

Docket #: S16-407

Scaffold-reinforced perovskite compound solar cells

Stanford researchers have for the first time, demonstrated the use of scaffolding to increase the mechanical and chemical stability of perovskite solar cells. This robust, thin film (100 nm thick) scaffold provides structural reinforcement to the fragile perovskite layer and inhibits crack formation in the layer that would lead to device failure. The scaffold shields cells from applied loads, increasing their fracture toughness by at least 30-fold, and prevents destructive diffusion of chemical species throughout the device. Integration of these scaffolds into perovskite solar cells can improve device reliability and service lifetime, making them competitive with established photovoltaic technologies such as c-Si, CdTe, and CIGS.

Figure

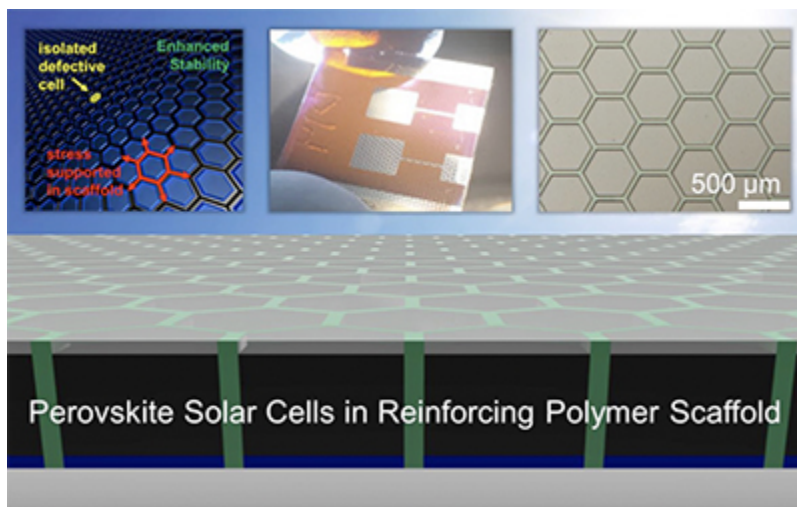


Figure description - One example of the stability a scaffold imparts on a thin film. As a solution to overcome the inherent mechanical fragility of perovskites and their susceptibility to cracking under applied loads, a scaffold was integrated into the device. The scaffold partitions a planar cell into many smaller, mechanically isolated, and chemically contained solar cells. This approach shields the perovskite from mechanical stress and environmental species.

Stage of Research

This design, the compound solar cell (CSC) exhibited a significantly increased fracture energy of $\sim 13 \text{ J m}^{-2}$, a 30-fold increase over previously reported planar perovskite ($\sim 0.4 \text{ J m}^{-2}$), while maintaining efficiencies comparable to planar devices.

Applications

- **Perovskite solar cells**
- Can be integrated into other devices such as **organic solar cells, light-emitting diodes, organic transistors, batteries, electrodes, anti-reflection coatings**
- Scaffolding can be integrated into any thin film that requires enhancement of its thermomechanical or chemical resilience

Advantages

- **Dramatically increases thermomechanical and chemical stability** of perovskite solar cells
- **Mechanically isolated and chemically contained**, limiting failure of cell to one section not entire device
- **Tunable properties:**
 - Scaffold geometry to tune mechanical properties
 - Scaffold chemistry by material selection
- **Multiple, established manufacturing methods:**
 - Photolithography used for initial demonstration
 - Other techniques include embossing, printing (inkjet, 3D, doctor-blading, screen printing, slot-die), evaporation, and solution-based deposition

Publications

- Watson, B.L., Rolston, N.J., Printz, A.D. and Dauskardt, R.H., 2017. [Scaffold-Reinforced Perovskite Compound Solar Cells](#). *Energy & Environmental Science*.

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