

## Excitonic emission of hybrid lead iodide perovskite single crystals

E. Deleporte<sup>(a)</sup>, H. Diab<sup>(a)</sup>, G. Trippé-Allard<sup>(a)</sup>, F. Lédée<sup>(a,b)</sup>, G. Bouchez<sup>(c)</sup>, C. Vilarid<sup>(c)</sup>, V.L.R. Jacques<sup>(d)</sup>, A. Tejada<sup>(d)</sup>, P. Audebert<sup>(b)</sup>, J.-S. Lauret<sup>(a)</sup>, D. Garrot<sup>(c)</sup>

<sup>(a)</sup> Laboratoire Aimé Cotton, ENS Cachan, UPSud, Univ. Paris-Saclay, Orsay, 91405, France.

<sup>(b)</sup> PPSM, ENS Cachan, Université Paris-Saclay, 94235 Cachan, France

<sup>(c)</sup> Groupe d'Etude de la Matière Condensée, UVSQ, Versailles, 78035, France.

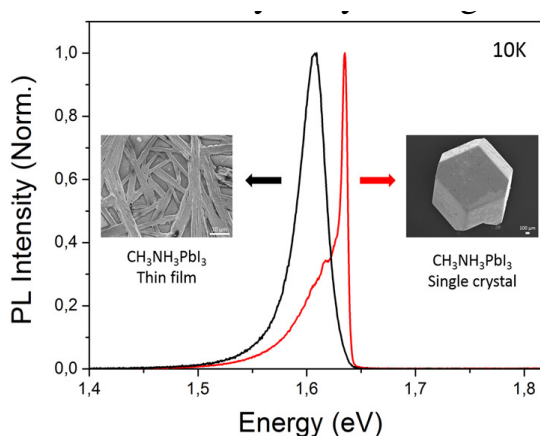
<sup>(d)</sup> Laboratoire de Physique des Solides, Université Paris-Sud, Orsay, 91405, France

Since 2012, the 3D Hybrid Organic Perovskites of formula  $\text{CH}_3\text{NH}_3\text{PbI}_3$  and their derivatives represent a “material breakthrough” for photovoltaics: in only 3 years, the efficiency of 3D HOP-based solar cells has progressed from 12% to more than 20%. These HOP molecules appear also very attractive for light-emitting devices such as electroluminescent diodes and lasers.

Improvement of the performance of perovskite solar cells and optoelectronic devices may benefit from a better understanding of the intrinsic photophysics of materials. However, the properties of films are very dependent of the grain structure. We will focus here on the synthesis of HOP single crystals and we will study their optical properties.

Figure 1 shows a millimetric  $\text{CH}_3\text{NH}_3\text{PbI}_3$  single crystal, whose optical properties are compared to those of thin polycrystalline films. In particular, the main feature in single crystals is the appearance, in the low temperature luminescence spectra, of a sharp emission line (FWHM  $\sim 5$  meV) at high energy which is attributed to the free exciton signature (figure 1). Experiments performed as a function of temperature confirm the existence of a strong electron-phonon coupling.

We highlight the extremely high stability of the single crystals compared to the thin layers: defects and grain boundaries are then thought to play an important role in the degradation mechanism.



**Figure 1** Photoluminescence spectra of  $\text{CH}_3\text{NH}_3\text{PbI}_3$  thin film (black) and crystal (red) at 10K.

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