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Hybrid solar cell converts both light and heat from sun's rays into electricity

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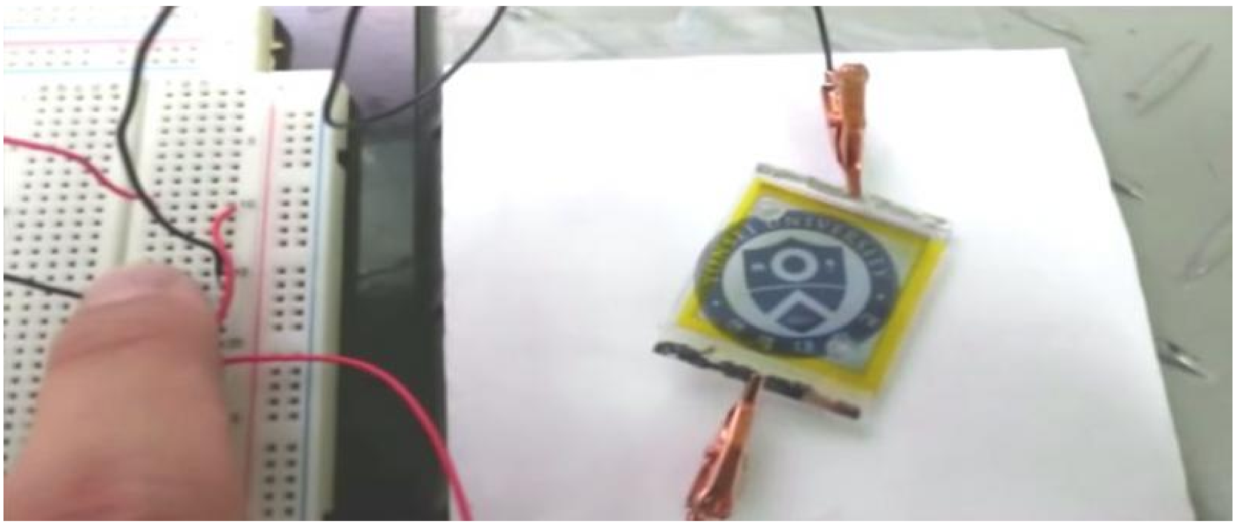

Scientists have developed a new hybrid, solar-energy system that harnesses the full spectrum of the sun's radiation by pairing a photovoltaic cell with polymer films. The films convert the light that goes unused by the solar cell into heat and then converts the heat into electricity. They report on their device, which produces a voltage more than five times higher than other hybrid systems, in the journal *ACS Nano*.

Solar cells today are getting better at converting sunlight to electricity, but commercial panels still harvest only part of the radiation they're exposed to. Scientists are working to change this using various methods. One approach is to hybridize solar cells with different materials to capture more of the sun's energy. Eunkyoung Kim and colleagues turned to a clear, conductive polymer known as PEDOT to try to accomplish this.

The researchers layered a dye-sensitized solar cell on top of a PEDOT film, which heats up in response to light. Below that, they added a pyroelectric thin film and a thermoelectric device, both of which convert heat into electricity. The efficiency of all components working together was more than 20 percent higher than the solar cell alone. With that boost, the system could operate an LED lamp and an electrochromic display.

More information: Photothermally-Activated Pyroelectric Polymer Films for Harvesting of Solar Heat with a Hybrid Energy Cell Structure, *ACS Nano*, Just Accepted Manuscript, DOI: 10.1021/acsnano.5b04042

Abstract
Photothermal effects in poly(3,4-ethylenedioxythiophene)s (PEDOTs) were explored for pyroelectric conversion. A poled ferroelectric film was coated on both sides with PEDOT via solution casting polymerization of EDOT, to give highly conductive and effective photothermal thin films of PEDOT. The PEDOT films not only provided heat source upon light exposure but worked as electrodes for the output energy from the pyroelectric layer in an energy harvester hybridized with a thermoelectric layer. Compared to a bare thermoelectric system under NIR irradiation, the photothermal-pyro-thermoelectric device showed more than 6 times higher thermoelectric output due to the additional pyroelectric output. The photothermally driven pyroelectric harvesting film provided a very fast electric output

with a high voltage output (Vout) of 15 V. The pyroelectric effect was significant due to the transparent and high photothermal PEDOT film, which could also work as an electrode. A hybrid energy harvester was assembled to enhance photo-conversion efficiency (PCE) of a solar cell with a thermoelectric device operated by the photothermally generated heat. The PCE was increased more than 20% under sunlight irradiation (AM 1.5G) utilizing the transmitted light through the photovoltaic cell as a heat source that was converted into pyroelectric and thermoelectric output simultaneously from the high photothermal PEDOT electrodes. Overall, this work provides a dynamic and static hybrid energy cell to harvest solar energy in full spectral range and thermal energy, to allow solar powered switching of an electrochromic display.

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