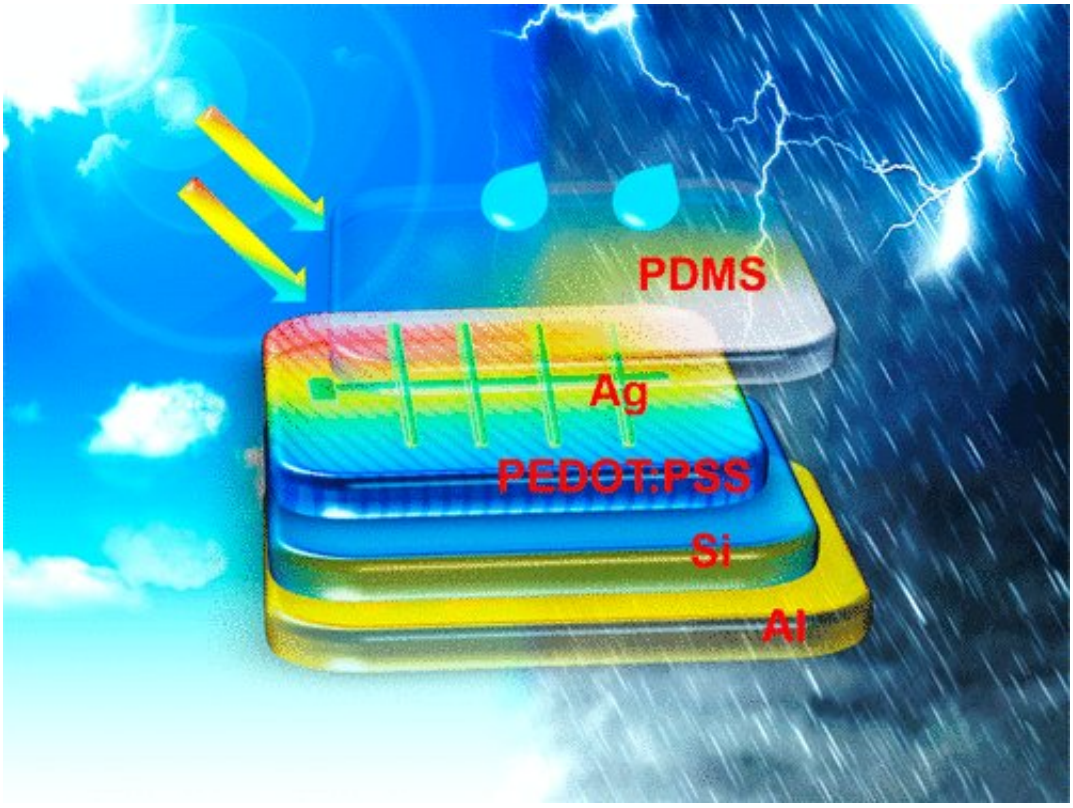
# With a TENG, solar cells could work come rain or shine

March 7 2018




Credit: American Chemical Society

Despite the numerous advances in solar cells, one thing remains constant: cloudy, rainy conditions put a damper on the amount of electricity created. Now researchers reporting in the journal *ACS Nano* have developed hybrid solar cells that can generate power from raindrops.

In areas where it frequently rains, solar cells might not seem like the best choice for energy production. The sky becomes cloudy, preventing the sun's rays from reaching the cell. Researchers have been developing devices that can generate energy in rainy conditions. Previous studies add a pseudocapacitor or triboelectric nanogenerator (TENG) to an existing solar cell, creating a device that can make energy from the motion of raindrops. But these devices are usually complicated to manufacture and are bulky. So Zhen Wen, Xuhui Sun, Baoquan Sun and colleagues wanted to develop a better hybrid energy harvesting system.

The researchers imprinted two polymers, PDMS and PEDOT:PSS, with grooves by placing them onto commercially available DVDs. PDMS is polydimethylsiloxane and PEDOT:PSS is poly(3,4-ethylenedioxythiophene):poly(styrenesulfonate). Adding texture to the PDMS increased the TENG performance of this material when water drops touched it and then fell off it. The textured PEDOT:PSS layer acted as a mutual electrode for both the TENG and the solar cell. It was placed between the two devices and conducted energy from the TENG to the cell. Because the polymers are transparent, the solar cell could still generate energy from sunlight, as well as from falling raindrops. The team notes this simple design demonstrates a new concept in energy harvesting during various weather conditions.

**More information:** Yuqiang Liu et al. Integrating a Silicon Solar Cell with a Triboelectric Nanogenerator via a Mutual Electrode for Harvesting Energy from Sunlight and Raindrops, *ACS Nano* (2018). DOI: 10.1021/acsnano.8b00416

**Abstract**
Solar cells, as promising devices for converting light into electricity, have a dramatically reduced performance on rainy days. Here, an energy harvesting structure that integrates a solar cell and a triboelectric nanogenerator (TENG) device is built to realize power generation from

both sunlight and raindrops. A heterojunction silicon (Si) solar cell is integrated with a TENG by a mutual electrode of a poly(3,4-ethylenedioxythiophene):poly(styrenesulfonate) (PEDOT:PSS) film. Regarding the solar cell, imprinted PEDOT:PSS is used to reduce light reflection, which leads to an enhanced short-circuit current density. A single-electrode-mode water-drop TENG on the solar cell is built by combining imprinted polydimethylsiloxane (PDMS) as a triboelectric material combined with a PEDOT:PSS layer as an electrode. The increasing contact area between the imprinted PDMS and water drops greatly improves the output of the TENG with a peak short-circuit current of ~33.0 nA and a peak open-circuit voltage of ~2.14 V, respectively. The hybrid energy harvesting system integrated electrode configuration can combine the advantages of high current level of a solar cell and high voltage of a TENG device, promising an efficient approach to collect energy from the environment in different weather conditions.

Provided by American Chemical Society