

## **Nanostructured Perovskites: Single Crystals for smart Optics and Optoelectronics**

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Metal Halide Perovskites (MHP) have emerged in recent years as a remarkable class of semiconductors, driving advancements in high-performance, solution-processed optoelectronics, from photovoltaics to low-threshold lasers. This work introduces an innovative approach to fabricating perovskite nanostructures using soft lithography as a bottom-up platform. In recent years, this method has shown unmatched results in the materials growth, from inorganic semiconductors to purely organic samples. Unlike traditional top-down processes, which require high cost facilities to manipulate and etch materials into desired geometries, bottom-up lithography focuses on growing samples directly into the desired shapes and dimensions. This approach has revolutionized physical research by overcoming standard lithographic limitations, such as material quenching and degradation under high-energy beams, while maintaining low costs due to the ease of manipulation in standard experimental facilities and large availability of the materials employed. We aim to demonstrate the application of bottom-up processes to the growth of perovskite single crystals, highlighting the suitability of these methods for this emerging material, furthermore, it showcases how these techniques can be seamlessly applied to prepare samples of various dimensions and chemical compositions, all while ensuring superior specimen quality. Additionally, the work developed explores two main applications of this perovskite-based materials in optics and optoelectronics. MHPs exhibit strong optical absorption due to stable excitons at room temperature, this allowed the study of strong optical nonlinearities and the development of an innovative kind of detector of ionizing radiation able to perform a true photon and electron counting with a fraction of the cost and dimensions of detectors belonging to the previous generation. We are confident that such results can pave the way for a new era of optical devices.