Technical Assistance Request

Microporous Oxides Science and Technology, L.L.C. (MOST) offers an aqueous suspension of a mixture of nanoparticles of silica (about 2 nm diameter) and titania (5 – 7 nm diameter) that has been shown in laboratory experiments and tests with 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 coating. MOST has worked with the University of Wisconsin and Madison Area Technical College (MATC) to conduct preliminary experiments that suggest that these suspensions provide effective self-cleaning coatings for solar panels. MOST is seeking support from the American Made Solar Prize competition to complete more rigorous and larger-scale field trials to demonstrate the efficacy of the self-cleaning coating. The ultimate goal for MOST is to transfer this technology to a US-based solar panel manufacturer that is capable of integrating these coatings into a photovoltaic module assembly line.

The major drawback to using this suspension is that it is not stable for more than 1 to 2 weeks, i.e., during that time the nanoparticles will aggregate, eventually forming particles that are large enough to fall out of suspension. Once this happens, the suspension will no longer form a uniform thin film and so will not provide a useful coating. Therefore, shipping the suspension for use by other groups becomes problematic unless those groups are local. For this reason, the ultimate end user should be willing to prepare the suspension in-house.

MOST is also a very small company with limited resources. In order to attract interest from solar panel 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 MATC, which is serving as our American Made Solar Prize Connector. MATC is a national leader in solar photovoltaics and is positioned to facilitate the need for experimental field data. MATC 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 the state of Wisconsin, and it will be completing four more solar projects ranging in size from 100 to 150 kW in the upcoming year. 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 MATC alumni. MATC also offers related programs in electrical engineering, construction, and electrical apprenticeship. MATC solar installations have been designed with an eye towards research and development, data monitoring, and visualization. It has a current National Science Foundation project that specifically addresses Supervisory Controls and Data Acquisition.

MOST and MATC have collaborated on small-scale tests of MOST's coating material, with one outcome being that MOST estimates the cost for the mixed silica-titania suspension itself would be roughly $\$2/m^2$ for each coat applied to the panel. Although hopefully a larger test will be started fairly soon, 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 will be needed. In addition, MATC does not have the equipment needed to fully characterize the fundamental material properties of the coating.

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

I. Testing under different climatic conditions

MATC 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 MATC in the past. Both tests would require sophisticated data acquisition measurements with enough panels to provide statistically significant results, likely at least 25 coated and 25 uncoated panels.

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

These measurements require the use of fairly sophisticated instrumentation not directly available to MOST or MATC. 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;
- Performing Rockwell indentation hardness and/or Wolff-Wilburn scratch hardness tests of the coating;
- Estimating the lifetime of the coating through accelerated weathering tests.

A final need is for MOST to identify a US-based solar panel manufacturer who is willing to 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 and bring this promising technology to market.