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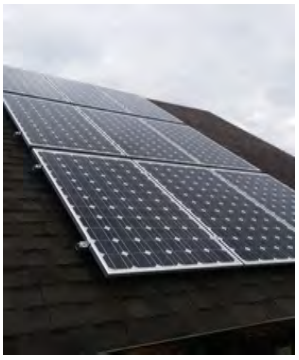
Self-Cleaning Solar Panels

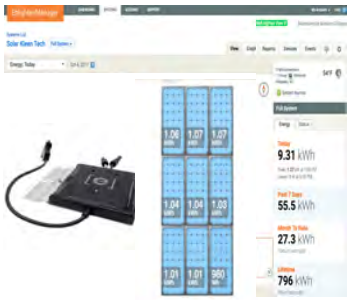
Introduction

Solar system output can experience power losses of 10-15% due to soiling of the panels. This study was motivated through a partnership with a local start-up company, Solar Kleen Tech LLC to address that problem. Solar panels were spray coated in the field with a silca-titania sol to see if it would aid the panels in self-cleaning and enhance electrical output. This nano-material coating increases the surface area of the photovoltaic panels on a microscopic level. Using electron-hole pairs created by the sun's UV rays, the coating oxidizes and breaks down any organic molecules that find their way onto the photovoltaic panels.



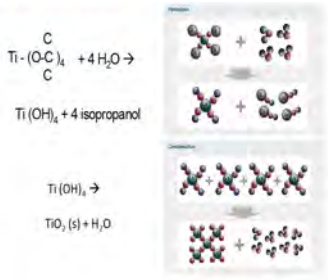
Experimental Methods - Data Acquisition

Nine SolarWorld 175 Watt solar panels were installed with Enphase microinverters in June of 2017 to collect baseline data. The micro-inverters allow for monitoring of individual solar panel output. Monitoring indicated that individual panels differed by less than 5 %. Five of the nine panels were then coated in October, 2017, while the other four serve as controls.



Experimental Methods – Wet Chemistry

The Sol-Gel Process



A silica/titania sol was made from tetra ethoxy silicon and tetra sec-propoxy titanium reagents. Sequential hydrolysis and dehydration results in the formation of nanoscale metal oxide particles suspended in water and alcohol that can be applied to solar panels. The particles are too small to be seen with the naked eye but with a laser they scatter light revealing a visible beam.

Experimental Methods - Application Process

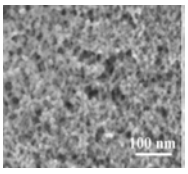
Panels were spray coated in the field rather than removing and replacing them. UV rays from the sun dry the solution and sinter the silica and titania to crystalize their structures and chemically bond the coating to the glass.

Factors affecting coating

- Distance from panel
- Rate of application
- Streaking ☹
- Wind!

Results

Photographic and Scanning Electron Microscope images showing SiO_2/TiO_2 thin film macroscopic and microscopic structure



Photos of coated solar panels. Note the undesirable streaking on the left, and the barely distinguishable properly coated panel on the right

Next Steps - Plans for Future Work

Our next step is to monitor each individual panel to observe for visual signs of soiling and to see how its electric output changes over time. Hopefully the coatings will impart self-cleaning properties to prevent soiling of the panels and maintain power output near rated values.

Acknowledgements

The coating materials used in this study were developed by Professor Marc Anderson at the University of Wisconsin. Jessica and Jennifer Sanfillipo of Solar Kleen Tech LLC provided technical advise for the coating of the solar panels. Partial financial support for this project was provided by the Center for Renewable Energy Advanced Technological Education and the National Science Foundation Advanced Technological Education Program (NSF Award # 1600934)