Strong passivation effect at the $MAPbI_3$/GaAs hetero-interface

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Gallium Arsenide is the most heavily studied III-V semiconductor with excellent optoelectronic properties**.** It has a direct band gap at 1.42 eV, an ultra-high mobility of free carriers, as well as strong light emission and absorption phenomena, which make GaAs a very attractive material for applications ranging from solar cells to lasers and sensors. A well-known disadvantage of GaAs however, is the high non-radiative surface recombination velocity. Many works in the past have focused on the passivation of the GaAs surface with different approaches such as plasma treatment [1], chemical passivation [2] and deposition of another material on the surface as protection [3]. On the other hand, perovskite materials in the form of AMX_3 [A: monovalent cation (methylammonium (MA), formamidinium (FA), Cs), B: divalent metal cation (Sn, Pb), X: monovalent anion (I, Br, Cl)] [4] have recently attracted a lot of attention for a variety of optoelectronic applications, due to the low-cost and ease of fabrication, the direct and tunable bandgap, the relatively low exciton binding energy, long lifetimes and large diffusion length of the free carriers.

In this work, we merge the two material systems in view of novel hybrid devices. We investigate $MAPbI_3$ thin films deposited directly on undoped GaAs (100) substrates. We find that the presence of $MAPbI_3$ in contact with the GaAs surface, produces systematically a spectacular (nearly three-orders of magnitude) enhancement of the GaAs photoluminescence (PL) emission at low temperatures. We interpret this PL enhancement as due to some efficient passivation process of the GaAs surface caused by $MAPbI_3$.

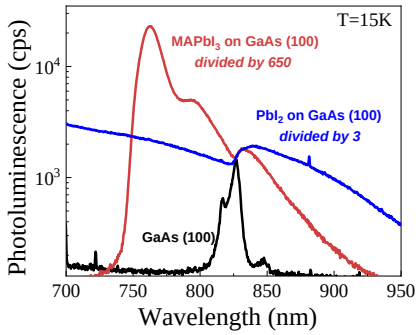

Figure 1 *Low-T PL spectra of GaAs, $MAPbI_3$/GaAs and PbI_2/GaAs, divided where appropriate by the enhancement factor.*

References

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