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

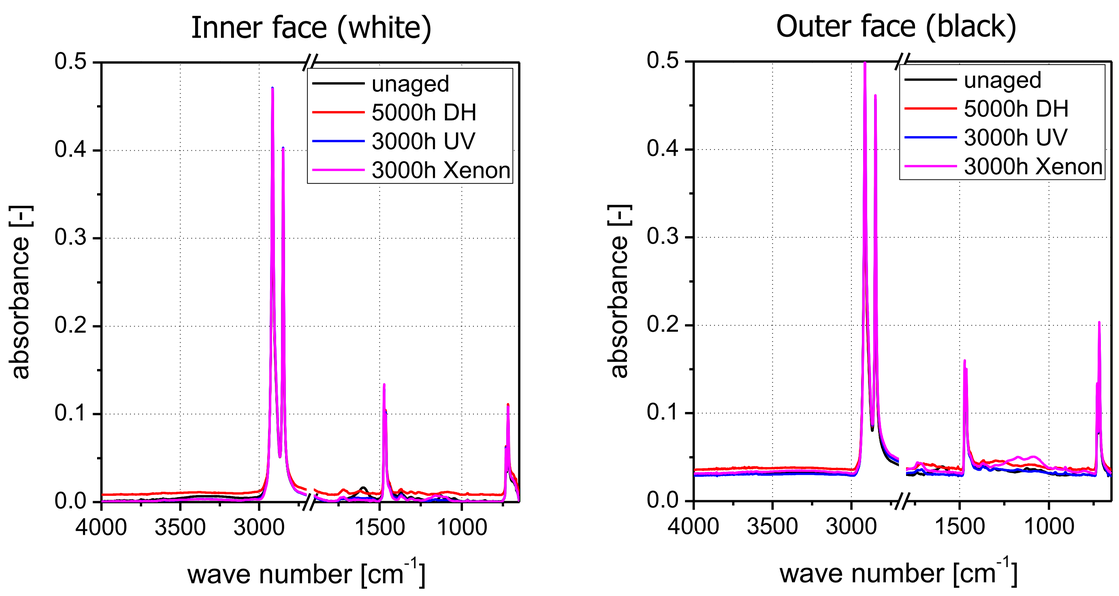
- Increasing cost pressure led to significant R&D efforts in order to find effective alternatives to fluoropolymer containing backsheets
- 3M™ ScotchShield™ 800, based on multi-layer polyolefin technology, offers an alternative and cost effective option for PV module manufacturers
- → Determination of 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

