

## **Technical Assistance Request: Pellucere Oregon State**

**We need the following technical assistance to realize our proposed solution.**

### **1. Assistance to perform outdoor testing on solar PV modules with and without TALUS DRT AS coatings.**

The Outdoor testing facilities listed below at NREL will allow us to evaluate PV technologies under simulated, accelerated, and prevailing conditions.

Capabilities relevant to our solution at NREL Outdoor testing Lab:

- Simulated, accelerated indoor and outdoor testing
- Outdoor field testing
- Real-time PV and solar resource testing
- Degradation and soiling analysis

The Performance and Energy Rating Testbed can be used to monitor modules for performance under various weather conditions continuously. In the adjacent array field, testbeds are used to conduct outdoor exposure and stability tests on PV modules.

### **2. Assistance in using advanced mechanical characterization equipment to characterize the mechanical properties of TALUS DRT AS coatings — strength, adhesion, and ability to protect abrasion of PV cover glass from soils.**

The following tools at NREL will be useful for the development of our solutions.

- Hot water baths – Used to condition absorber materials in hot water before being pulled on Instron 5500R.
- Sebastian Quad Pin-Pull – Adhesion or material-strength measurements (Sebastian quad, pin-pull, etc.)
- Mocon Permatran W 3/31 – Measures the amount of moisture that diffuses across polymers; blows dry air along one side of polymer membrane and humidified air along the other side, measuring the transient water-vapor transmission rate; diffusivity, solubility, the permeability of a tested polymer can be determined by fitting measurements to theoretical modules; measurements are made 20°C to 85°C, 100% relative humidity.
- Thermogravimetric analyzer – Directly measures water up-take in a sample to analyze water diffusivity in samples.
- Mocon OxTran-100 – Measures the oxygen transmission rate through synthetic film, coated papers, and other flexible or semi-rigid packaging materials; oxygen flows on one side of the barrier, and oxygen-free carrier gas flows on the other side, carrier gas conveys the oxygen that diffuses through the barrier to oxygen-specific coulometric detector; measurements are made ambient to 70°C, 0% to 100% relative humidity.

- TABER® Abraser (Abrader) Test – Measures abrasion resistance for accelerated wear testing.
- Rockwell or Vickers hardness testing—Tests sample hardness by applying force on a sample using a diamond stylus; measures the amount of indentation to calculate hardness.

**3. Assistance in advanced materials and surface characterizations to understand Surface of the solar PV module cover before and after TALUS DRT AS coatings and surface of the solar PV module cover before and after outdoor soiling testing with and without TALUS DRT AS coatings.**

We believe the state-of-the-art tools listed below at the Science and Technology Facility at NREL will be useful for our development.

- Electro-optical characterization, including spectroscopic ellipsometry, photoluminescence, photocurrent decay, reflectometry, Fourier transform spectroscopy, Raman scattering, and thermal and luminescence imaging tools
- A surface analysis laboratory to study and control photovoltaic surfaces and interfaces
- High-spatial-resolution Auger electron spectroscopy that provides information on the elemental makeup and distribution in photovoltaic films
- An XPS/UPS system that provides core-level and valence-band electronic structures and information on the chemical environments of specific elements
- Scanning probe microscopies and scanning electron microscopy to provide real-space characterization of photovoltaic material morphologies and electronic structures down to the nanometer scale

