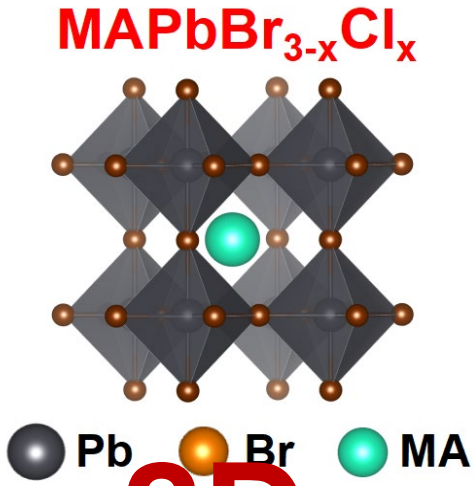
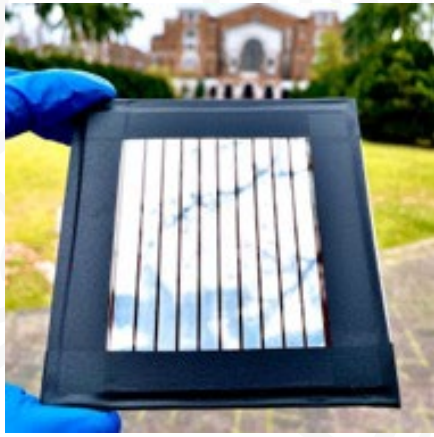



Lightning talk
SOLSTICE Proposers Day IARPA
May.7.2024

# 2D perovskite solar cells and the interfaces



**Wanyi Nie**
**Associate Professor, Department of Physics**
**SUNY University at Buffalo**
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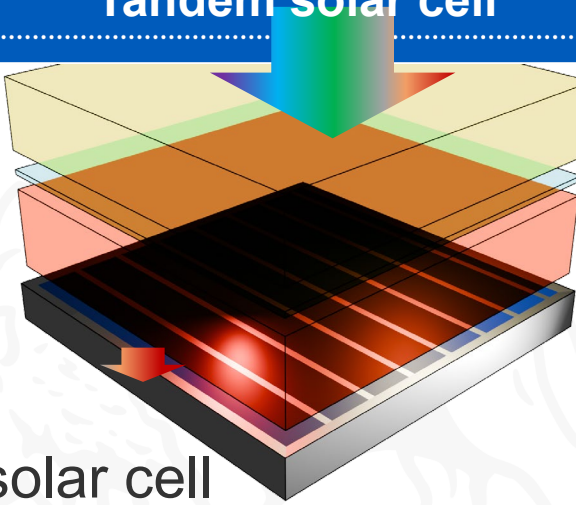
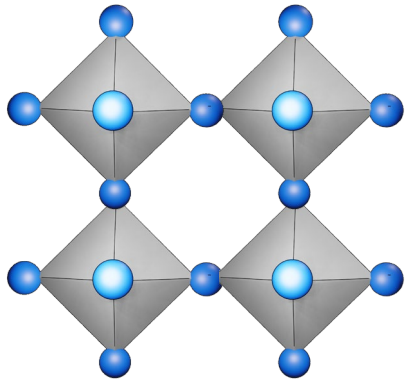
Tandem solar cell