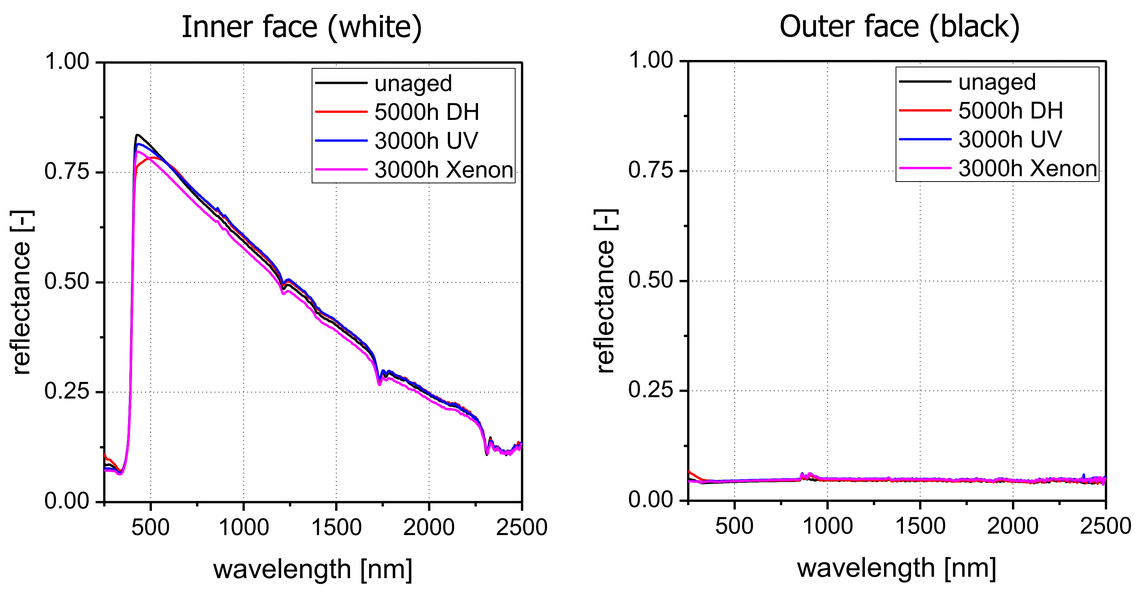
Results: Aging characterization

IR-ATR spectroscopy

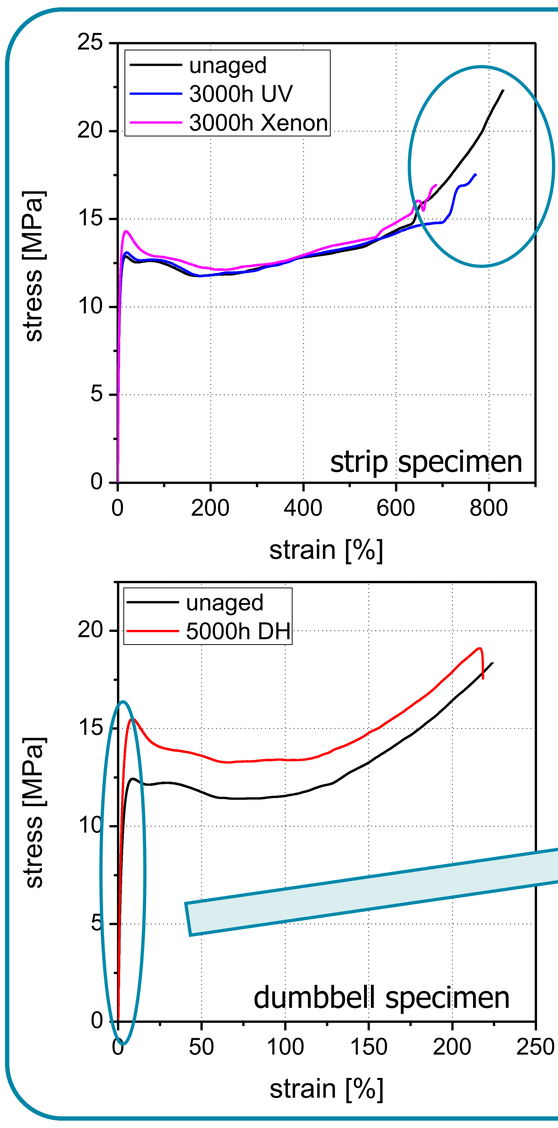


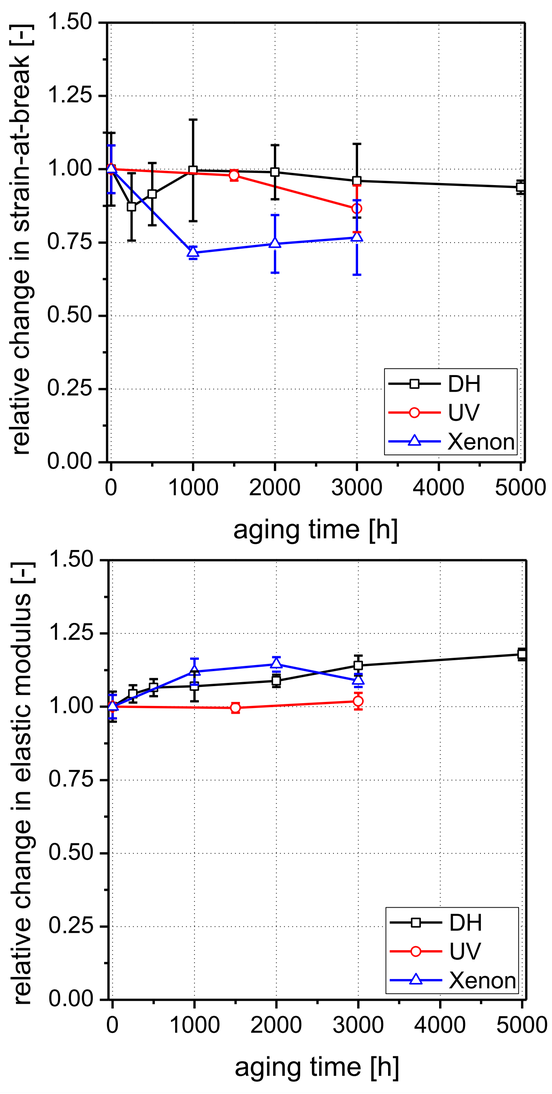
- No significant changes in characteristic polyolefin absorbance spectra due to chemical aging during accelerated weathering
  - Formation of small peaks around 1720 cm^{-1} and between 1300 and 1000 cm^{-1}
    - Carbonyl groups
  - Slight changes in the region between 1700 and 1500 cm^{-1}
    - Vibrations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

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