Low Dimensional Organic Metal Halide Hybrids with White Emissions for LED Applications

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Abstract

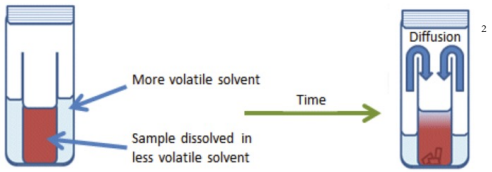
Low dimensional organic metal halide hybrids (OMHHs) are the most promising candidates for display and lighting with excellent color tunability. Here, we report an approach to create a white emitting single layer by combining red emitting 0 dimensional (0D) ($TPPcarzSbBr_4$) OMHHs and greenish-blue emitting $[(CH_3)_2NH_2]_{22}[Pb_2Br_{11}]$ $[Pb_6Br_{27}]$ 0D OMHHs clusters.

Introduction

White light emitting didoes (WLEDs) have many applications. However, materials used in white LEDs have not yet reached their full potential, as performance needs have not yet been optimized. In synthesizing new materials, we hope to improve the capabilities of WLEDs for commercial use. This is accomplished by the synthesis of $[(CH_3)_2NH_2]_{22}$ $[Pb_2Br_{11}]$ $[Pb_6Br_{27}]$ (**B**) and $TPPcarzSbBr_4$ (**R**).

Methods

Crystallization is achieved via vapor diffusion. This process involves an anti-solvent slowly condensing into a solution of the compound. The organic cations and inorganic metal halide dissolve in DMF with Et_2O as the antisolvent.



Results

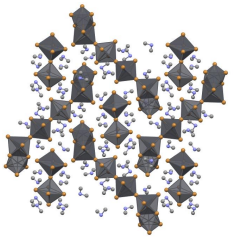


Figure 1. Single crystal structure of B

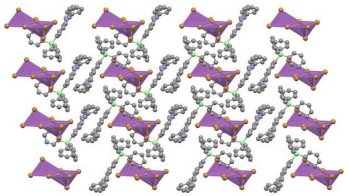


Figure 2. Single crystal structure of R

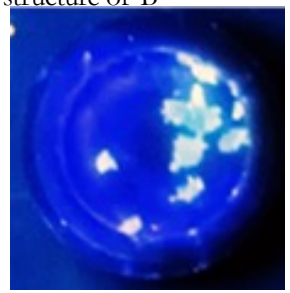


Figure 3. B under UV illumination

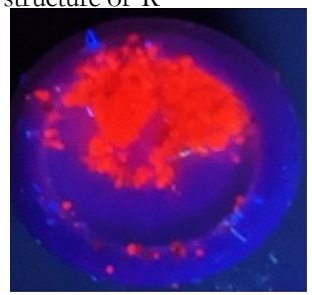


Figure 4. R under UV illumination

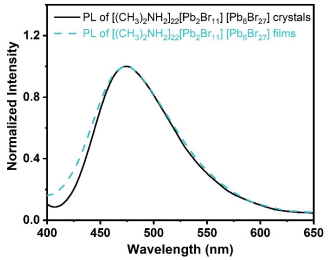


Figure 5. Photoluminescence of B crystals and films

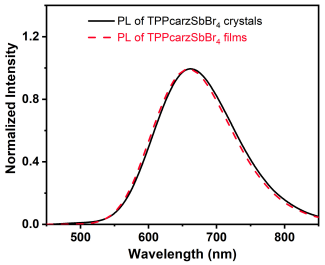


Figure 6. Photoluminescence of R crystals and films

Conclusion

Individual components for getting red and greenish-blue emissions have been synthesized. $[(CH_3)_2NH_2]_{22}$ $[Pb_2Br_{11}]$ $[Pb_6Br_{27}]$ is greenish-blue under UV illumination and has an emission peak about 462 nm. $TPPcarzSbBr_4$ is red under UV illumination and demonstrates an emission peak about 653 nm. $TPPcarzSbBr_4$ has a photoluminescence quantum efficiency (PLQE) of 93.8%. The red LEDs based on $TPPcarzSbBr_4$ with an external quantum efficiency (EQE) of 5.12%, the best organic metal halide hybrid based LEDs to date.[3] The white emitting single layer has not yet been been assessed, as further testing is necessary to determine the molecular arrangement and chemical composition of materials.

References

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Acknowledgements

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