UNIVERSITY OF CAMBRIDGE
Cavendish Laboratory

THE WINTON PROGRAMME FOR THE Physics of Sustainability

EPSRC CENTRE FOR DOCTORAL TRAINING NEW AND SUSTAINABLE PHOTOVOLTAICS
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Solar panels: the next generation

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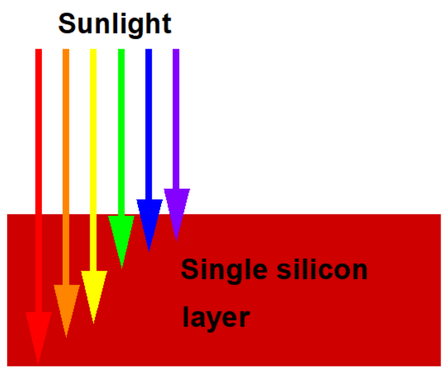
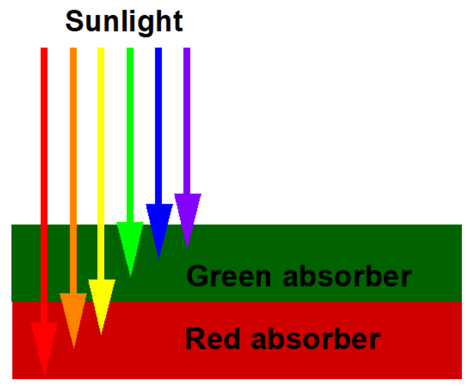
Today's solar panels

Current solar panels have a single layer of silicon to capture the sun's light. This design has a maximum efficiency of 29 %. Efficiency is defined as the energy output by the panel compared to the sun's energy on the panel.

