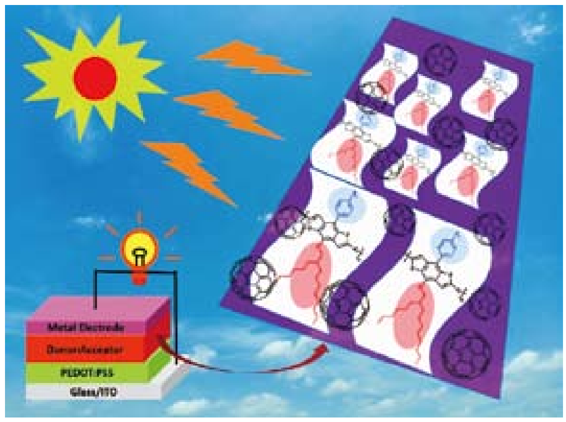
Symmetry-breaking for Flexible Solar Cells: A Better Commercialization Perspective?

You may have seen solar cells on satellites and street lights, but do you know why these solar cells are not widely used in our daily life? Complex device structures, fabrication difficulties, area limitation, high costs, and heavy weight – these factors have all led to their limited application. In contrast, polymer solar cells (PSCs) are emerging as promising alternatives to traditional inorganic solar cells. For instance, if flexible PSCs are available, our office lights can consume the electricity generated from the window curtains containing PSCs.



A symmetry-breaking strategy for constructing flexible solar cells.

An organic molecule called benzodithiophene (BDT) has been identified as one of the most promising electron donor units to obtain high-performance PSCs. The BDTs are usually employed as the building units in a symmetric mode. However, up to now, these symmetric BDTs are still unable to simultaneously attain decent short-circuit current density and high open-circuit voltage, both of which are the key parameters responsible for higher efficiency of PSCs.

For the first time, asymmetric BDTs have been designed to build up PSCs in a research group led by YANG Renqiang from the Qingdao Institute of Bioenergy and Bioprocess Technology. They greatly improved the photovoltaic properties of PSCs in comparison with corresponding symmetric BDT based polymers, and the best PSC showed the highest power conversion efficiencies of 9.44% among the reported photovoltaic polymers with similar structures.

The novel asymmetric idea was somewhat inspired by an interesting experimental incident. Before they came up with such an idea, the researchers had completed a number of tests to improve the performance of PSCs by using symmetric BDTs that other groups were also using. However, the enhancements were quite tiny. One day, during the experiment, a PhD student added the wrong raw materials into the reaction system, and it turned out that the final PSC showed a much higher property than before. After careful analyses, they concluded that it is the asymmetric structure of BDT that had remarkably improved the photovoltaic performance.

This progress provides a novel symmetry-breaking strategy to design high-performance PSCs, which might pave the way for quick commercialization of flexible solar cells in the near future. Their work was recently published in *Advanced Materials*.