# Perovskite for high efficiency photovoltaics

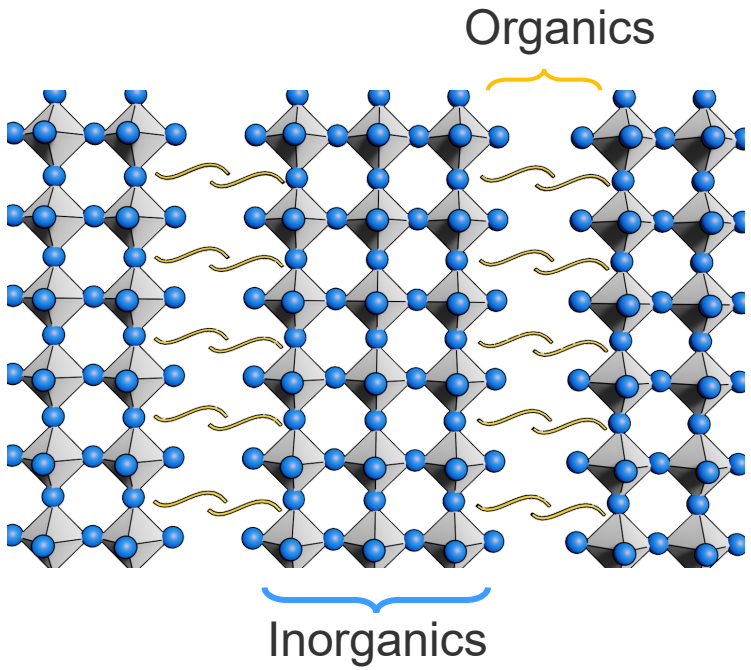
3D perovskite $ABX_3$

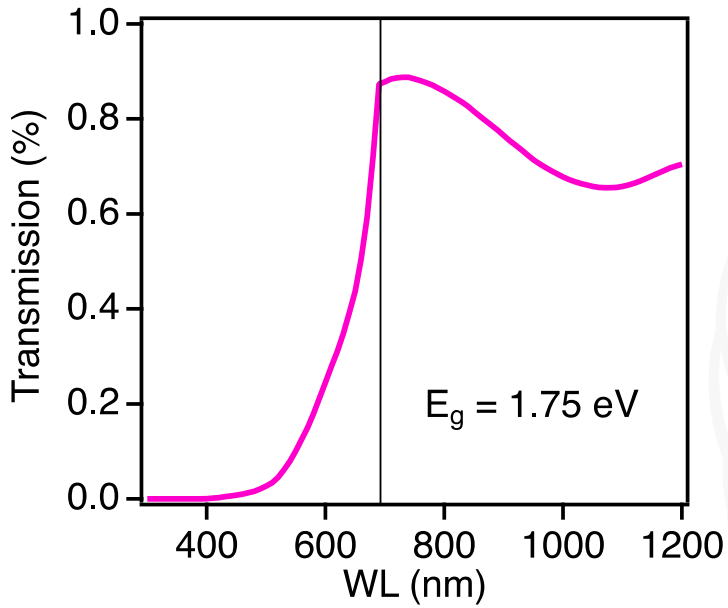


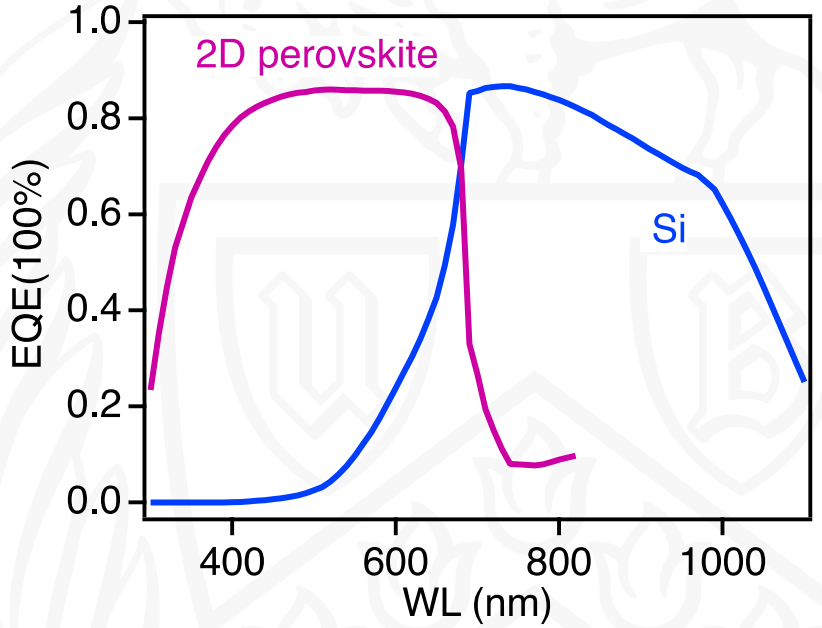
A = Cations
B = Pb, Sn
X = halides

- Solution grown semiconductor for ultra-thin solar cell
- Single junction perovskite cell with 25% power conversion efficiencies demonstrated
- Wide gap perovskite top cell can boost Si cell's efficiency to approach 40% by building a tandem
- Radiation hardness properties – feasible for space PV
- **However, wide gap 3D perovskite isn't stable**

