A.W., Pern, F.J, Encapsulation of PV modules using ethylene vinyl acetate copolymer as a pottant: A critical review, Solar Energy Materials and Solar Cells, Vol. 43, Issue 2, 1996, pp. 101-181

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Sklodowska-Curie grant agreement No 721452.