Designing Water-Stable Halide Perovskites for Underwater Photovoltaic Solar Cells

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Introduction

Perovskite solar cells (PSCs) offer sustainable solar energy where a perovskite (ABX_3) layer absorbs light. However, PSCs are unstable with water. The study investigates various polymer-based encapsulants on the perovskite layer using a pressure cooker to simulate underwater environments.

Materials & Methods

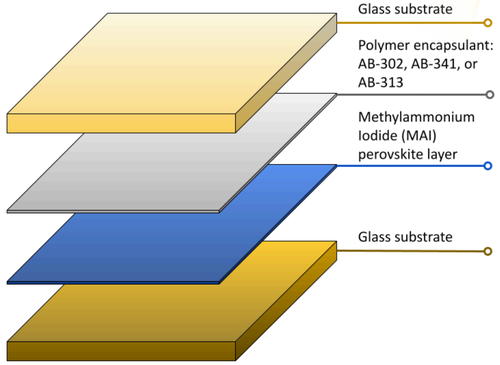


Fig. (1) Layers of the PSC. Encapsulants (Eversolar AB 302, Eversolar AB 341, Eversolar AB 313) were applied and UV-cured.

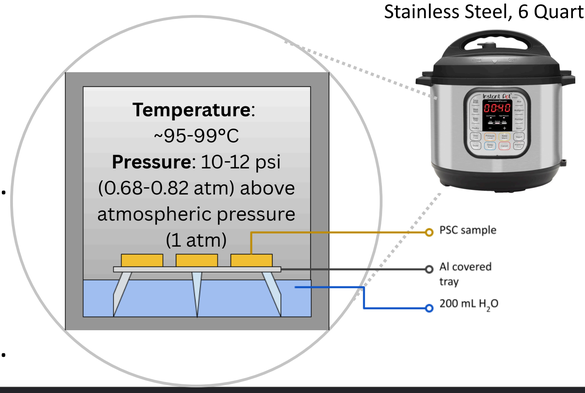
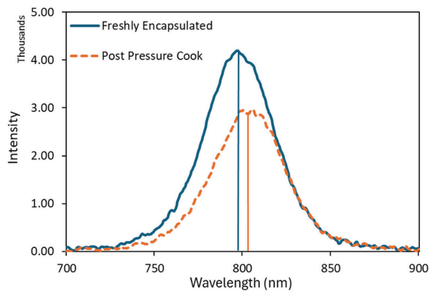


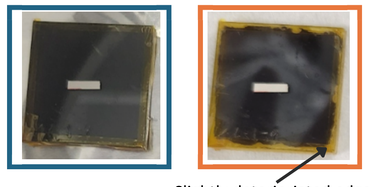
Fig. (2) Six PSC samples were placed on an aluminum-covered tray above the 200 mL waterline. Samples were pressured cooked with ~5 min cook time at high pressure.

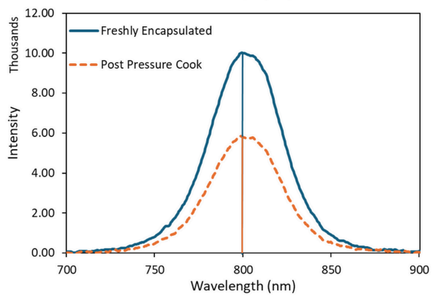
Results

Figs. (3)-(5) Photoluminescence (PL) spectra of the three polymer-encapsulated PSCs before and after pressure cooking. Notice the decrease in intensity after pressure cooking. The pictures on the right show PSCs before (blue) and after (orange) trials.

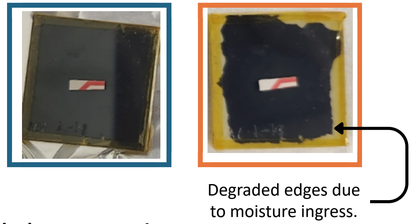


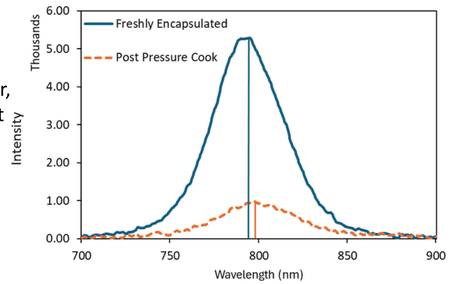
(3) Eversolar AB-302



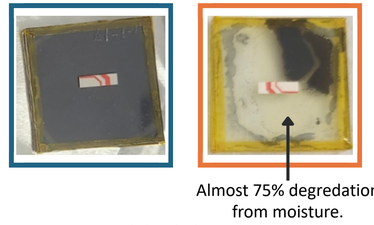


(4) Eversolar AB-341





(5) Eversolar AB-313



Encapsulant	Pre-Peak Wavelength (nm)	Post-Peak Wavelength (nm)
Eversolar AB-302	797	803
Eversolar AB-341	799	799
Eversolar AB-313	795	798

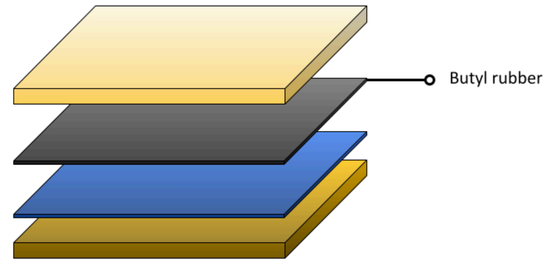
Table (1) Measured peak wavelengths (nm) of PSCs before and after pressure cooking. Minor shifts in AB-302 and AB-313 were observed.

Conclusion

Encapsulants demonstrated potential in expanding PVK's compatibility retaining its bandgap energy and preserving up to 60% of original PL intensity. However, the encapsulants failed to maintain the edges where water easily entered.

Future Work

- Integrate aluminum as edge sealant, providing greater shield from PVK degradation.
- Test butyl rubber as the 4th encapsulant.



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FURI

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