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# Role on Methylammonium Lead Bromide on Microstructure, Photophysics, and Device Performance in Triple Cation based Perovskite Solar Cells

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Solution processable hybrid perovskite materials have gained significant interest in recent years owing to the ability to control the optical and electrical properties via compositional engineering. But the influence of compositional engineering on microstructure formation and charge carrier dynamics in the solar cell device is poorly understood.[1.2]

Here, we fabricated Cs-$FAPbI_3$-$MAPbBr_3$ triple cation mixed cation perovskite solar cells by systematically varying the concentration of $MAPbBr_3$. Using in-suit temperature-dependent XRD and grazing incidence wide-angle X-ray scattering techniques, the evolution of microstructure with a change in the $MABr_3$ concentration is revealed. A combination of transient photovoltaic and transient absorption spectroscopy techniques is used to understand the charge carrier dynamic process occurring in these devices which are then correlated with the perovskite microstructure and device performance.

Our results reveal that an optimum concentration of $MAPbBr_3$ is required to achieve mixed perovskite film without any secondary phase and preferential crystal orientation. The absence of secondary phase and oriented crystals helps in improving the charge transport inside the device and increasing the solar cell performance. The findings presented here elucidate the microstructure evolution process in different mixed cation perovskites and their role on the charge carrier dynamics and device performance which helps to develop new perovskite materials for high-performance solar cells.

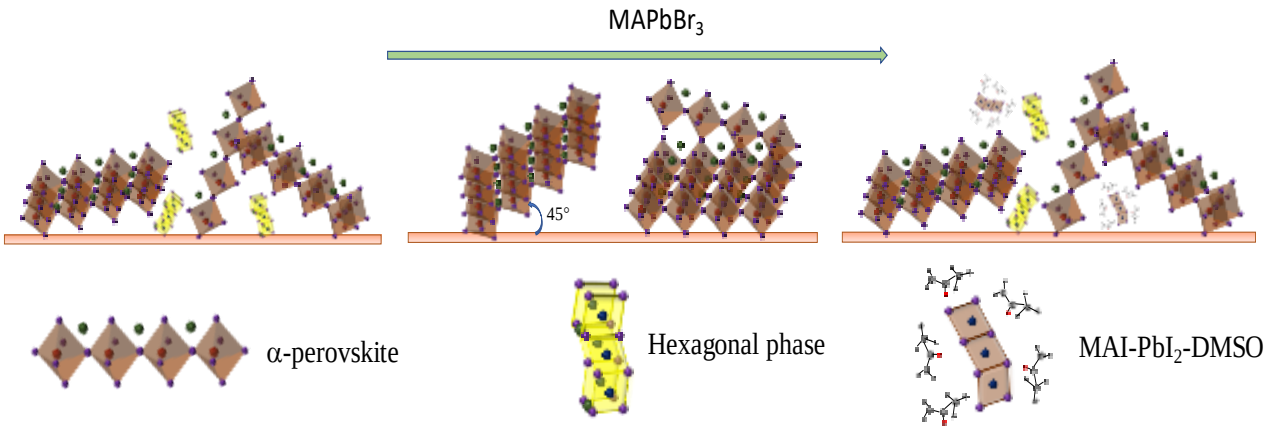


**Figure 1. Schematic representation of microstructure evolution with increase (left to right) in the concentration of $MAPbBr_3$ in Cs-$FA_{0.9-x}$ $MA_x$ mixed perovskite films.**

## References

1. Jeon, N. J.; Noh, J. H.; Yang, W. S.; Kim, Y. C.; Ryu, S.; Seo, J.; Seok, S. I. Compositional Engineering of Perovskite Materials for High-Performance Solar Cells. *Nature* **2015,** *517* (7535), 476-480.
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