Scientists demonstrate high-efficiency quantum dot solar cells

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Research shows newly developed solar powered cells may soon outperform conventional photovoltaic technology. Scientists from the National Renewable Energy Laboratory (NREL) have demonstrated the first solar cell with external quantum efficiency (EQE) exceeding 100 percent for photons with energies in the solar range. (The EQE is the percentage of photons that get converted into electrons within the device.) The researchers will present their findings at the AVS 59th International Symposium and Exhibition, held Oct. 28—Nov. 2, in Tampa, Fla.

While traditional semiconductors only produce one electron from each photon, nanometer-sized crystalline materials such as quantum dots avoid this restriction and are being developed as promising photovoltaic materials. An increase in the efficiency comes from quantum dots harvesting energy that would otherwise be lost as heat in conventional semiconductors. The amount of heat loss is reduced and the resulting energy is funneled into creating more electrical current.

By harnessing the power of a process called multiple exciton generation (MEG), the researchers were able to show that on average, each blue photon absorbed can generate up to 30 percent more current than conventional technology allows. MEG works by efficiently splitting and using a greater portion of the energy in the higher-energy photons. The researchers demonstrated an EQE value of 114 percent for 3.5 eV photons, proving the feasibility of this concept in a working device.

Joseph Luther, a senior scientist at NREL, believes MEG technology is the right direction. "Since current solar cell technology is still too expensive to completely compete with non-renewable energy sources, this technology employing MEG demonstrates that the way in which scientists and engineers think about converting solar photons to electricity is constantly changing," Luther said. "There may be a chance to dramatically increase the efficiency of a module, which could result in solar panels that are much cheaper than non-renewable energy sources."

Provided by American Institute of Physics

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