From Lab to Industry: Starch as a Green Stabilizer for Cost-Effective Perovskite Solar Cells

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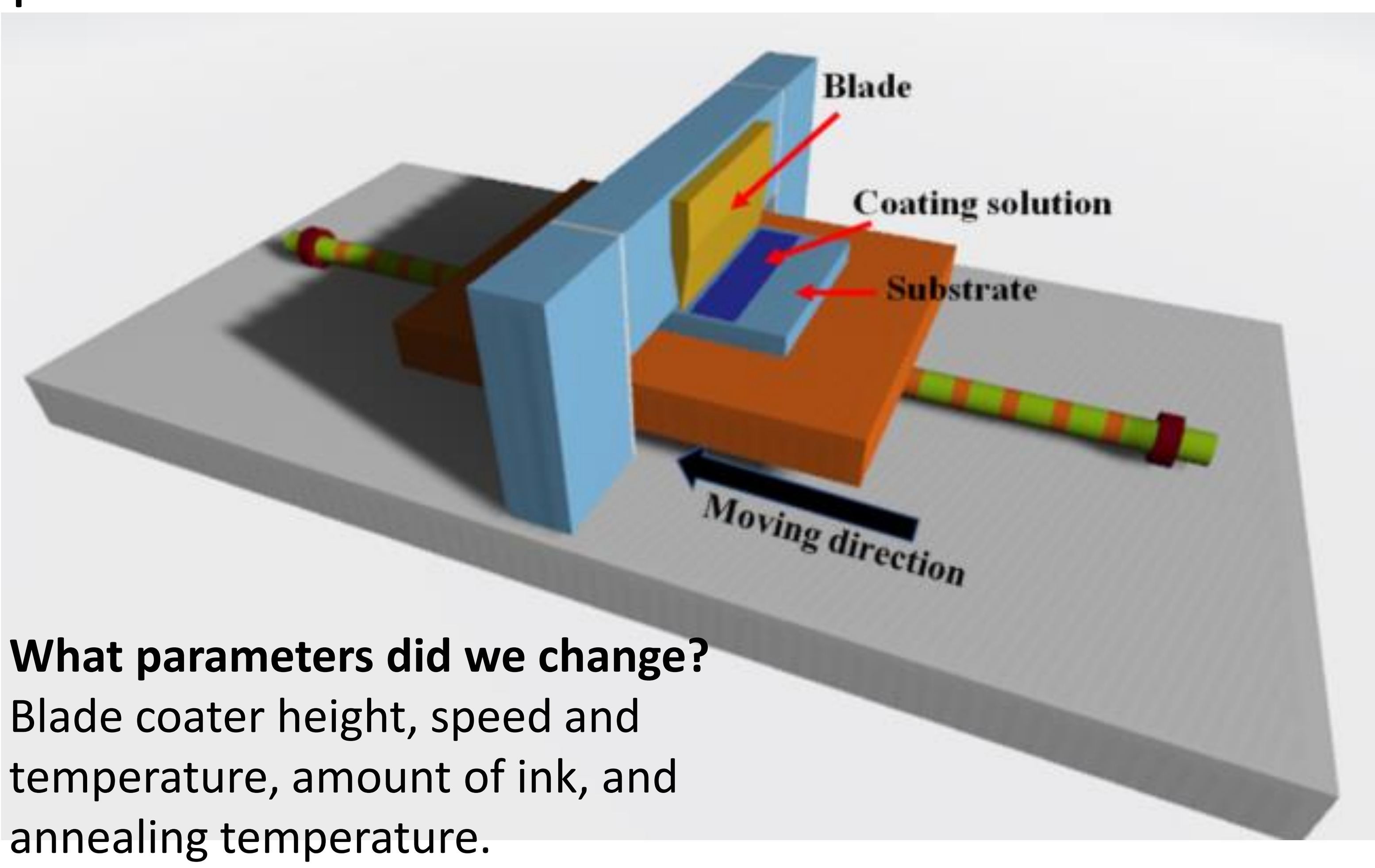
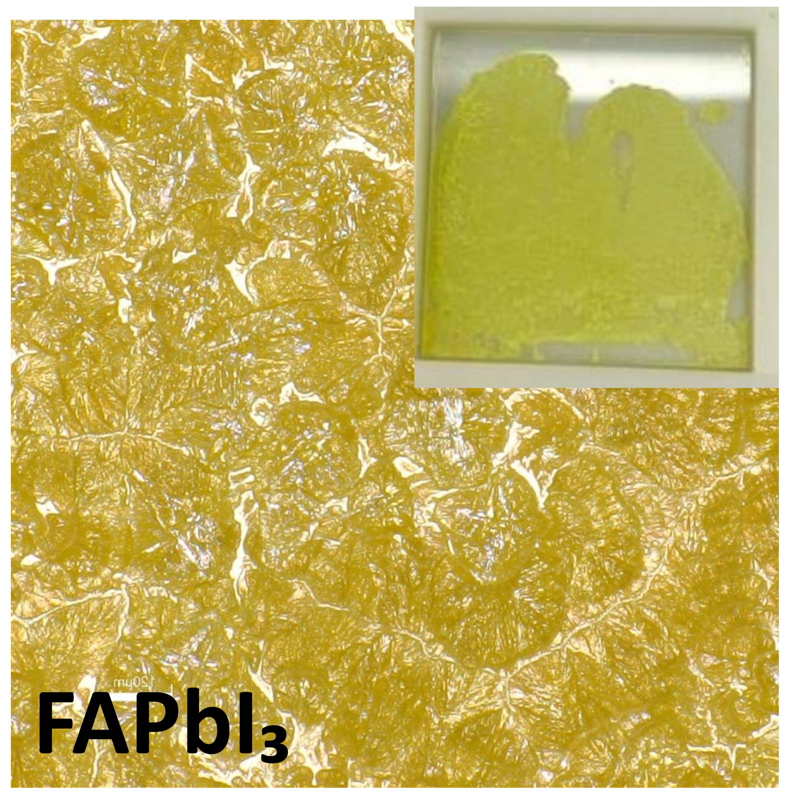
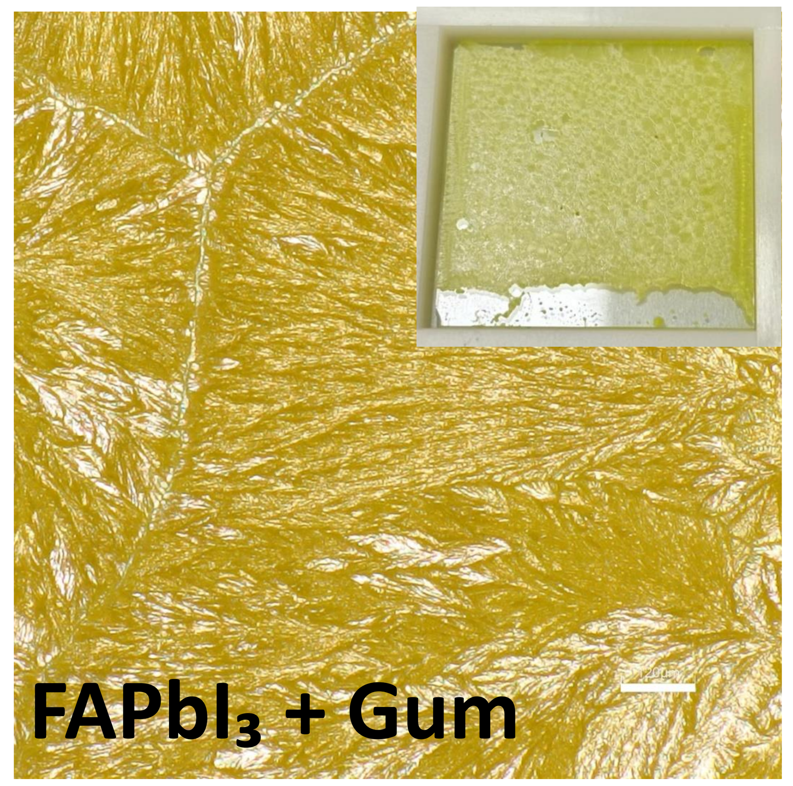
Research Question: Perovskites are crystalline materials with the general formula **ABX_3**, where 'A' and 'B' are cations and 'X' is an anion, usually a halide. Their structure efficiently absorbs light. and transports charge, making them highly promising for solar cell applications. In *formamidinium lead iodide* ($FAPbI_3$), FA^+ occupies the A-site, Pb^{2+} the B-site, and I^- the X-site The main question is: how can we stabilize FaPbI3 to produce a reliable photoactive panel, that can be scaled to industrial proportions.

