# The future of perovskite solar cells has just got brighter—come rain or shine

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Widely known as one of the cleanest and most renewable energy sources, solar energy is a fast growing alternative to fossil fuels. Among the various types of solar materials, organometal halide perovskite in particular has attracted researchers' attention thanks to its superior optical and electronic properties. With a dramatic increase in the power conversion efficiency (PCE) from 3% in 2009 to as high as over 22% today, perovskite solar cells are considered as a promising next-generation energy device; only except that perovskite is weak to water and quickly loses its stability and performance in a damp, humid environment.

A team of Korean researchers led by Taiho Park at Pohang University of Science and Technology (POSTECH), Korea, has found a new method to improve not only the efficiency, but stability and humidity tolerance of perovskite solar cells. Park and his students, Guan-Woo Kim and Gyeongho Kang, designed a hydrophobic conducting polymer that has high hole mobility without the need of additives, which tend to easily absorb moisture in the air. They recently published their findings in *Energy & Environmental Science*.

Perovskite solar cells in general consist of a transparent electrode, an electron transport layer, perovskite, a hole transport layer, and a metal electrode. The hole transport layer is important because it not only transports holes to the electrode but also prevents perovskite from being directly exposed to air. Spiro-MeOTAD, a conventionally used hole-transport material, needs additives due to its intrinsically low hole mobility. However, Bis(trifluoromethane)sulfonimide lithium salt (LiTFSI), one of the common additives, is prone to suck in moisture in the air. Moreover, Spiro-MeOTAD forms a slightly hydrophilic layer that easily dissolves in water, and thus it cannot work as a moisture barrier itself.

Park's team focused on an idea of an additive-free (dopant-free) polymeric hole transport layer. They designed and synthesized a hydrophobic conducting polymer by combining benzodithiophene (BDT) and benzothiadiazole (BT). As the new polymer has a face-on orientation, which helps vertical charge transport of holes, the researchers were able to achieve high hole mobility without any additives.

Park and colleagues confirmed that the perovskite solar cells with the new polymer showed high efficiency of 17.3% and dramatically improved stability—the cells retained the high efficiency for over 1400 hours, almost two months, under 75 percent humidity.

"We believe that our findings will bring perovskite one step closer to use and accelerate the commercialization of perovskite solar cells," commented Taiho Park, a professor with the Department of Chemical Engineering at POSTECH.

Provided by Pohang University of Science & Technology

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