Lightweight and Flexible Metal Halide Perovskite Thin Films for High Temperature Solar Cells

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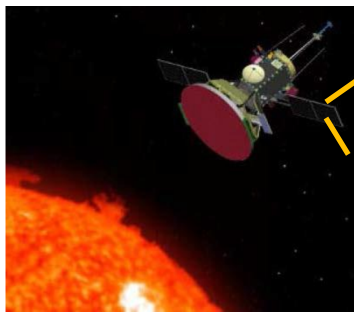
Research Objectives

(1) Develop solar cells with > 20% power conversion efficiency operating above 200 ^{o}C by exploiting positive temperature coefficient of bandgap (dE_g/dT), excellent photovoltaic performance and thermal stability of metal-halide perovskites.

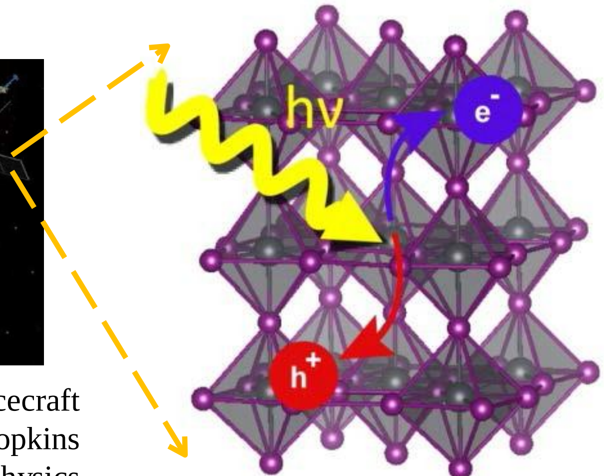
(2) Study structure-bandgap relationships to probe the origin of positive dE_g/dT and enable rapid materials screening and discovery.

(3) Bring the proposed technology from TRL 1 to TRL 3.

Metal-halide perovskite solar cells for high temperature space missions



Solar Probe Plus spacecraft (Credit: NASA/Johns Hopkins University Applied Physics Laboratory)



Approach

- High quality single crystal growth and thin film deposition.
- Solar cell fabrication with novel device architecture.
- High temperature device performance characterization.
- Determination of material degradation temperature.
- Characterization of temperature dependent atomic structure and bandgap with X-ray diffraction, neutron diffraction, Rietveld refinement and optical spectroscopy.
- Establishment of structure-bandgap relationships through density functional theory calculations.

Potential Impact

- Transformative advances in space solar power generation with higher specific power, lower cost and simpler operations compared to the state of the art approaches.
- Reduced need for reflective mirrors, active cooling systems and thermal radiators.
- Flexible thin films enable novel system level concepts for re-stowable/re-deployable arrays
- Infusion with terrestrial solar concentration techs.
- Introduction of a completely new class of materials to high temperature solar cell research field.