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Toward Stable and Reproducible Metal Halide Perovskite Solar Cells: From Solution to Vapor Deposition

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Metal halide perovskite solar cells (PSCs) have been spotlighted as a promising next-generation solar cell. Nevertheless, several challenges remain unresolved toward commercialization. One of the major challenges is their poor operational stability originating from abundant mobile defects. In this presentation, I will first report our strategies to mitigate detrimental effects of the defects. We identified the side effects caused by conventional defect passivation processes, which seriously degrade performance and stability of the perovskite solar cells. We propose a possible solution for minimizing the side effects to maximize attainable performance and stability of the devices [1, 2]. In second part of the presentation, I will discuss the reproducibility issue of the PSCs. Reproducible fabrication of PSCs is a critical consideration for market viability and practical commercialization. In this work, we unravel the critical function of atmospheric humidity to regulate the crystallization and stabilization of formamidinium lead triiodide ($FAPbI_3$) perovskites. We demonstrate that the humidity content during processing underlies profound variations in perovskite stoichiometry, thermodynamic stability, and optoelectronic quality [3]. Finally, our approaches toward reproducible fabrication of PSCs will be introduced. We demonstrate highly reproducible PSCs based on a vacuum thermal evaporation process.

References:
[1] Nature, 605, 268-273 (2022).
[2] Nat. Mater., 21, 1396-1402 (2022).
[3] Adv. Mater. 36, 14, 2307265 (2023).