ENERGY FOCUS

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Thinner solar cells use dielectric core–shell optical antennas

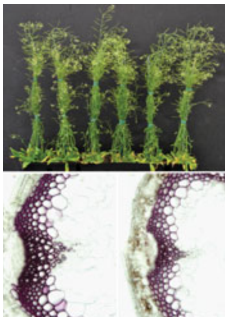
Nano Lett. DOI: 10.1021/nl301435r

Dielectric core–shell optical antennas can enhance the trapping of solar radiation in photovoltaic devices, enabling a 70-nm-thick a-Si:H thin film to absorb about as much radiation as a typical 400-nm-thick anti-reflection coating thin film. The structures tested used semiconducting a-Si:H as the core and dielectric materials such as ZnO and Si_3N_4 as the shell. Linyou Cao of North Carolina State University and A. Paul Alivisatos at the University of California, Berkeley, and their colleagues reported in *Nano Letters* that the solar radiation absorption enhancement comes from multiplication of contributions from leaky mode resonances in the semiconductor and anti-reflection effects in the dielectric. The size ratio of the core and shell is the key to optimal absorption. After optimizing the dielectric shell for anti-reflection, sizing the semiconductor core at a 0.5–0.6 core–shell ratio preserves the intrinsic leaky mode resonances. This technology could lead to thin solar cells with improved conversion efficiencies and lower cost than currently available solar cells.

Artificial enzyme could enhance biofuel production

The Plant Cell DOI: 10.1105/tpc.112

Lignin, the tough biopolymer in plant cell walls that gives them structural strength, presents significant difficulties when trying to convert biomass to biofuels; it interferes with digestive enzymes that must access the sugars inside the plants to produce these fuels. Now, using mutagenesis to create an artificial enzyme that inhibits the polymerization of three lignin precursors called monolignols, researchers at Brookhaven National Laboratory and the University of Wisconsin, Madison, have developed a method of reducing the amount of lignin in *Arabidopsis* plants by up to 24 percent without compromising the growth of the plants. As reported in the July 31 edition of *The Plant Cell,* this development could significantly reduce the cost of biofuels by removing pretreatment steps that are currently needed to reduce lignin content in industrial biofuel processes.

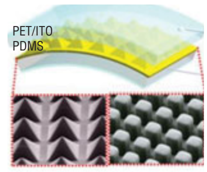


Transgenic plants with an enzyme variant designed to limit the production of the cell wall component lignin showed no dramatic difference in growth (top) compared to the control plants, but had less lignified xylem tissue (stained violet on bottom).

Transparent nanogenerators use triboelectric effect

Nano Lett. DOI: 10.1021/nl300988z

Flexible transparent nanogenerators (FTNGs) based on triboelectric phenomena could be used as self-powered systems for touchscreens in electronic displays according to research done by Zhong Lin Wang of the Georgia Institute of Technology and co-workers from Xiamen University, China. The triboelectric effect refers to electrification resulting from frictional contact between materials. The FTNGs use only transparent materials, including a patterned polydimethylsiloxane (PDMS) thin film sandwiched between two sheets of polyester, each capped with an indium tin oxide electrode. The 460-micron-thick devices with an area of 5.4 cm^2 produced up to 18 V of electricity at a current density of approximately 0.13 $\mu A/cm^2$ when flexed, yielding 0.7 μA of current (up to ~13 μW of power) at a flexing frequency of 1 Hz. The researchers fabricated PDMS thin films with linear, cubic, and pyramidal patterns to increase friction during bending. As reported in *Nano Letters,* the triboelectric effect was greatest in devices with pyramidal patterns, followed by the cubic, linear, and flat PDMS sheets in decreasing order.



A new high-output, flexible and transparent trioboelectric nanogenerator produced from transparent polymer materials. *Credit: Zhong Lin Wang.*

Study clarifies short Li-S battery lifetime

J. Am. Chem. Soc. DOI: 10.1021/ja2121926

By studying the morphology and crystal structure of lithium-sulfur (Li-S) batteries during operation, researchers at Stanford University led by Michael Toney have discovered phenomena that largely contradict previous *ex situ* studies. Sulfur has great promise as a cathode in this system because of its high energy density and low cost. However, Li-S batteries fail after only a few tens of cycles, compared to thousands for Li-ion batteries. Previous *ex situ* studies have attributed the short lifetime to the dissolved sulfur forming electrically insulating crystalline Li_2S following discharge and to sulfur's failure to recrystallize at the cathode following charging. Now, using *in operando* synchrotron-based XRD and transmission x-ray microscopy, Toney and colleagues have shown that no crystalline Li_2S forms; they speculate that in previous studies, it was an artifact of the *ex situ* XRD process. Furthermore, recrystallization of sulfur can occur depending on the cathode morphology. They concluded that *in operando* studies are necessary for further evaluation of sulfur cathodes for Li-S batteries. □

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