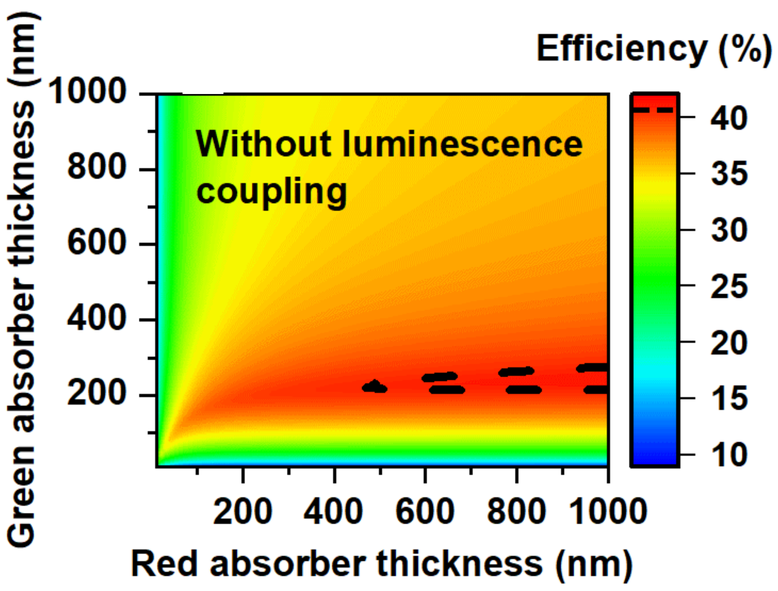


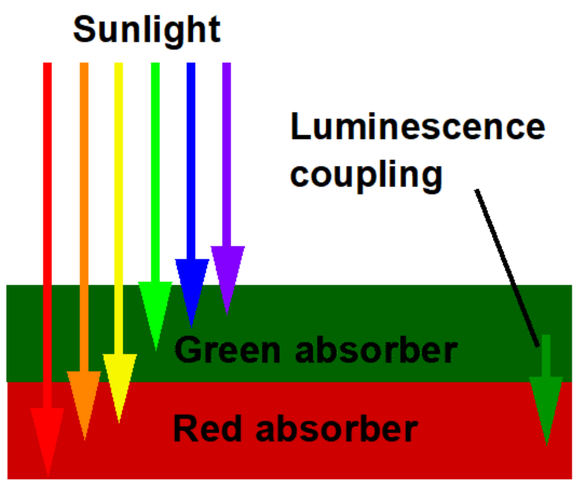
New materials for the next generation

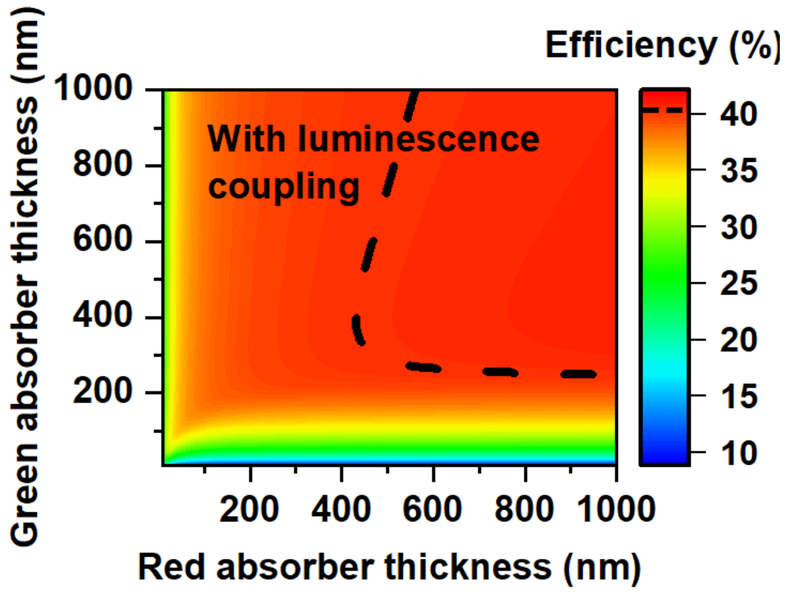
A group of materials called halide perovskites has recently shown promise as solar panels. By combining two of them it's possible to absorb different colours of the sun's light in each layer. This is called a ***tandem solar panel.***



We found the maximum efficiency of a halide perovskite tandem is 41 %







We calculated the maximum efficiency with different thicknesses of the two (red and green) halide perovskite layers. The dashed line shows the thicknesses needed to get 41% efficiency.

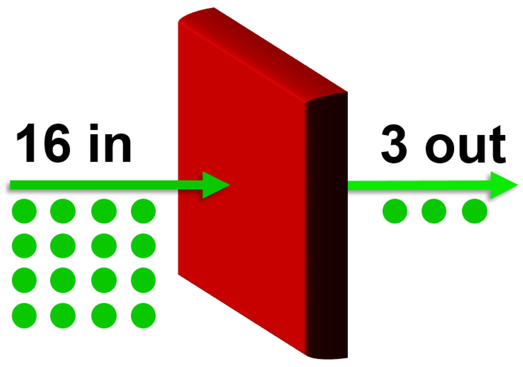
Results improved further when we established a process called luminescence coupling (light transferring from the green to red absorber, see diagram) was important in these tandems.

Luminescence coupling meant more thicknesses could be used to make tandems with 41% efficiency (as the dashed line covers a larger area).

Luminescence coupling means that halide perovskite tandems are easier to make and work better in cloudy conditions than previously thought.

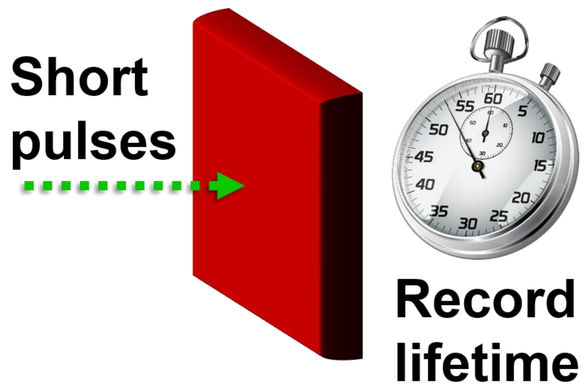
What we measured to obtain these results:

1. Light absorption



We measured the amount of light each halide perovskite could absorb. We sent a known number of photons (light particles) at the halide perovskite and counted how many were not absorbed. In this example 13 out of every 16 photons are absorbed.

2. Energy loss



We needed to understand how halide perovskites could lose the energy absorbed from the sun. To do this we fired short pulses of light (like camera flashes) at the halide perovskite and timed how long the absorbed energy lasted within the material.

Halide perovskite tandems hold great promise as the next generation of solar panels

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For more information please see: A. R. Bowman, F. Lang, Y. H. Chiang, A. Jiménez-Solano, K. Frohna, G. E. Eperon, E. Ruggeri, M. Abdi-Jalebi, M. Anaya, B. V. Lotsch and S. D. Stranks, *ACS Energy Lett.*, 2021, **6**, 612–620.