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Highly Flexible and Scalable Photo-Rechargeable Power Unit Based on Symmetrical Nanotube Arrays

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Abstract

Here, we report an ultrathin flexible photo-charging power pack that integrates a perovskite solar cell (PSC) and electro-chemical supercapacitor (ESC) on bi-polar TiO₂ nanotube arrays (TNARs). Instead of two independent components, the integrated sandwich-type device allows the direct injection of the electrons generated by the PSCs into the ESCs through shared highly ordered bi-polar TNARs. Meanwhile, the holes separated from the perovskite layer divert into positive electrode of ESCs through an external circuit effectually. When the flexible photo-supercapacitor was illuminated with simulated solar light, the voltage of ESC was increased to 0.63 V within 30 s at the beginning of the charging period immediately. The optimized power pack exhibits a remarkable overall photoelectric conversion (4.9%) and storage efficiency up to 80%, with fast response and superior cycling capability. To meet applicable demands with a larger output voltage, these photo-supercapacitors are successfully woven into “bamboo slip” architecture, which can be folded, bended and allows tuning the open-circuit voltage (>2.4 V) by charging the number of photo-supercapacitor strips.

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