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Transformation of the excited state and photovoltaic efficiency of $CH_3NH_3PbI_3$perovskite upon controlled exposure to humidified air

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Humidity has been an important factor, in both negative and positive ways, in the development of perovskite solar cells and will prove critical in the push to commercialize this exciting new photovoltaic technology. The interaction between $CH_3NH_3PbI_3$ and H_2O vapor is investigated by characterizing the ground-state and excited-state optical absorption properties and probing morphology and crystal structure. These undertakings reveal that H2O exposure does not simply cause $CH_3NH_3PbI_3$ to revert to PbI_2. It is shown that, in the dark, H_2O is able to complex with the perovskite, forming a hydrate product similar to $(CH_3NH_3)_4PbI_6{\cdot}2H_2O$. This causes a decrease in absorption across the visible region of the spectrum and a distinct change in the crystal structure of the material. Femtosecond transient absorption spectroscopic measurements show the effect that humidity has on the ultrafast excited state dynamics of $CH_3NH_3PbI_3$. More importantly, the deleterious effects of humidity on complete solar cells, specifically on photovoltaic efficiency and stability, are explored in the light of these spectroscopic understandings.

SciVal Topic Prominence
Topic: Perovskite | Solar cells | methylammonium lead
Prominence percentile: 100.000

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Indexed keywords

Engineering controlled terms:	Absorption spectroscopy; Crystal structure; Electromagnetic wave absorption; Ground state; Hydrates; Light absorption; Optical properties; Perovskite; Photovoltaic effects; Solar cells; Solar power generation
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EMTREE medical terms:	Air; Article; crystal structure; humidity; morphology; optics; vapor; water vapor

Chemicals and CAS Registry Numbers:
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