



Tweaking quantum dots powers-up double-pane solar windows

January 2, 2018

Engineered quantum dots could bring down the cost of solar electricity

LOS ALAMOS, N.M., Jan. 2, 2018—Using two types of “designer” quantum dots, researchers are creating double-pane solar windows that generate electricity with greater efficiency and create shading and insulation for good measure. It’s all made possible by a new window architecture which utilizes two different layers of low-cost quantum dots tuned to absorb different parts of the solar spectrum.

“Because of the the strong performance we can achieve with low-cost, solution-processable materials, these quantum-dot-based double-pane windows and even more complex luminescent solar concentrators offer a new way to bring down the cost of solar electricity,” said lead researcher Victor Klimov. “The approach complements existing photovoltaic technology by adding high-efficiency sunlight collectors to existing solar panels or integrating them as semitransparent windows into a building’s architecture.”

The key to this advance is “solar-spectrum splitting,” which allows one to process separately higher- and lower-energy solar photons. The higher-energy photons can generate a higher photovoltage, which could boost the overall power output. This approach also improves the photocurrent as the dots used in the front layer are virtually “reabsorption free.”

To achieve this, the Los Alamos team incorporates into quantum dots ions of manganese that serve as highly emissive impurities. Light absorbed by the quantum dots activates these impurities. Following activation, the manganese ions emit light at energies below the quantum-dot absorption onset. This trick allows for almost complete elimination of losses due to self-absorption by the quantum dots.

To transform a window into a tandem luminescent sunlight collector, the Los Alamos team deposits a layer of highly emissive manganese-doped quantum dots onto the surface of the front glass pane and a layer of copper indium selenide quantum dots onto the surface of the back pane. The front layer absorbs the blue and ultraviolet portions of the solar spectrum, while the rest of the spectrum is picked up by the bottom layer.

Following absorption, the dot re-emits a photon at a longer wavelength, and then the re-emitted light is guided by total internal reflection to the glass edges of the window.

There, solar cells integrated into the window frame collect the light and convert it to electricity.

Publication: Kaifeng Wu, Hongbo Li, and Victor I. Klimov, Tandem luminescent solar concentrators based on engineered quantum dots, *Nature Photonics*, DOI 10.1038/s41566-017-0070-7, January 1, 2018.

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Acknowledgements: This work was supported by the Center for Advanced Solar Photophysics (CASP), an Energy Frontier Research Centre funded by the U.S. Department of Energy, Office of Science, Basic Energy Sciences

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