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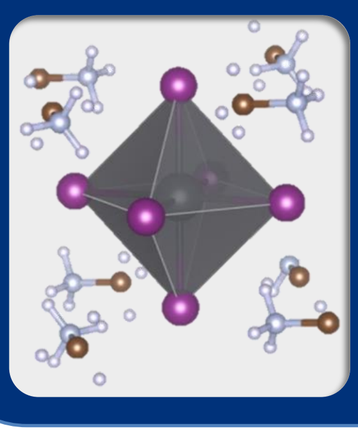
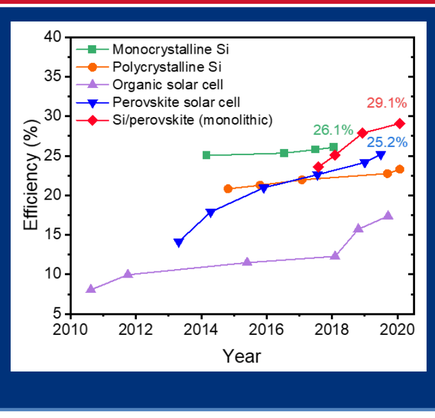
Perovskite Photovoltaics: Advances and Applications

Introduction



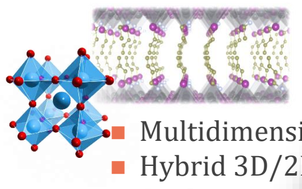
- A is organic cation
  $CH_3NH_3^+$ or $(NH_2)_2CH_3^+$
- B is divalent cation
  Pb^{2+} or Sn^{2+}
- X is halide anion
  I^- , Br^- , Cl^-

Fast-growing efficiency



Characteristics	CdTe	CIGS	C-Si	Perovskite
Materials cost	Low	Medium	Low	Low
Fabrication cost	Low	High	High	Low
LCOE	Medium	High	High	Low
Efficiency	Medium	Medium	High	High
Transparent	No	No	No	Yes

RESEARCH FOCUS

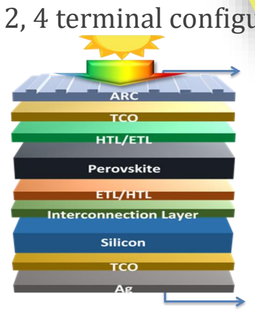


Key Research Approaches

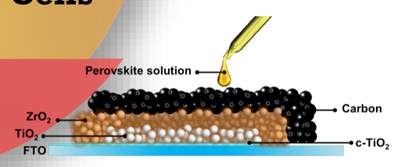
Material Stability
- Multidimensional perovskites
- Hybrid 3D/2D system
- Surface passivation

Ultra Light-weight Solar Cells
- Ultrathin perovskite layer
- Parylene-C flexible substrate
- Low temperature processing

Tandem Solar Cells
- Semi-transparent perovskite PV
- Perovskite/Si, Perovskite/CIGS etc
- 2, 4 terminal configurations

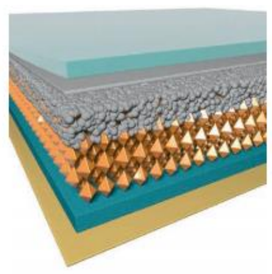


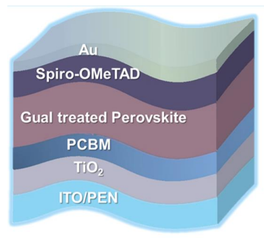
Scale-up

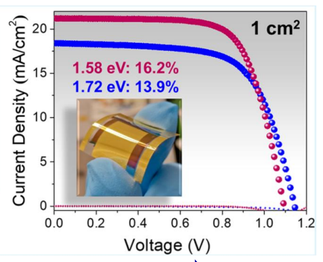


Screen-print, Slot-die, Encapculated prototype
Long-term stability testing

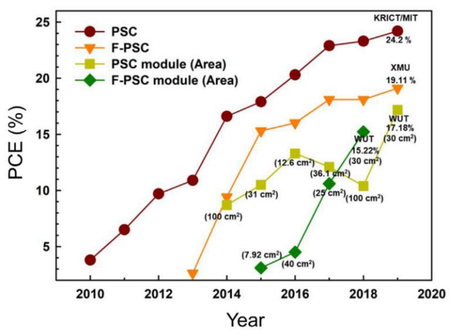
ULTRA LIGHT-WEIGHT SOLAR CELLS

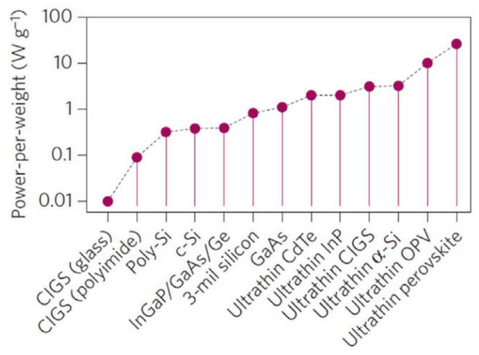






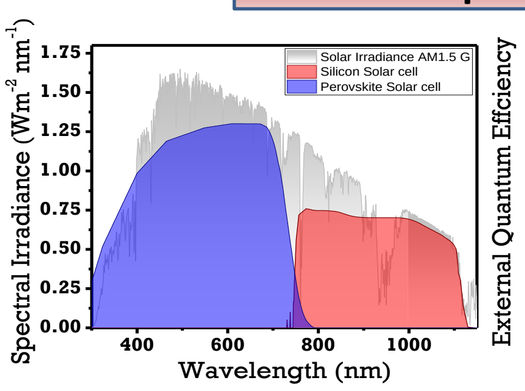
Translation from rigid-thick to flexible light-weight devices

