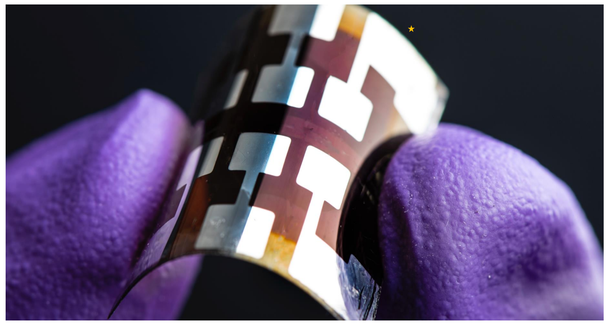
Low-Cost Perovskite Solar Cells for Space & Lightweight Applications

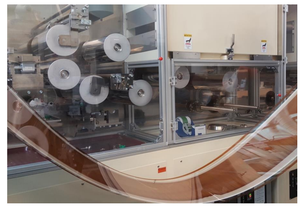
The What



Highest efficiency solar cell ever made on plastic



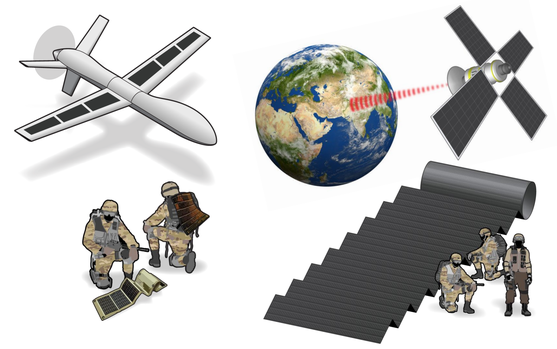
Susanna Blume, Director of Cost Assessment and Program Evaluation, painting a perovskite solar cell



Large-area, roll-to-roll coating on flexible glass—a key technique for low-cost manufacturing

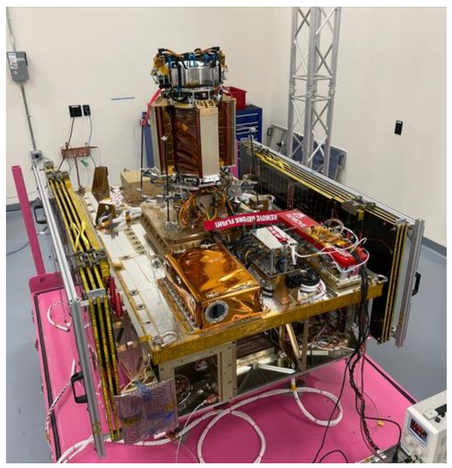
- To perform as needed in space, perovskites solar cells must be hardened against radiation damage.
- The National Renewable Energy Laboratory is developing perovskites solar cells that:
  - Demonstrate 10-year stability in the space environment
  - Reach a power conversion efficiency of 30% at the low cost of < $1/watt.

The Why



- New solar energy applications—like space power beaming and lightweight field deployment—require a new generation of solar cell materials that are:
  - Lightweight
  - Mountable on smooth, flexible surfaces
  - Low-cost
  - Easy to manufacture (print like newspaper).
- Perovskite solar cells meet all these requirements, enabling them to:
  - Supply portable, rapidly deployable power to units and aircraft to mitigate operational energy deficits and enable new capabilities
  - Provide ubiquitous power in the battlespace via power beaming to any point on or above Earth from very large, flexible orbital arrays.

