Exploration of Degradation in Perovskite Solar Cells via Thermal Hysteresis of Photocurrent and Capacitance

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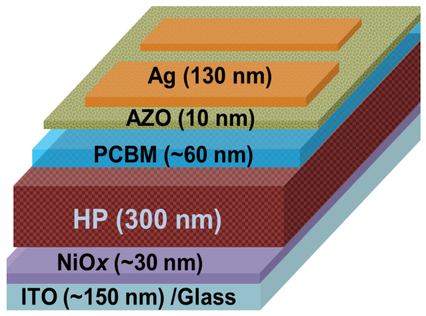
Introduction

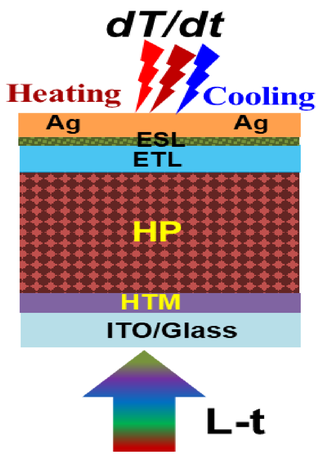
- Exploration of the degradation mechanisms of perovskite solar cells is paramount to addressing stability-related issues.
- Our study delves into the deterioration of PSC by probing thermal hysteresis of photocurrent (THPC) and thermally active ionic dynamics.
- Capacitance analysis reveals changes driven by the accumulation of interfacial ionic charges and active defects under photo-thermal drifting.
- This work underscores the direct correlation between the degradation of PSC devices and the presence of thermally activated charges.

Experimental

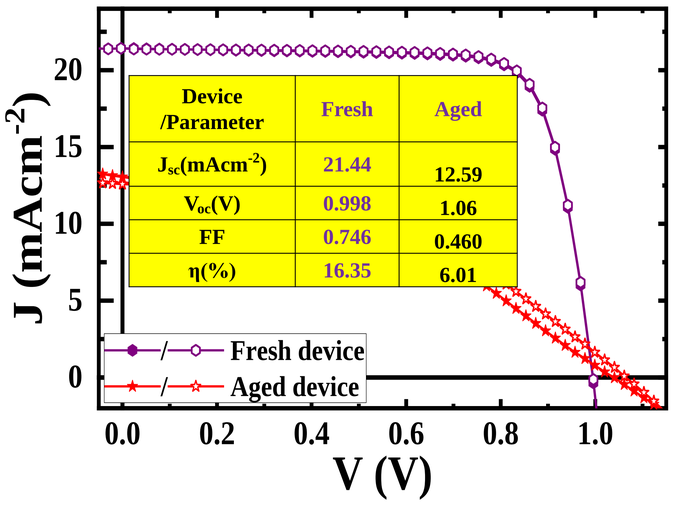
Device structure



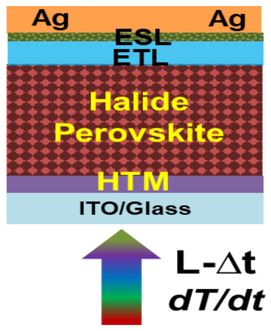
Schematic of the THPC spectra measurement

