Developing perovskite-polymer composites for printed solar cells and plastic scintillators via additive manufacturing

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Abstract:

The emergence of metal halide perovskites has represented a significant breakthrough in optics and optoelectronics.[1] Their outstanding performance, especially in perovskite-based solar cells, which now exceed 26% efficiency at the laboratory scale, has drawn considerable interest from both academia and industry for real-world applications.[1,2] Overall, metal halide perovskite materials combine remarkable photophysical properties, low weight and the ability to create semi-transparent and flexible films beyond photovoltaics. This versatility makes them highly attractive for a wide range of devices, including light-emitting diodes, transistors, photonic devices and ionising radiation detectors, as well as a variety of applications from building integration to space technologies.

One of the key advantages of perovskite materials is their solution-processability, which allows large-area films to be deposited using scalable, roll-to-roll manufacturing methods. Nonetheless, the sensitivity to environmental factors and the need for controlled conditions during film deposition represent major roadblocks. Herein, I will show how the use of polymeric additives incorporated into perovskite precursor inks can be used to control the crystallisation dynamics of metal halide perovskites deposited from solution. [3,4] Carefully selecting the polymeric additive enables both the tuning of perovskite ink viscosity for compatibility with various printing methods and the formation of multiple interactions with perovskite components in solution. Polymer functional groups can also be designed to passivate uncoordinated surface Pb^{2+} ions resulting in perovskite films with fewer defects. This dual role allows precise control over film deposition, which is essential for achieving uniform, stable, and mechanically robust perovskite films with high optoelectronic quality. [5,6]

Finally, I will highlight how tailoring the polymer matrix can introduce additional functional properties to perovskite composites, namely compatibility with additive manufacturing 3D printing techniques. These features open new avenues for the use of perovskite-polymer systems in printed plastic scintillators with tunable and complex geometries.[7]

Conflicts of Interest

The author declares no conflict of interest.

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