Solar beyond silicon: developing next-generation solar cells with quasi-2D perovskites

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Context

97%

of silicon wafers are made in China[1], creating a global monopoly

> £6 bn/yr

cost to the UK from importing solar panels[2]

100 GW

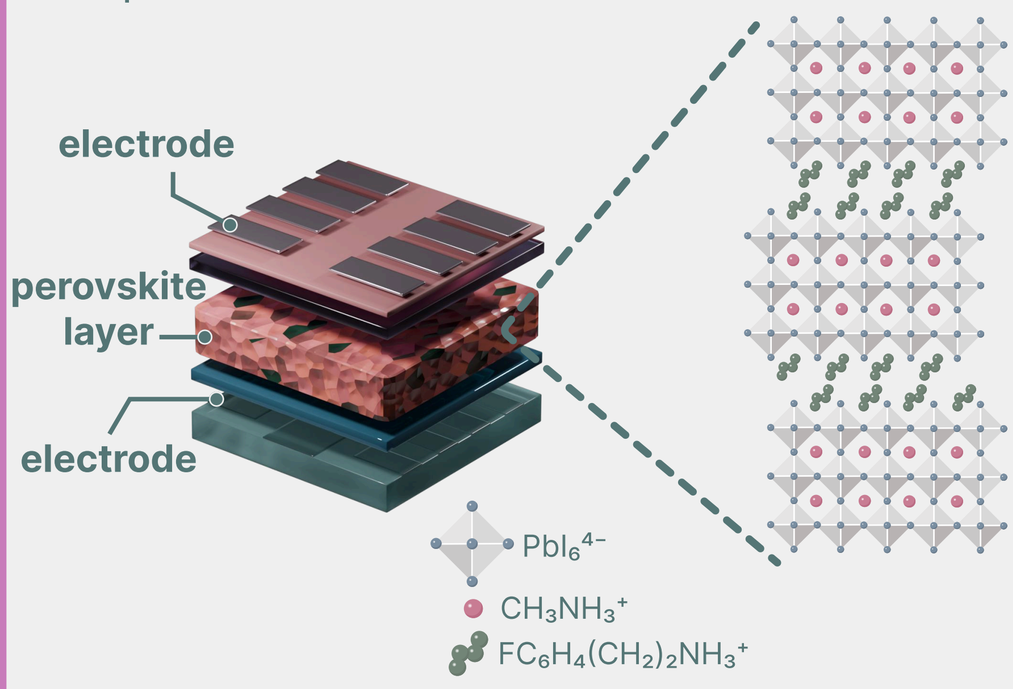
of solar capacity needed to reach net zero by 2050[3], ~ 5X current capacity[4]

Achieving this scale of deployment requires the development of **new technologies** that can be **fabricated in the UK** from abundant materials.

Targeting higher **efficiencies** means that the **total capacity** can be increased with fewer modules, and the **levelised cost of electricity** can be reduced.

Perovskite solar cells

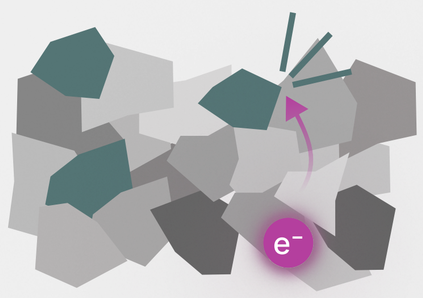
Quasi two-dimensional (q-2D) perovskites are a type of **semiconductor** that can replace silicon in conventional solar cells.



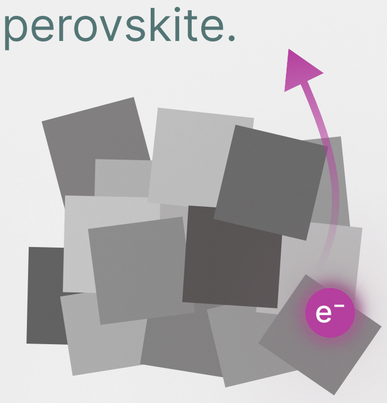
These materials can be manufactured **anywhere in the world** and have the potential for higher efficiencies than silicon, reducing the **cost-per-watt** of energy generation.

The challenge: controlling disorder

q-2D perovskites suffer from **disorder**, leading to poor solar cell efficiency. Overcoming this requires **controlling the growth** of the perovskite.

