Technical Assistance Request

Microporous Oxides Science and Technology, L.L.C. (MOST) markets an aqueous suspension of a mixture of silica (about 2 nm diameter) and titania (5 – 7 nm diameter) nanoparticles that has been shown in laboratory experiments and tests with academic and industry partners to provide a self-cleaning ceramic coating for glass surfaces. The suspension is applied via dip coating or spray coating to form a thin film (<1 micron thick) with minimal light absorption or reflection from the coating. The coating cures by self-sintering on exposure to near-UV light to form a durable and weather-resistant surface. MOST is collaborating with Madison College (MC) for field tests that already demonstrate the effectiveness of these self-cleaning coatings for solar panels (Walz et al., 2023). MOST is seeking support from the American Made Solar Prize competition to characterize the properties of these coatings and to complete more rigorous and larger-scale field trials to further demonstrate the efficacy of these self-cleaning coatings. The ultimate goal for MOST is to transfer this technology to a US-based glass and/or solar panel manufacturer that will integrate these coatings into their assembly lines.

MOST is a small company with limited resources. In order to attract interest from manufacturers, MOST needs to demonstrate that its coating material:

- reduces energy losses due to soiling for solar panels exposed to various types of soiling deposition and variable climatic conditions,
- exhibits minimal absorption/reflection of the solar radiation striking the solar panel,
- is easily applied, and
- is durable and long-lasting.

Such demonstrations require assistance from other sources, primarily expected to be the DOE National Laboratories.

MOST can meet some of its field demonstration needs through its partnership with MC, which is serving as our American Made Solar Prize Connector. MC is a national leader in solar photovoltaics and is positioned to facilitate the need for experimental field data. MC has more experience with real-world solar field installations than most institutions of higher learning including four-year universities. The college is home to the largest rooftop solar system in Wisconsin and has six other solar installations of 100-150 kW. The college has had a solar energy educational program since 2005, which provides strong contacts with many regional solar energy companies, most of whom employ college alumni. MC also offers related programs in electrical engineering, construction, and electrical apprenticeship. Its solar installations have been designed with an eye towards research and development, data monitoring, and visualization.

MOST and MC have collaborated on a small-scale test of MOST's coating material that has demonstrated, over almost two years of testing, >3% increases in energy output for coated panels as compared to uncoated panels whether mounted on 10-degree tilt, fixed south-facing modules or 30-degree tilt vertical axis tracker units (Walz et al., 2023). Another result is that the cost for the mixed silica-titania suspension itself would be less than US$3 to coat a 2x1-m solar panel. However, these tests are conducted locally. There is enough precipitation in Wisconsin to keep solar panels fairly clean except in unusual circumstances, so it is challenging to demonstrate the

effectiveness of the coating on panels that are not heavily soiled. Independent verification of the effectiveness of the coating under varied climatic conditions is needed.

Therefore, MOST is seeking assistance from the DOE laboratories and other test facilities to demonstrate the utility of its coating for glass and/or solar panel manufacturers. Assistance in two specific areas would be invaluable.

I. Testing under different climatic conditions

MC has suggested that MOST provide solar panels for testing under at least two climatic conditions that differ from those in Wisconsin. One test should be conducted under dry, desert conditions where wind-borne deposition of aluminosilicate soil particles affects solar panel performance. For this test, NREL, Sandia or possibly Hanford would seem appropriate. A second test should be performed under humid conditions where deposition of organic materials and biofilm formation would affect performance. A possible partner would be Indian River State College at Fort Pierce, FL, a group that has worked with MC in the past. Both tests would require sophisticated data acquisition measurements with enough panels to provide statistically significant results, likely at least 10 coated and 10 uncoated panels.

II. Characterizing the properties of the MOST coating when deposited on solar panels

These measurements require the use of sophisticated instrumentation not directly available to MOST or MC. These measurements include:

- Determining the amount of solar energy absorbed by the thin film;
- Determining the amount of solar energy reflected from both the surface of the coating and the interface between the coating and the solar panel;
- Monitoring the thickness and uniformity of the coating, likely using profilometry;
- Estimating the lifetime of the coating through accelerated weathering tests. One component of these tests would involve exposing recently coated glass to different intensities of UV radiation for different amounts of time in an effort to optimize a UV-curing protocol for coated glass panel covers.

A final need is for MOST to identify a US-based solar panel manufacturer who will sell uncoated solar panels to MOST for use in testing the efficacy of its ceramic coating. Ideally, once the effectiveness of the MOST coating process has been convincingly demonstrated, this panel supplier would be prepared to incorporate this technology into its panel manufacturing assembly line or convince its glass supplier to do the same so as to bring this promising technology to market.

Reference

Walz, K.A.; Hoege, T.D.; Duensing, J.W.; Zeltner, W.A.; Anderson, M.A. Field tests of a self-sintering, anti-soiling, self-cleaning, nanoporous metal oxide, transparent thin film coating for solar photovoltaic modules. Sol. Energy Mater. Sol. Cells, accepted for publication.