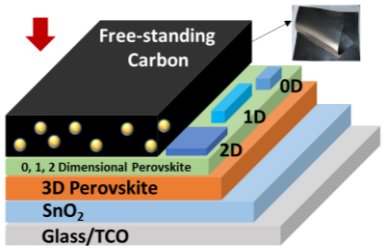
Highly Efficient, Low-cost, and Large-scale Carbon-based Perovskite Solar Cells

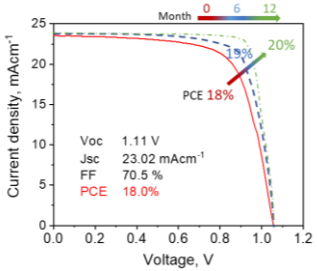
CARBON SOLAR

Project Summary

In this project, our team will demonstrate an innovative low-cost, low temperature and fast hot pressed planar carbon-based planar perovskite solar cell (C-PSC) mini-module (10x10 cm^2) manufacturing with power conversion efficiency >15% using combinational of slot die coating and hot roller to roller approaches. Such fast vacuum free hot-pressed C-PSC can significantly reduce the manufacturing cost and improve the stability of PSC technology. The proposed planar n-i-p device with a baseline efficiency of >18% set in the PI's lab with a triple perovskite. The interface engineering, carbon electrode modification and device engineering will be employed to further improve the efficiency and stability.

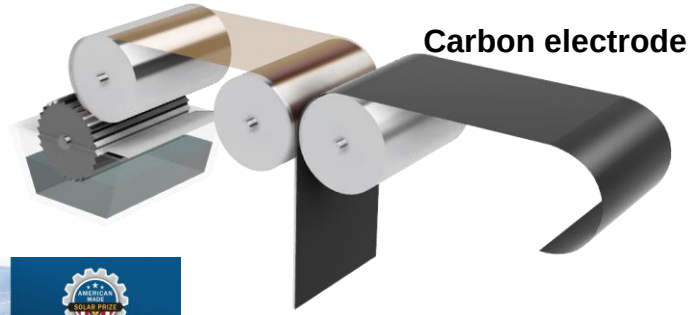
Carbon-based perovskite solar cell





Perovskite films

Carbon electrode



Key Project Members/Partners

The University of Alabama: Dr. Feng Yan, Mr. S. N. Vijayaraghavan, Mr. Jacob Wall, Ms. Wenjun Xiang

National Renewable Energy Lab: Dr. Joseph Berry, Dr. Kai Zhu

Deliverable Technical and Business Goals

- **Demonstrate highly efficiency and stable carbon-based perovskite with efficiency > 20% at small area (0.1 cm^2)**
- **Fabricate carbon-based perovskite mini-module with area 10 x 10 cm^2 and efficiency >15%**
- **Test the cells and mini-module stability at accelerated conditions, including the temperature, moisture, and light intensity.**
- **Demonstrate manufacturability of the carbon-based perovskite solar cells using the roller-to-roller approach.**

Project Impact

This project will significantly reduce the cost of the perovskite solar cells by integrating the low-cost printable free standing carbon electrode. The improved efficiency and stability of the C-PSCs originate from the interface engineering, carbon electrode optimization, and thermal press crystallization. The low cost and high efficient carbon electrode application will significantly drop the cost by replacing the gold-based PSC and extend the PSC lifetime using the hydrophobic carbon electrode. Overall, this project will pave the way for highly efficient, sustainable, and affordable carbon-based perovskite solar module manufacturing. Also, this project will help the flexible PSC, and building-integrated PV (BIPV), even the flexible perovskite solar cells using carbon electrode-based PSC technologies.

Cost effective and scalable Carbon-based planar perovskite solar cells with synergy of high efficiency and stability