Cross-Sectional Chemical and Mechanical Characterization of a Multilayer Polymeric Backsheet During UV Exposure

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Introduction

In the field, degradation of the polymeric multilayer backsheet can be detrimental to the efficiency of the photovoltaic (PV) module, causing catastrophic failure and safety concerns. This is a costly problem for industry due to the lack of comprehensive knowledge of multilayer system during weathering.

In this study, cross-sectional characterization techniques were used to provide structural and property changes of a multilayered backsheet before and after exposure to accelerated environmental conditions. New insight into the failure of PV polymeric materials during accelerated aging is presented.

Materials and Measurements

PET/PET/EVA (PPE) - Section of backsheet was embedded in epoxy
- Sample was faced with diamond knife using cryo-microtomy

Simulated Exposure
- Sample shape/size: Free standing PET/PET/EVA backsheet, 19 mm in diameter
- UV exposure: PET outer layer side face to light
- Exposure conditions: Simultaneous UV irradiation, temperature, and humidity.
- T = 85 °C
- R.H. = 5% (dry) or 60% (wet)

NIST-Patented 2-meter SPHERE®
- Nanoindentation with continuous stiffness measurement technique
- Atomic force microscopy with quantitative nanomechanical mapping
- Laser scanning confocal microscopy
- Raman spectroscopy with laser λ = 785 nm

Conclusions

- Both nanoindentation and Raman spectroscopy suggest that high humidity accelerates the photodegradation of backsheet materials in the presence of UV radiation.
- Cross-sectional chemical and mechanical profiling using nanoindentation, Raman spectroscopy, and AFM QNM is an effective tool to understand the interfacial property changes of multilayer backsheet films during UV degradation.