Developing the Solar Cells Needed for Space Power and Other Lightweight, Mobile Applications



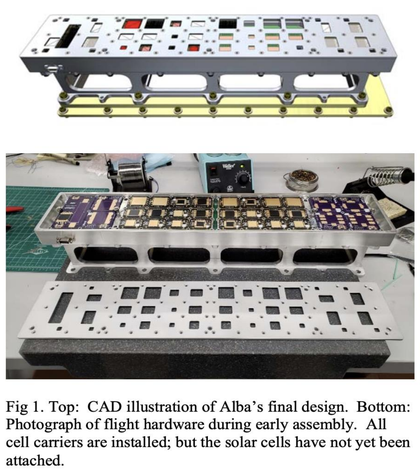


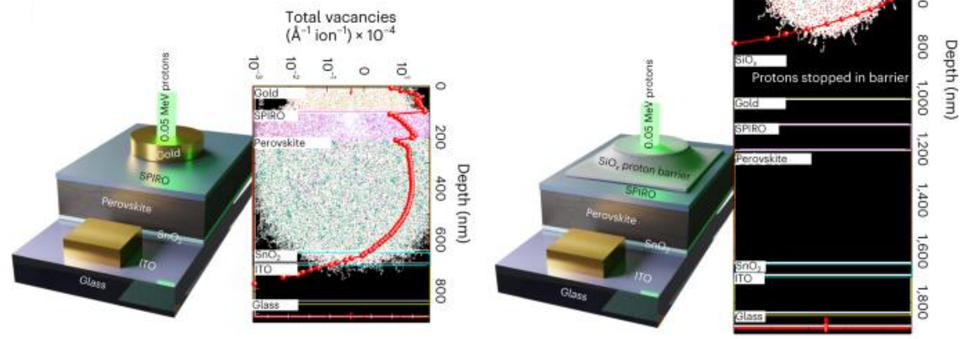
Fig 1. Top: CAD illustration of Alba's final design. Bottom: Photograph of flight hardware during early assembly. All cell carriers are installed; but the solar cells have not yet been attached.

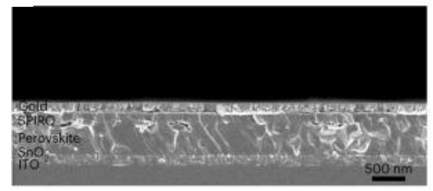


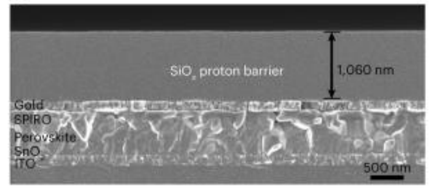
NREL Perovskite Solar Cells in orbit on Momentus Vigoride 5

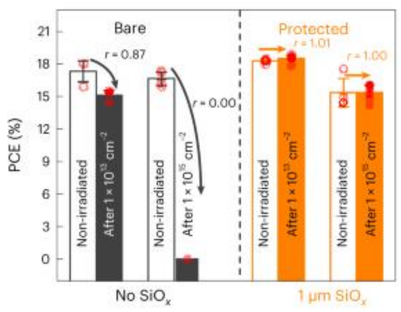
Recent Results

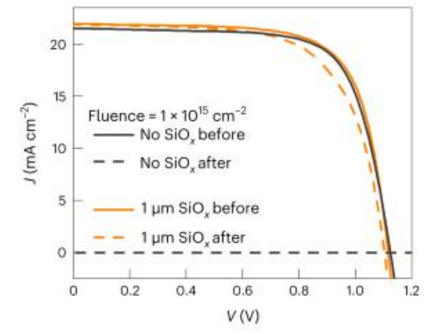
- Developed simple, low cost, thin oxide packaging scheme 125X thinner than traditional cover glass
  - Deposited at the back of the solar cell
  - Provides sufficient protection from the most damaging radiation



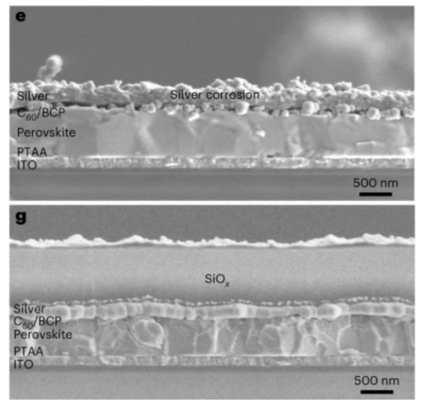








- Protects against extremely harsh atomic oxygen as well as full submersion in DI water with no loss in device performance.



Kirmani et al. Nature Energy 2022