

Photophysical Study of Perovskite Organic Blends for Applications in Light Emitting Diodes

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Solid-state heterojunction photovoltaic cells and white light emitting diodes are the most promising solutions in the modern, global energetic needs. Among the different materials that fulfil the desirable conditions for serving as active materials for the above-mentioned applications, a new class of materials called perovskites, has gained a lot of attention during the current decade. The numerous advantages of perovskites, including high absorption coefficient, high photoluminescence quantum yields, good transport properties, bandgap tunability and solution-processability, have situated them among the most intensively studied and the most promising candidates for solar cells and light emitting diodes.

Despite their advantages, perovskites stability and control of their synthesis conditions need to be further improved before their implementation in commercially available devices. Concerning their application in white light-emitting diodes that is less studied compared to the solar cells, except from their stability, also charge injection and light-extraction efficiencies must be improved, while the non-radiative recombination losses that lead to a decreased photoluminescence quantum yield need to be reduced.

In the present work, an attempt towards the improvement of the photoluminescence properties of methylammonium lead bromide (MAPbBr₃) thin films is attempted. For this purpose either a high molecular weight polymer or a low molecular weight Spiro Fluorene derivative was mixed into the precursor solution in different weight ratios with the perovskite and the resulted solutions were spin-coated as thin films. It is shown that additive containing films showed a large increase in their photoluminescence quantum yield of the perovskite. To further investigate the reasons for this improvement perovskite films with and without the addition of the additives were investigated with several transient techniques of ns-time-resolved photoluminescence, ns- and fs- transient absorption spectroscopy. We attribute the increase of the photoluminescence quantum yield of the perovskite to the enhanced excitonic recombination due to the creation of quantum confinement upon the addition of the additives. Furthermore, proofs for the trap passivation of the perovskite are provided.