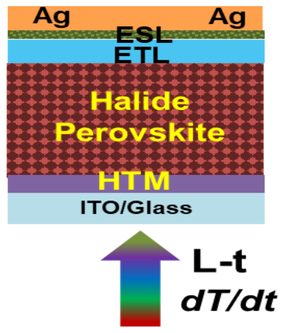


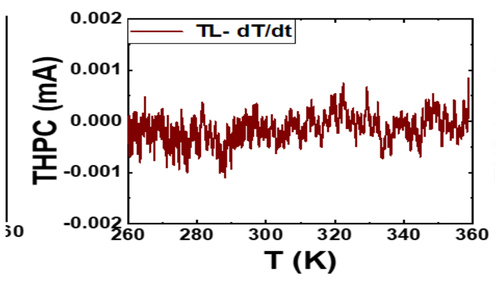
J-V curves of fresh and aged PSCs

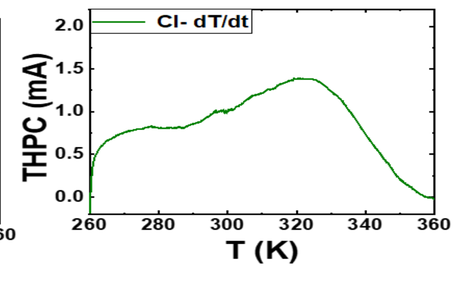


➢ Schematic of the THPC measurement and corresponding spectra



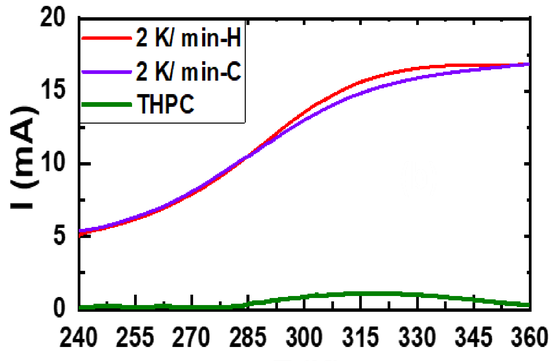


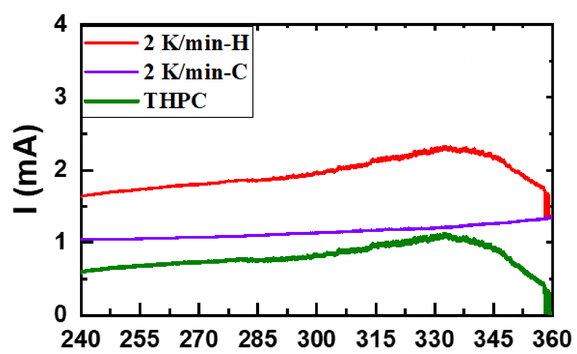




Device Results and Analysis

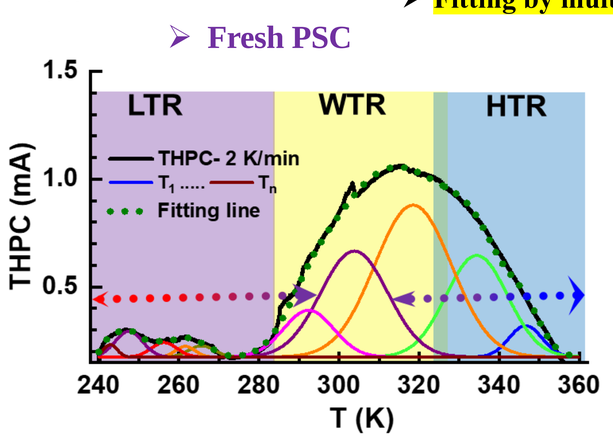
➢ THPC spectra of the fresh-PSCs under temperature drifting rate (2 K/min)



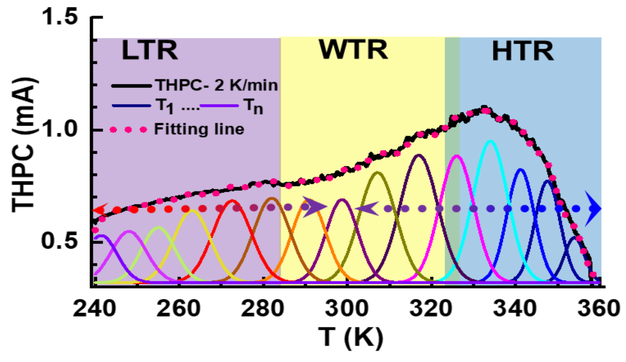


➢ Fitting by multiple peak analysis methods

➢ Fresh PSC



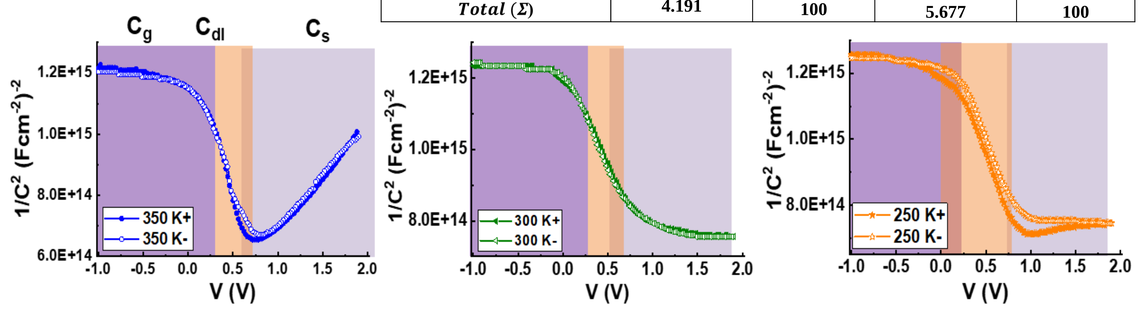
➢ Aged PSC



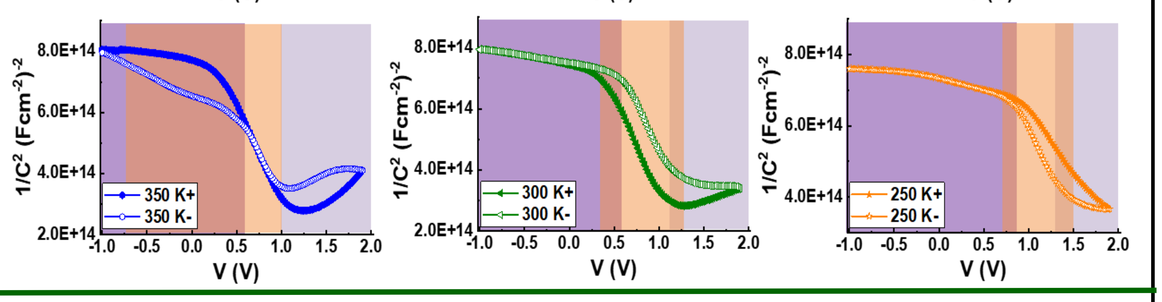
Thermal drifting rate (2 k/min) Temperature Range ↓	Fresh		Aged	
	Q_{THPC} (mC)	Q_{THPC} (%)	Q_{THPC} (mC)	Q_{THPC} %)
LTR (240-283 K)	0.429	10.24	1.927	33.95
WTR (283-323 K)	2.452	58.52	2.105	37.08
HTR (323- 363 K)	1.309	31.24	1.644	28.97
Total (Σ)	4.191	100	5.677	100

➢ Capacitance and Device Degradation

➢ Fresh PSC



➢ Aged PSC



Summary

- THPC emissions with a complex thermally active charge or ion accumulations due to interfacial deterioration.
- These photoactive mobile charges are more pronounced in aged PSC with higher charge densities.
- Capacitance analysis demonstrates that the thermally triggered charge accumulation is more pronounced in aged PSC.
- THPC plays a detrimental role in losing photo-current in the degraded PSCs.

Ref :

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