Foldable Perovskite Solar Cells Using Carbon Nanotube-Embedded Ultrathin Polyimide Conductor

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Recently, foldable electronics technology has become the focus of both academic and industrial research. The foldable device technology is distinct from flexible technology, as foldable devices have to withstand severe mechanical stresses such as those caused by an extremely small bending radius of 0.5 mm. To realize foldable devices, transparent conductors must exhibit outstanding mechanical resilience, for which they must be micrometer-thin, and the conducting material must be embedded into a substrate. Here, a carbon nanotubes-polyimide composite film with a thickness of 7 μm is synthesized and used as a foldable transparent conductor in perovskite solar cells. During the high-temperature curing of the carbon nanotubes-embedded polyimide, the carbon nanotubes are stably and strongly *p*-doped using MoO_x, resulting in enhanced conductivity and hole transportability. The ultrathin foldable transparent conductor exhibits a sheet resistance of 82 Ω $sq.^{-1}$ and transmittance of 80% at 700 nm, with a maximum-power-point-tracking-output of 15.2% when made into a foldable solar cell. The foldable solar cells withstood more than 10,000 folding cycles.