# Enhanced Photodetection in Facile Solution-Processed Fabrication of $MoS_2$-Perovskite Heterostructures

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Abstract

Hybrid halide perovskites and transition metal dichalcogenides can be combined into heterostructures to overcome issues related to performance of perovskite photodetectors, such as low responsivity and high dark current.[1] We used *N*-methylformamide (NMF) as both the solvent to exfoliate bulk $MoS_2$ and as source of the methylammonium cations for the in-situ formation of the perovskite in the presence of exfoliated $MoS_2$.[2] In the presence of $MoS_2$, the perovskite crystals are larger in size, and the crystalline structure of the perovskite is less compressed with respect to the control perovskite. The resulting $MoS_2$-$MAPbBr_3$ heterostructure films showed extremely low trap density (5.7 x $10^{10}$ cm $^{-3}$) when compared to reported values with better charge transfer, as evident from the ~55% photoluminescence quenching and enhanced photoresponsivity with reduced dark current in vertical photodetectors.

## References

[1] Y. Wang *et al.*, "Solution-Processed MoS2/Organolead Trihalide Perovskite Photodetectors," *Advanced Materials*, vol. 29, no. 4, p. 1603995, 2017, doi: 10.1002/adma.201603995.
[2] J. Shamsi *et al.*, "N-Methylformamide as a Source of Methylammonium Ions in the Synthesis of Lead Halide Perovskite Nanocrystals and Bulk Crystals," *ACS Energy Lett.*, vol. 1, no. 5, pp. 1042–1048, Nov. 2016, doi: 10.1021/acsenergylett.6b00521.

## Figures

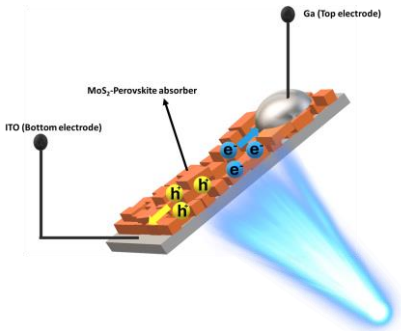


**Figure 1:** Pictorial view of the device architecture of the photodetector device structure based on $MoS_2$-$MAPbBr_3$.

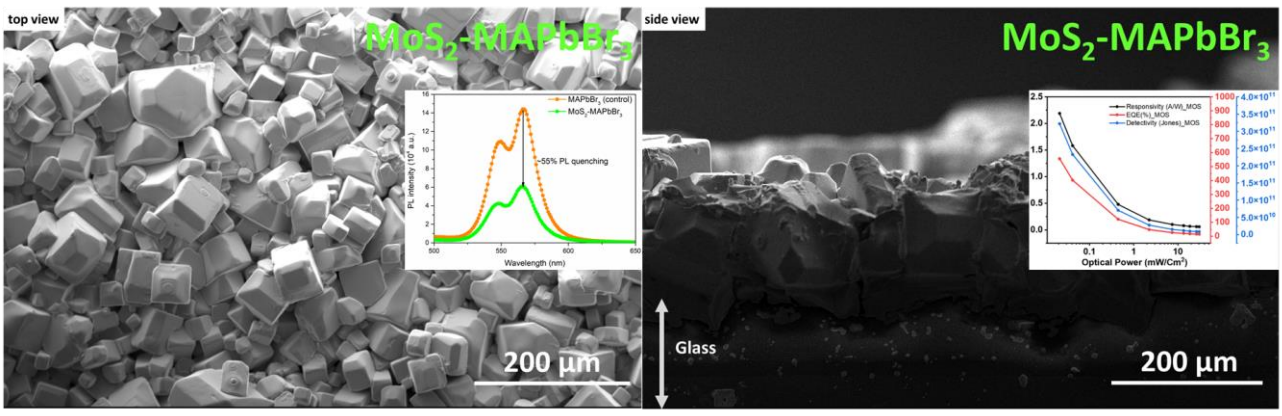


**Figure 2:** SEM images of the MoS2-MAPbBr3 films, showing top view (left) and side view (right). The insets show 55% PL quenching of the MoS2-MAPbBr3 films in comparison to the control (left) and responsivity, EQE% and detectivity in terms of optical power output (right).