POLYMER COMPETENCE CENTER LEOBEN GMBH

Degradation behavior and reliability of a novel multi-layer polyolefin backsheet film 3M™ ScotchShield™ 800 for PV encapsulation

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Introduction and Objectives

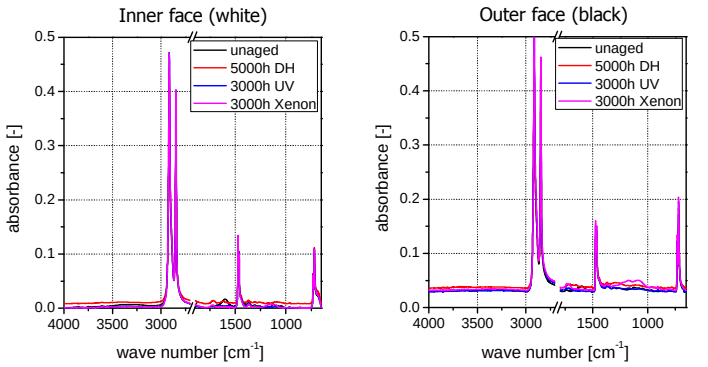
- Increasing cost pressure led to significant R&D efforts in order to find effective alternatives to fluoropolymer containing backsheets
- 3M™ ScotchShield™ 800, based on multi-layer polyolefin technology, offers an alternative and cost effective option for PV module manufacturers
- → Determination of the material behavior after exposure to relevant load parameters temperature, humidity and ultraviolet radiation

Accelerated weathering

Test	Phases	Irradiance	Temperature	Humidity
Damp heat (DH) IEC 61215	-	-	85 °C	85 % RH
Xenon ISO 4892-2 Method A Cycle 1	**Phase 1:** 102 min dry **Phase 2:** 18 min water spray	**Xenon arc lamp** 60 W/m² between 300 und 400nm	65 °C	50 % RH
UV ISO 4892-3 Method A Cycle 1	**Phase 1:** 8 h dry **Phase 2:** 4 h condensation	**UVA340 fluorescent lamp** **Phase 1:** 0,76 W m^{-2} nm^{-1} at 340nm **Phase 2:** light off	Phase 1: 60 °C Phase 2: 50 °C	Not controlled

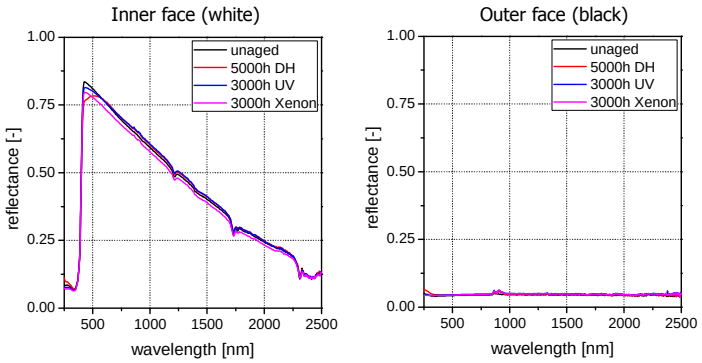
Results: Aging characterization

IR-ATR spectroscopy



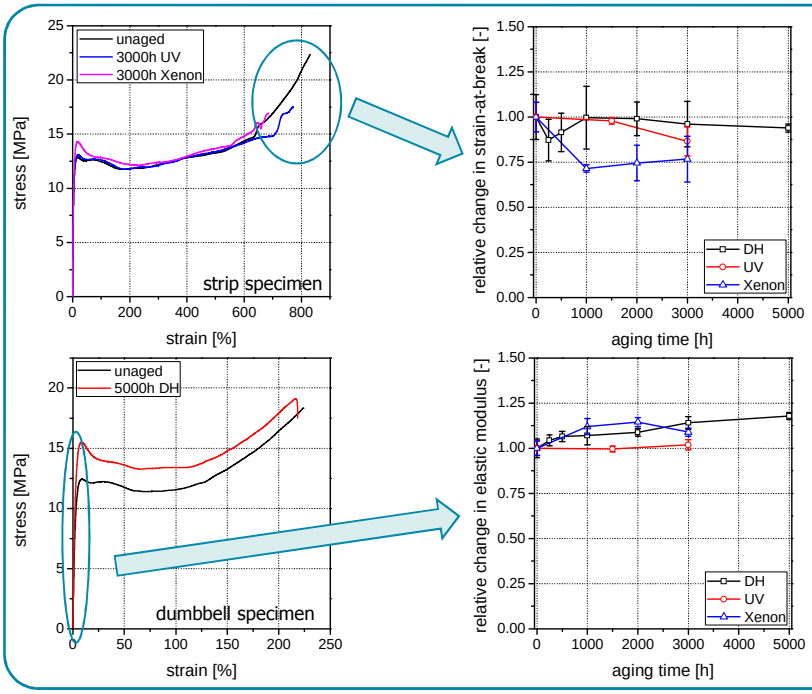
- No significant changes in characteristic polyolefin absorbance spectra due to chemical aging during accelerated weathering
  - Formation of small peaks around 1720 cm^{-1} and between 1300 and 1000 cm^{-1}
    - Carbonyl groups
  - Slight changes in the region between 1700 and 1500 cm^{-1}
    - Vibrations of aromatic rings of additives and stabilizers

UV/Vis/NIR spectroscopy



- No significant changes in reflectance spectra due to chemical aging during accelerated weathering
  - Slight discoloration of inner face after damp heat testing
    - Formation of chromophoric groups due to chemical aging
  - No significant changes in the UV region of wavelength
    - Effective UV protection also after weathering

Tensile test



- Material exhibits ductile behaviour with high plastic deformation and strain hardening after the yield point
- Scattering in strain-at-break and stress-at-break values presumably due to the laboratory co-extrusion process
- No significant changes in ultimate mechanical properties after damp heat testing
  - No effects of chemical aging observable
    - → Materials used in the backsheet film are not susceptible to hydrolysis
    - → Temperature level of 85 °C to low to induce thermo-oxidation
- Slight changes in ultimate mechanical properties after exposure to UV radiation
  - Chemical aging
  - Stronger decrease after xenon weathering, presumably due to the higher specimen temperature during exposure
- Slight increase in elastic modulus and yield strength after damp heat and xenon test
  - Physical aging
- No delamination effects after weathering

Conclusion

- **No significant chemical aging effects were observed for the polyolefin multi-layer film**
  - → **Excellent long term weathering stability estimated**
- **3M™ ScotchShield™ 800 film offers a high potential as a backsheet for PV modules**

This research work was performed at the Polymer Competence Center Leoben (PCCL) within the project "PV Polymer" (FFG Nr. 825379, 3. Call "Neue Energien 2020", Klima- und Energiefonds) in cooperation with the Chair of Materials Science and Testing of Plastics at the University of Leoben, Perkin Elmer and 3M. The PCCL is funded by the Austrian Government and the State Governments of Styria and Upper Austria.