# 2D perovskite solar cell is an intrinsically stable top cell material for tandem



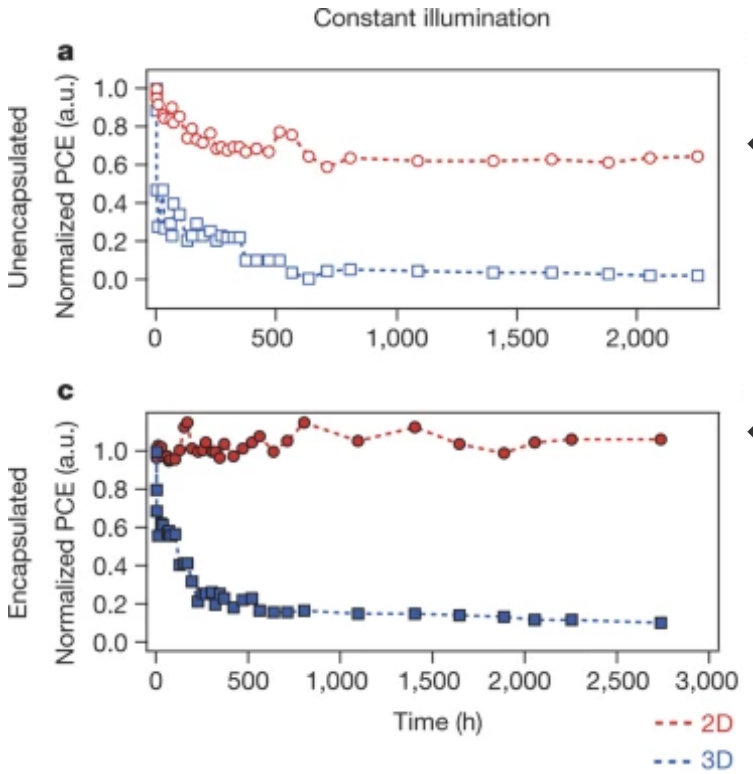

- 2D perovskite has an intrinsic band gap of 1.75 eV by the quantum confinement effect

Ahn et al, under prep (2024)

- Our optical simulation shows an ideal band gap matching with low band gap Si cell

# Stability and upscaling

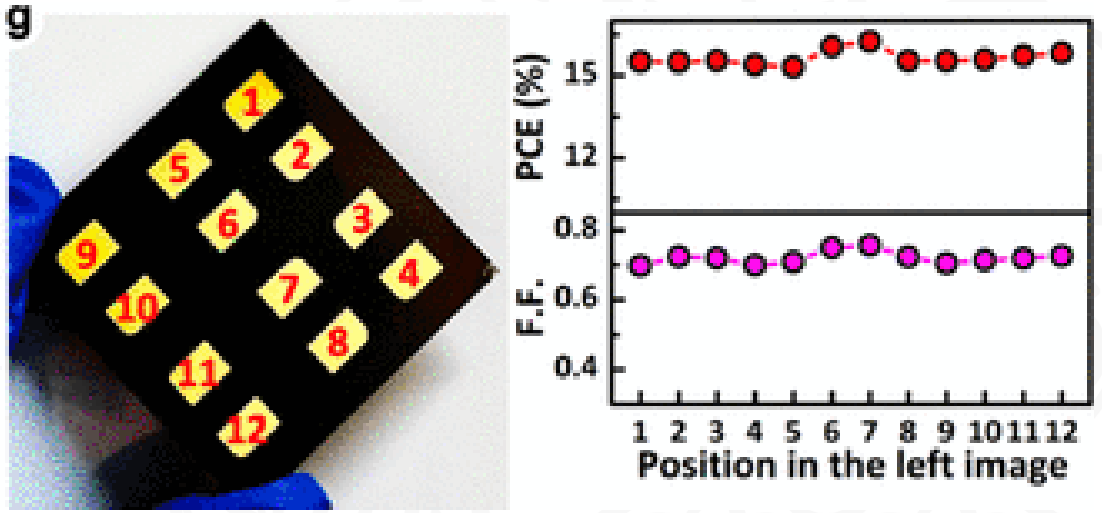
- Better stability of 2D perovskite




- PCE of 12.5% obtained from a 2D perovskite solar cell
- 2D cell shows a much stable performance under constant illumination

Tsai-Nie et al, Nature, 536, 312 (2016); Tsai et al., Adv. Mater.,30, 1704217(2018)

