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Seminar über Ultrafast Science and Technology

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Titel: Elucidating optoelectronic properties in mixed perovskite thin films via time-resolved spectroscopy

Recently, the power conversion efficiency (PCE) of perovskite solar cells (PSCs) has been achieved by over 25%. One of the most effective strategies for achieving high-efficiency PSCs is compositional engineering. However, the photo-physics of mixed perovskite thin films and the origin of improved device performance have not yet been fully understood. In particular, the structural properties, charge carrier dynamics, and photo-electric properties play a crucial role in the performance of solar cell devices. Therefore, a comprehensive elucidation of structural disorder and charge carrier dynamics, and subsequently its correlation with device performance is required to further improve the PCE and stability of PSCs.

In this work, it is revealed the crucial links between structural disorder, charge carrier dynamics, and photo-electric properties of mixed perovskite thin films, and consequently device performance. Based on structural and morphological analysis, it is found that the disorder of mixed perovskite thin films exhibits a composition dependence in the form of a checkmark. In transient absorption spectroscopy, it is demonstrated that charge carrier dynamics and optoelectronic properties exhibit corresponding dependence with the disorder. As the disorder of the perovskite thin film decreases, the trap density decreases, the charge carrier loss decreases during the thermalization process, and the carrier lifetime is prolonged. In addition, optical pump-THz probe measurement reveals improved charge transport properties such as effective mobility and diffusion length. Lastly, the device performance captures the composition

dependence, and champion PCE is achieved. Our comprehensive investigation shows the importance of understanding the charge carrier dynamics and provides deeper insights for optimizing the composition of mixed perovskite to further improve the PCE and stability of the PSCs.

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