

Fast growth of monocrystalline thin films of 2D layered hybrid perovskite

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During the past few years hybrid organic-inorganic perovskites (HOIPs) have attracted much interest as solution-processed semiconductors with high potentialities in optoelectronics and photovoltaics. On the one hand 3D HOIPs such as $\text{CH}_3\text{NH}_3\text{PbI}_3$ have shown their outstanding performances when incorporated in solar cells [1]. On the other hand their 2D layered counterparts such as $(\text{C}_6\text{H}_5\text{C}_2\text{H}_4\text{NH}_3)_2\text{PbI}_4$ (PEPI) are promising materials for light emitting devices because of their strong emission at room temperature [2]. However, the optoelectronic properties of hybrid perovskite polycrystalline films suffer from a microscale grain structure. In order to take advantage of the great potential of these materials for both photovoltaics and emitting devices, the synthesis of large monocrystalline films is a key issue. Here we propose a fast crystallization method for the 2D layered hybrid perovskite PEPI. A vapor-assisted process coupled with a capping of the precursor solution allows to grow 2-dimensional thin films with millimetric monocrystalline grains, a high aspect ratio and a good surface quality (Fig.1). Moreover, this growth is several orders of magnitudes faster than the other reported techniques. In addition, we highlight the benefits of using γ -butyrolactone (GBL) for the growth of layered perovskites monocrystalline grains.

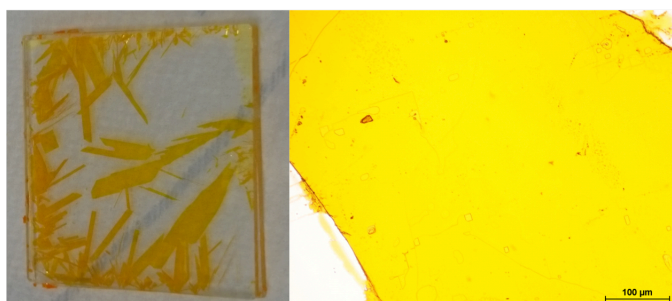


Figure 1. Optical images of 2-dimensional PEPI crystals (size of the quartz plate is 25x25 mm).

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- [1] D. Bi, C. Yi, J. Luo, J.-D. Décoppet, F. Zhang, S.M. Zakeeruddin, X. Li, A. Hagfeldt, M. Grätzel, Polymer-templated nucleation and crystal growth of perovskite films for solar cells with efficiency greater than 21%, *Nat. Energy*. 1 (2016) 16142. doi:10.1038/nenergy.2016.142.
- [2] K. Gauthron, J. Lauret, L. Doyennette, G. Lanty, A. Al Choueiry, S.J. Zhang, L. Largeau, O. Mauguin, J. Bloch, E. Deleporte, Optical spectroscopy of two-dimensional layered $(\text{C}_6\text{H}_5\text{C}_2\text{H}_4\text{-NH}_3)_2\text{-PbI}_4$ perovskite, *Opt. Express*. 18 (2010) 5912–5919. doi:10.1364/OE.18.005912.

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