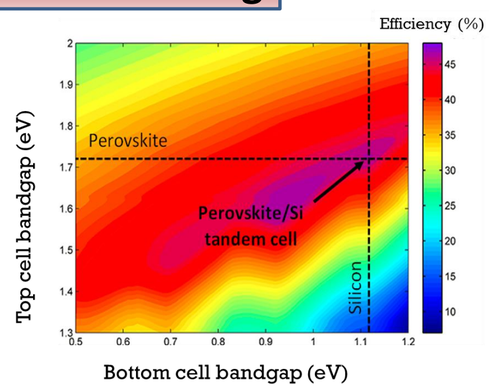


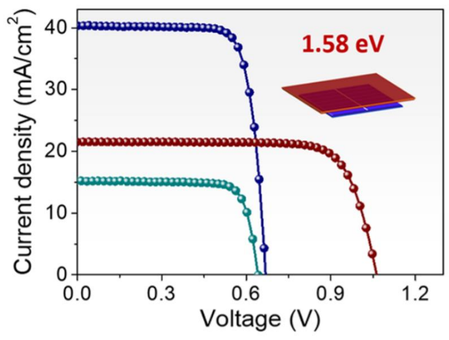


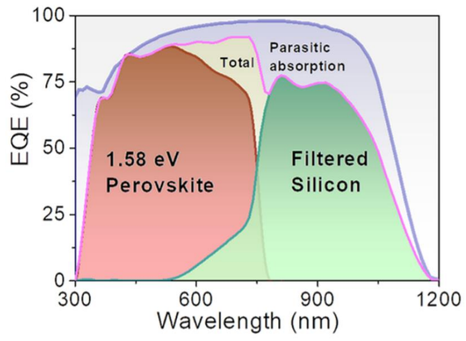
TOWARDS >30% EFFICIENT SOLAR CELLS

Increased spectral harvesting



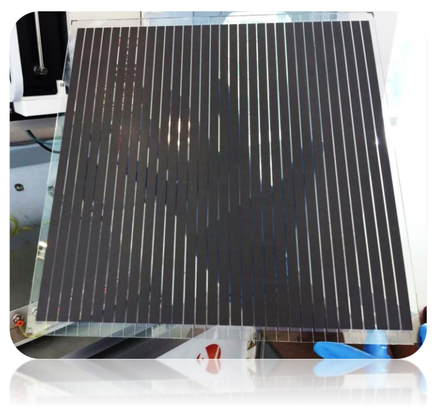




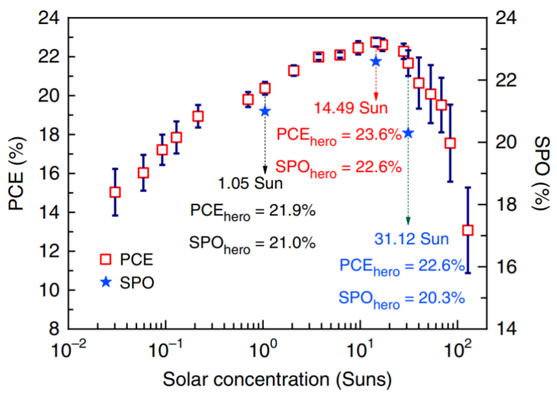


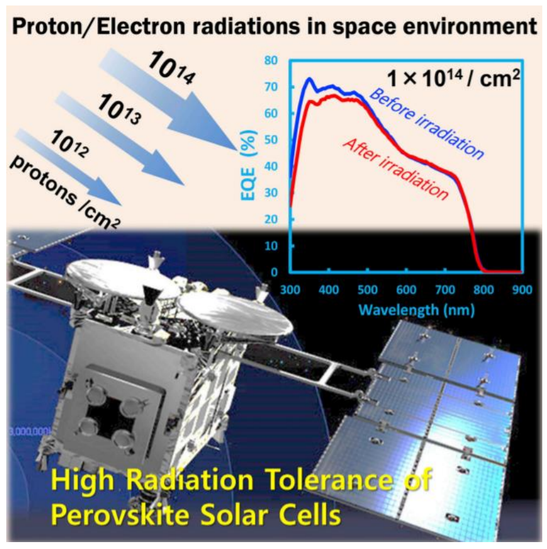
	V_{oc} (V)	J_{sc} (mA/cm²)	FF (%)	Efficiency (%)
Si unfiltered	0.66	40.2	79.0	21.1
Si filtered	0.63	15.2	81.1	7.8
Perovskite	1.06	21.5	77.5	17.7
				25.5

BUILDING-INTEGRATED PHOTOVOLTAIC AND SPACE APPLICATION



Going beyond terrestrial illumination





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1) *Nature Energy* **2018**, 3, 855; 2) *ACS Appl. Energy Mater.* **2020**, 3, 777; 3) *ACS Appl. Mater. Interfaces* **2019**, 11, 34178; 4) *iScience* **2018**, 2, 148; and 5*) Sci. China-Phys. Mech. Astron*. **2019**, 62, 974221.

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