Transparent Panels Open a New Window for Solar Energy

The earth receives more energy from the sun in one hour than the world's population uses in a whole year. Building-integrated photovoltaic (PV) technologies aim to tap into this tantalizing opportunity and capture some of that energy with rooftop solar panels. These black panels are designed to absorb as much radiant energy as possible across the light spectrum. However, while hundreds of companies are developing more-efficient photovoltaic devices at lower prices, the widespread adoption of such technologies is still hampered by the cost and aesthetics associated with mounting traditional PV cells.

With support from the National Science Foundation, Ubiquitous Energy, a start-up company spun out of the Massachusetts Institute of Technology (MIT), is aiming to address these issues by turning millions of square meters of window glass into solar energy harvesters. The company founders, Miles Barr, Vladimir Bulovic, and Richard Lunt, recognized that energy emitted by the sun that falls into the visible range is only about 35% of the total energy emitted, with about 56% in the infrared (IR) region and 9% in the ultraviolet (UV) region. Thus, a PV material that is transparent (does not absorb visible light) while absorbing UV and IR light to produce electricity could be promising for PV-integrated windows. That is exactly what Ubiquitous Energy has developed.

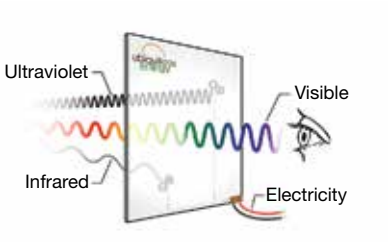
▲ ClearView Power materials are transparent photovoltaics that can be applied to windows to generate electricity.

The transparent PV material is made of excitonic materials. Unlike conventional solar materials such as silicon, which produce free electron-hole pairs upon light absorption, excitonic materials generate excitons, which are bound electron-hole pairs. This seemingly small distinction enables more flexibility in tuning excitonic materials to absorb specific wavelengths of light — something that is not possible with conventional PV materials.

The excitonic materials developed by Ubiquitous Energy are proprietary organic and inorganic small molecules that are applied via physical vapor deposition onto glass as nanofilms. With its year-old rapid prototyping line, Ubiquitous Energy has used a combinatorial approach to iteratively improve the coating. It now has a material that is stable and certified at 5% efficiency.

"We're on a trajectory to get to 10% efficiency without impacting the inherent transparency of the material," says Ubiquitous Energy CEO Miles Barr.

While efficiency is important, the company is willing to cede the distinction as the most-efficient solar cell to others in exchange for a tremendous advantage in the surface area on which its coating can be applied. The surface area available to solar cells on a 50-story building can be more than 20 times greater than that available on the roof. In addition, the building realizes additional value in energy efficiency, because



▲ Ubiquitous Energy designed the photovoltaic coating so that it would transmit visible light and absorb ultraviolet and infrared light from the sun.

the coating simultaneously serves as a solar-control layer, keeping unwanted infrared solar heat out of the building — thereby reducing the energy needed to cool the building. Thus, this coating could eliminate the need for existing low-E and solar-control window coatings.

The Ubiquitous Energy materials offer several other benefits that make the technology attractive and affordable for consumers. Because it is transparent, the coating does not impact the quality of indoor lighting. Also, the levelized cost of energy for this technology is competitive because it piggybacks on installation, framing, and maintenance costs already required to produce and install the windows. The ability to make use of existing infrastructure to produce energy at the point of utilization is a major breakthrough.

Having achieved its internal milestones for yield and power conversion efficiency, Ubiquitous Energy has moved into application development. The company is partnering with glass and advanced material companies to integrate its ClearView Power material into end products. These would take the form of solar-harvesting windows, films that can be applied to already existing buildings, and coatings for mobile electronic devices to extend battery life. CEP

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