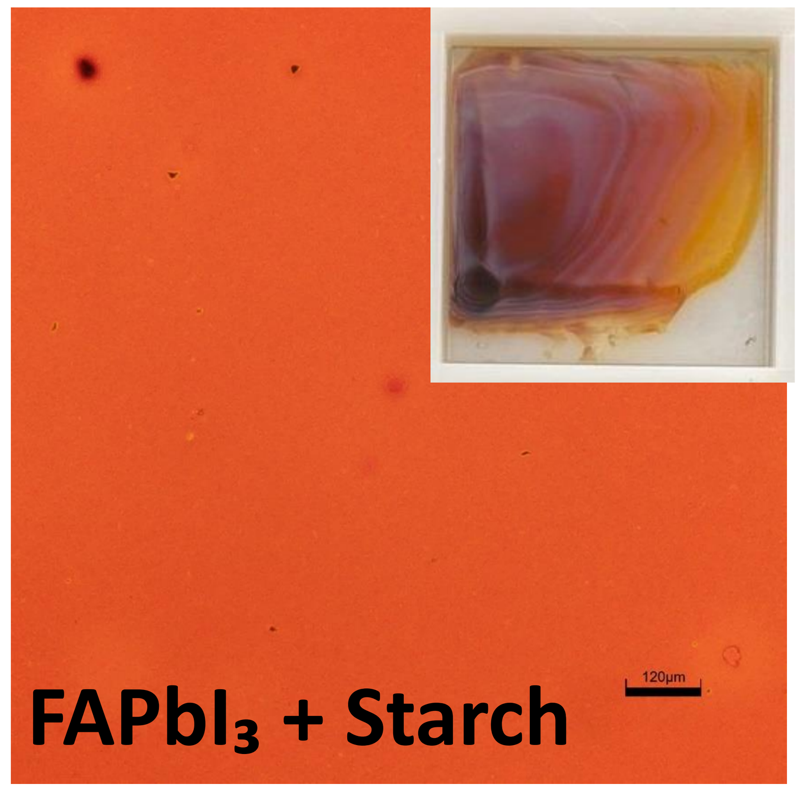
Research Methods: We used **blade coating** — a scalable thin-film deposition method that spreads a solution across a heated substrate using a sharp blade to form uniform layers. This technique mimics industrial roll-to-roll manufacturing, making it ideal for future large-scale production.



What parameters did we change?
Blade coater height, speed and temperature, amount of ink, and annealing temperature.