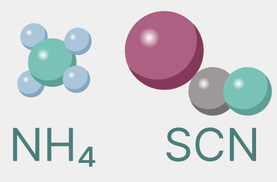


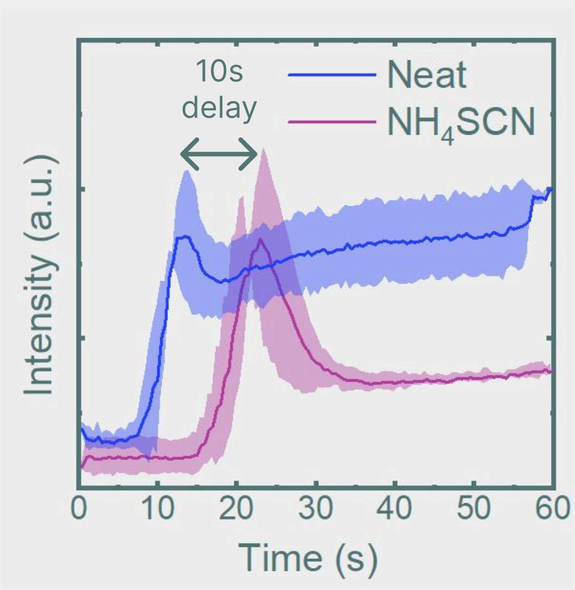
rapid, uncontrolled growth results in **current - blocking phases**



controlled growth = better **current extraction**

Impact: increased efficiency of q-2D solar cells

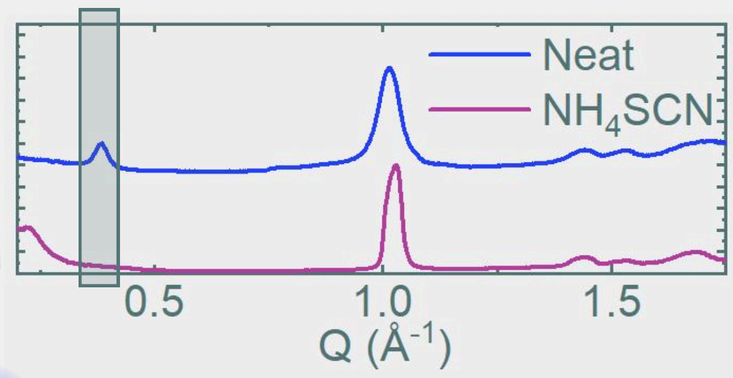




We utilise an additive, **ammonium thiocyanate (NH_4SCN)**, to slow down perovskite growth, allowing for control over the final structure.

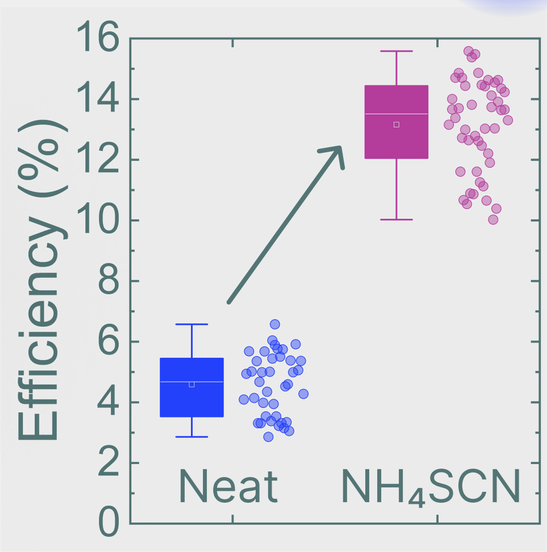
in-situ optical characterisation demonstrates a **slower crystallisation**

X-Ray diffraction shows **structural control** through the suppression of **current - blocking phases**



3X

efficiency increase for solar cells tested under sunlight conditions



These results demonstrate the criticality of controlling disorder in developing **next-generation solar cells**. We aim to build on this by field-testing these devices to study their operational stability, aiming for **high-performance, durable** solar cells.

References:

[1] Special Report on Solar PV Global Supply Chains, *IEA*, 2022
[2] Global Solar Panel Import Data 2024-25, *TradeImeX*, 2025
[3] The Seventh Carbon Budget, *Climate Change Comittee*, 2025
[4] Solar photovoltaics deployment, *DESNZ*, 2025