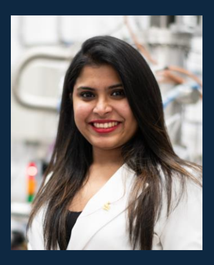
A NEW GENERATION OF STABLE, HIGH EFFICIENCY PEROVSKITE PHOTOVOLTAICS



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7 AFFORDABLE AND CLEAN ENERGY | 11 SUSTAINABLE CITIES AND COMMUNITIES | 13 CLIMATE ACTION

Targeted SDGs

UK's Clean Power 2030 plan:

50 GW

of solar power

Solar coverage needed for this target – London as a reference

Silicon solar cells

Need x 1.5 the area of London

Double-junction solar cells

Need the area of London

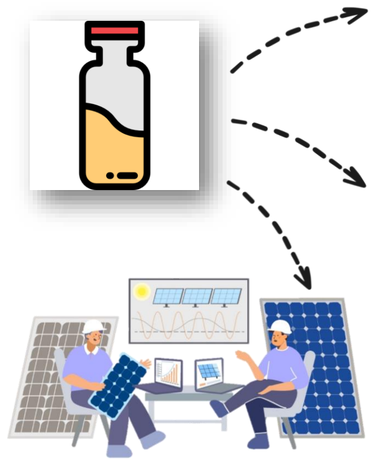
Triple-junction solar cells

Need x 0.8 the area of London

The Tandem Advantage!

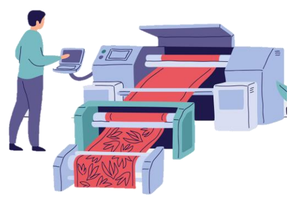
Stacked multiple semiconductors can overcome the efficiency limit of a single semiconductor solar cell.

PEROVSKITES



Manufacturing process
- compatible with Si

Printable
- like newspapers



Bandgap tunable
- suitable for tandem solar cells

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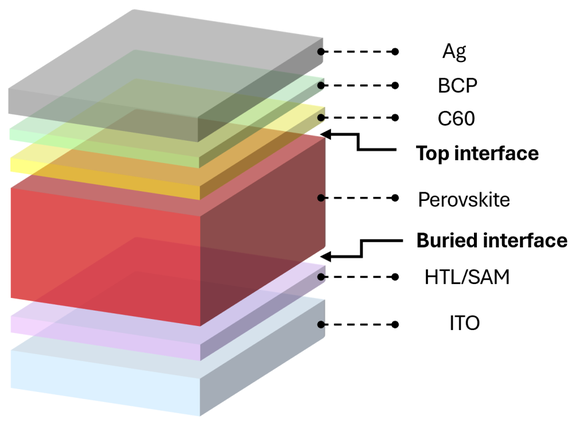
Major challenge for commercialisation of perovskite solar cells? STABILITY!

- Current silicon technology has ~25 years stability.
- Perovskite degradation is accelerated with exposure to heat, moisture and oxygen.
- While the **top interface** can be engineered for protection against the above factors, the **buried interface** remains less explored due to its inaccessibility.



Typical architecture of a perovskite solar cell

Interface-to-bulk engineering for stable, high efficiency photovoltaic devices

Nano-engineered material for capturing interface destabilising molecules

A **10-fold improvement in device lifetimes (~1500 h)** under accelerated stress testing.

Nano-driven design to improve chemical, electrical and electronic homogeneity of the perovskite semiconductor

Less performance drift during accelerated stress testing.

Molecular additive to stabilise the semiconductor bulk against degradation

Leading to **~30% improvement in device performance**.

Strong molecular reducing agent for enhanced durability

~66% improvement in device lifetime as compared to devices without the reducing agent.

Advanced nano and molecular engineering enables superior stability of perovskite semiconductors.

FUTURE WORK: AI-assisted discovery of improved molecular and nano stabilisers screened using high throughput automated manufacturing to push efficiency and stability for next generation multijunction modules.

RESEARCH OUTPUT

1. W. H. K. Perera et al., "Modification of hydrophobic self-assembled monolayers with nanoparticles for improved wettability and enhanced carrier lifetimes over large areas in perovskite solar cells", *Solar RRL*, 2023, **7**, 2300388.
2. W. H. K. Perera et al., "23.2% efficient low band gap perovskite solar cells with cyanogen management", *Energy & Environmental Science*, 2025, **18**, 439-453.
3. W. H. K. Perera et al., "Improved stability and electronic homogeneity in perovskite solar cells *via* a nanoengineered buried oxide interlayer", *EES Solar*, 2025, Advance Article.

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