Light-Induced Degradation of MAPI Perovskite Thin Films

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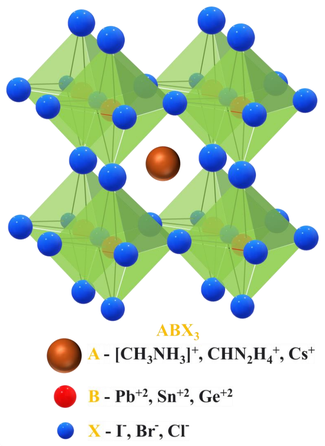
Introduction



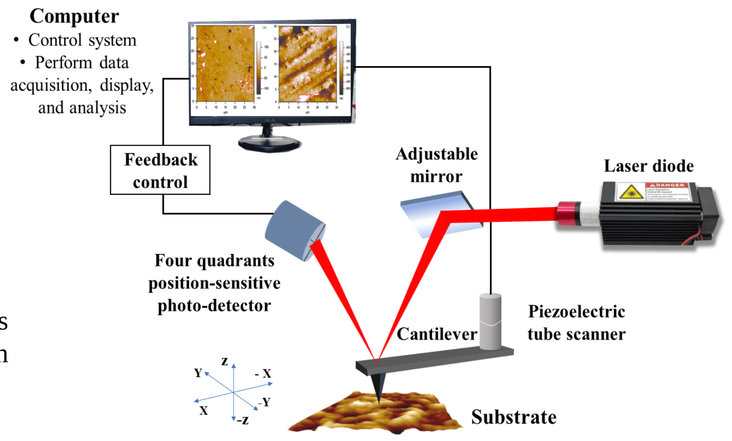
- Perovskites emerge as next-generation solar material - potentially cheaper & more efficient than silicon.
- Strong light absorption, efficient charge transport, and easily tunable bandgap (1.5-3.2 eV).
- Already achieved efficiencies rivaling c-Si, reaching 26.1% (single junction) and 33.9% (tandem).
- Solution-processable via spin coating, screen printing, and slot-die coating.

Why stability is a bottleneck for perovskites?

Perovskite solar cell commercialization hinges on stability improvements. These materials are naturally **sensitive to light, moisture, heat, and oxygen** in the environment, so we need solutions to prevent them from degradation.

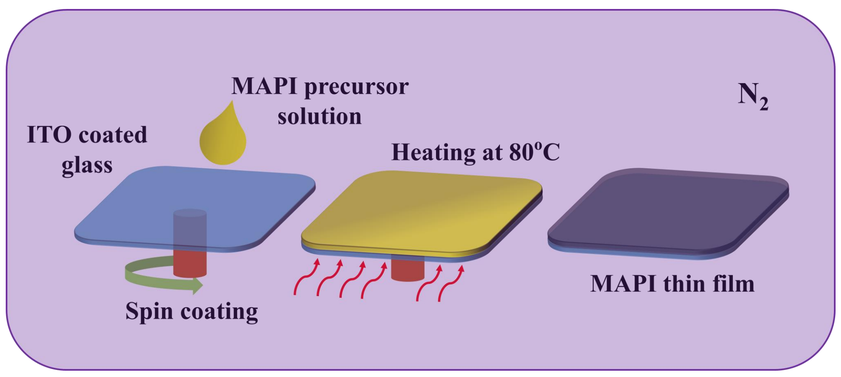
Significance of inert nitrogen environment

Excludes moisture and humidity. Nitrogen's protective effect in perovskites is key in unlocking their solar potential.

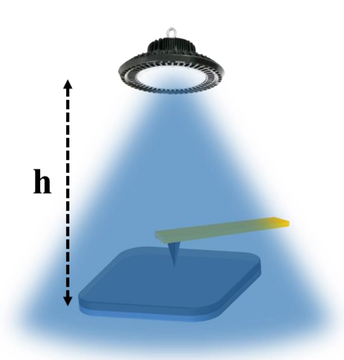


AFM: High-resolution imaging of surface features via tip-sample interactions (electrostatic, van der Waals, etc.).

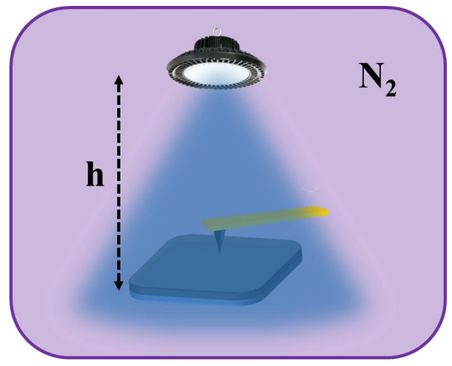
Sample Fabrication and Experimental Design