- Upscaling method for 2D perovskite solar module

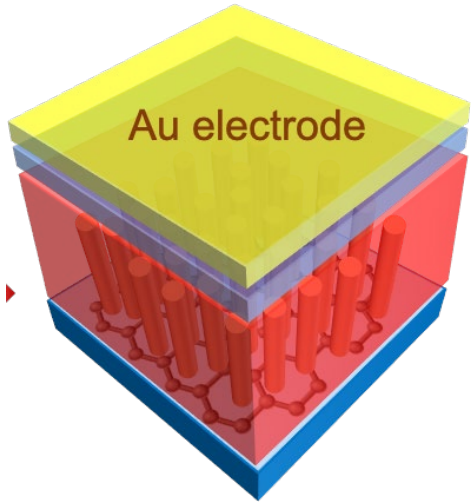



- PCE > 15% achieved from a 2D large area device

Huang et al, ACS Materials Lett. 2023, 5, 5, 1384–1394

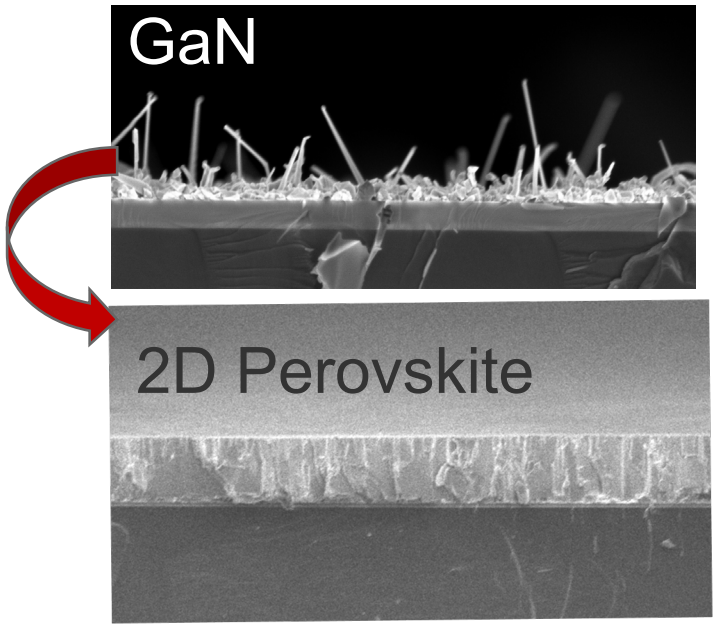
# GaN as robust n-type interface

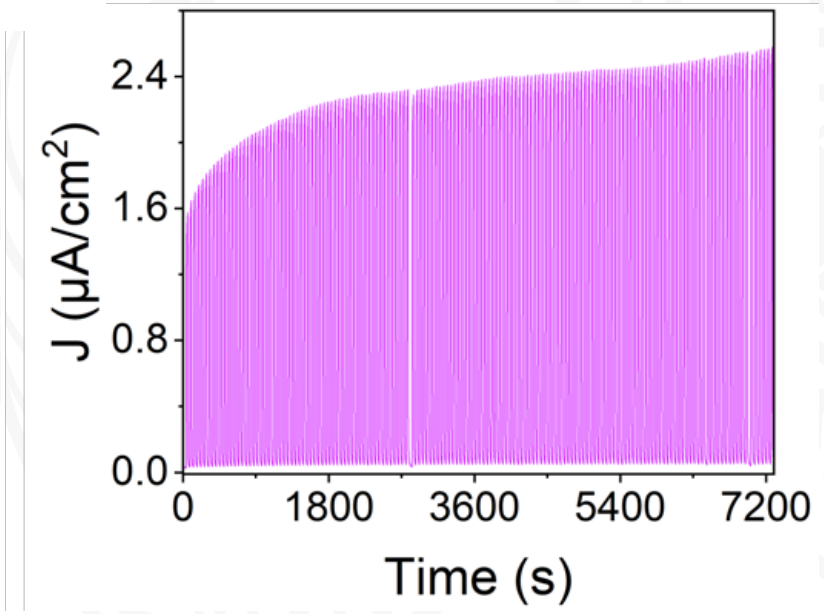
- GaN is a n-type, rad-hard semiconductor




- We built a PIN diode with perovskite/GaN interface

- Stable current output under 200 cycles of X-ray irradiation in ambient air




Kim et al, submitted (2024)