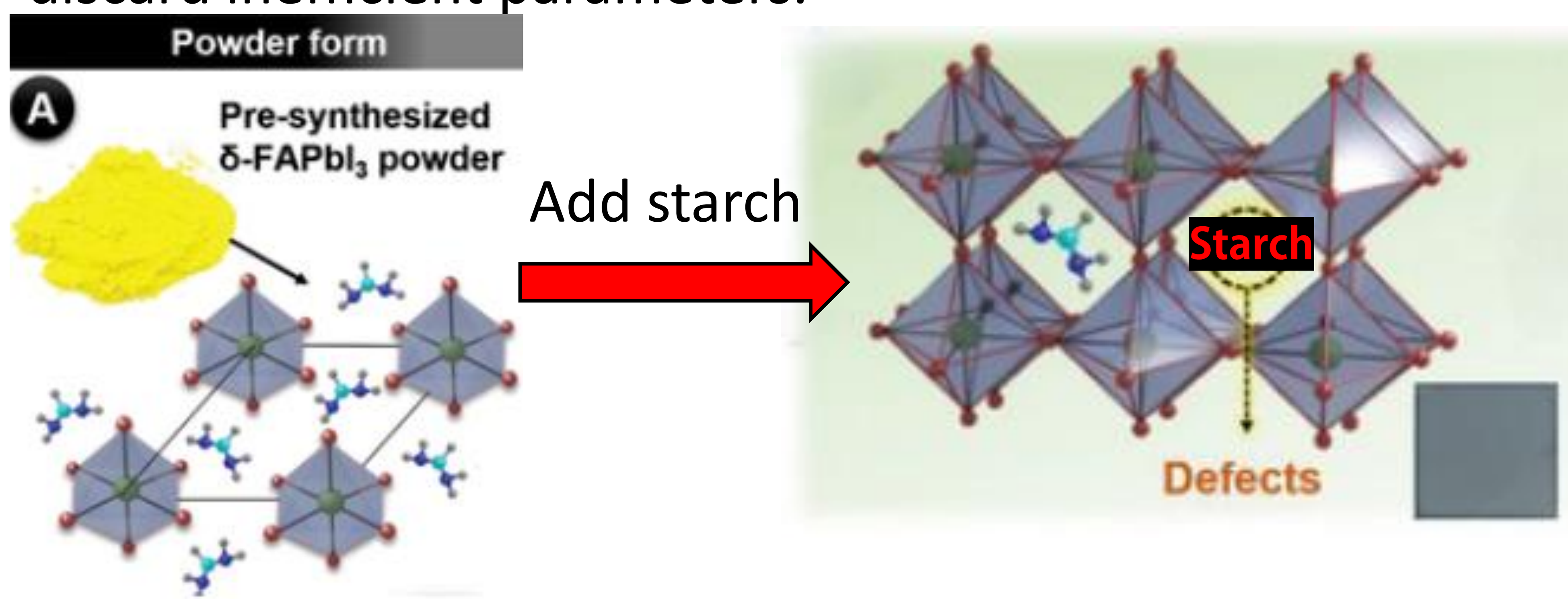


Obstacles faced and how we overcame them: Our first attempt was with pure $FAPbI_3$, which did not convert. Then, we decided to look for materials that could be added to our solution to stabilize it; we researched additives that have proven themselves as possible solutions for our inquiry. We added gum to test if it could stabilize our perovskite, which unfortunately did not work. Promising results appeared only after introducing **20% starch**, which helped promote black phase formation.

Findings and progress: Starch has proven to be an effective stabilizer for $FAPbI_3$ perovskite, promoting its conversion to the desired phase and maintaining its structural stability.

What is next?: We are currently testing different parameters to reach the best film possible. After that, we will work to ensure that the process is reproducible. These steps are important to scale up industrial production further.

We recently partnered with Gokcen Cair, a researcher from Turkey, to develop a Machine Learning model to guide us through more accurate parameters that can reduce the number of trials we need to do. The model will analyze how each parameter went based on observations while collecting the data and cross out those not working well without performing the thousands of attempts required to discard inefficient parameters.



FaPbI3 thermodynamically forms the yellow phase at room temperature; adding starch allows the conversion to the black phase.

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Image retrieved from: Butt, M. A. (2022). Thin-Film Coating Methods: A Successful Marriage of High-Quality and Cost-Effectiveness—A Brief Exploration. *Coatings*, *12*(8), 1115. https://doi.org/10.3390/coatings12081115

https://www.researchgate.net/figure/Schematic-figure-depicting-the-difference-in-a-d-phase-transition-rate-of-FAPbI3_fig1_365787111

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