Sample preparation



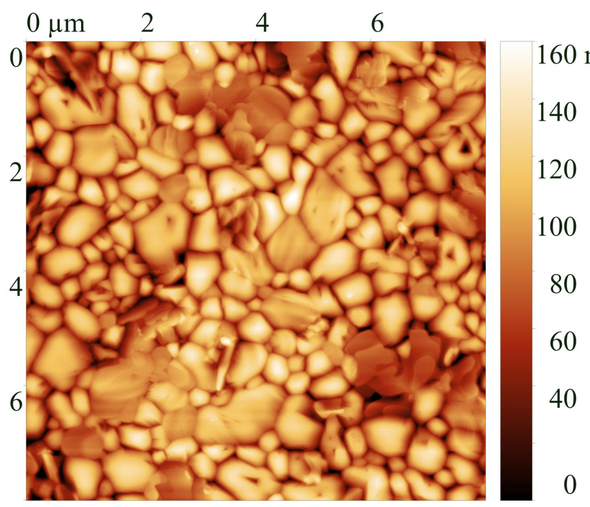
[X + Y] (t)



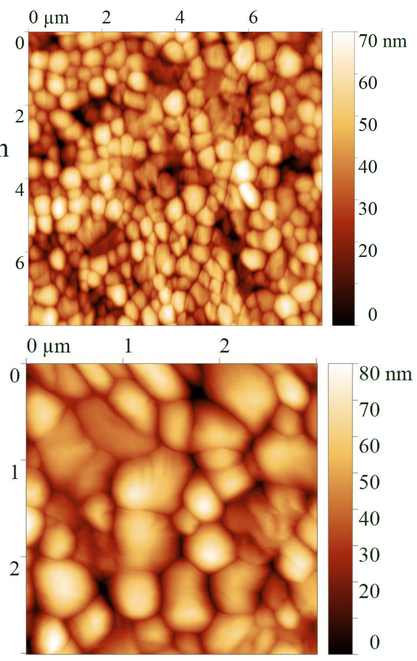
Y(t)

X(t)

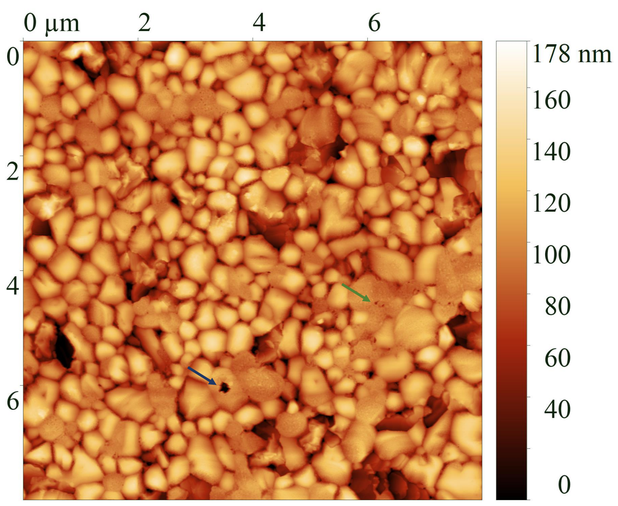
Results



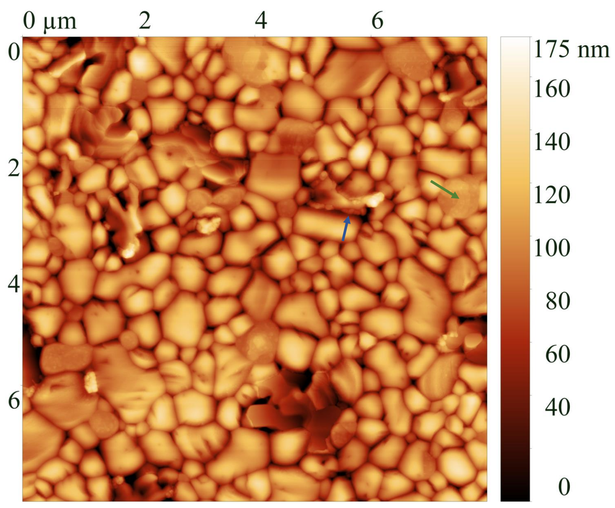
Pristine MAPI film prepared under Nitrogen.



After 12 days in nitrogen under mild light, no significant change



45 minutes under light in ambient condition



45 minutes under the same light intensity in nitrogen

Conclusion and Future Works

- MAPI Perovskite thin films can be shielded by a nitrogen atmosphere, which also slows down its decay.
- Low light intensity has little impact on surface morphology in nitrogen settings.
- For a commercially relevant assessment, conventional 1 sun illumination will be used in future Light-Induced Degradation investigations.
- We additionally wish to understand, do moisture-induced and light-induced degradation have independent effects (additive model) or if there is any interdependency.

References

1. Leijtens, T., Eperon, G. E., Noel, N. K., Habisreutinger, S. N., Petrozza, A., & Snaith, H. J. (2015). Stability of metal halide perovskite solar cells. Advanced Energy Materials, 5(20), 1500963.
2. Toloueinia, P., Khassaf, H., Shirazi Amin, A., Tobin, Z. M., Alpay, S. P., & Suib, S. L. (2020). Moisture-induced structural degradation in methylammonium lead iodide perovskite thin films. ACS Applied Energy Materials, 3(9), 8240-8248.

Acknowledgments

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