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Super-Hydrophobic Patterned Coatings for PV modules

Biomimetic nanostructured silica coatings

Biomimetic coatings inhibit accumulation of snow and dust on PV panels thereby increasing overall efficiency.

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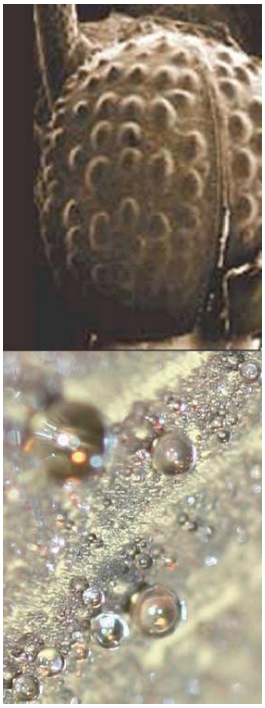
Problem Statement:

Dust and snow on the surface photovoltaic panels absorb and reflect incident photons. Water settles in micro-depressions in the glass surface and attracts dust. As the water evaporates, it leaves behind a dirty residue in the depressions that is hard to wash off. A superhydrophobic (SH) coating would both fill the depressions and prevent water from accumulating. With a workable coating, PV panels would remain clear increasing the amount of time they could absorb sunlight and generate electricity. A satisfactory SH coating for PV panels would be 100% transparent to light, durable with the ability to reapply in the field, and inexpensive.

Approach:

SNL developed a SH coating that mimics the finely nanostructured Namib Sternocara Desert beetle's super-hydrophobic carapace. The SH silicon dioxide network of the SH films (not reliant on binders) forms on evaporative drying so these films can be applied via several industrially appropriate methods including spray, dip or spin coating. The coating is silicon dioxide based, and compatible with glass and ceramic substrates. The nano-textured coating based on Brinker's formula adheres to a wide range of surfaces. Once dry, the nano-scale thin coating is transparent and super hydrophobic, achieving water droplet contact angles of up to 170 degrees. On the textured surface, dust is not able to make good Van der Waals contacts. As water rolls off the surface it then carries with it any accumulated dust. This coating will be tested using the SNL grime and protocol developed at the SNL PV reliability department. Indoor and outdoor tests on a cell and module level will be conducted to evaluate the coating's performance, spectral compatibility to various cell types, and long term durability.



Impact:

Success will present a key enabling technology for photovoltaic energy and will increase panel efficiency. Spinoff applications include concentrated solar technologies, window coatings, and other surfaces exposed to the elements.

U.S. DEPARTMENT OF ENERGY | NNSA National Nuclear Security Administration

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