Highly luminescence hybrid perovskite:Al_2O_3 composites

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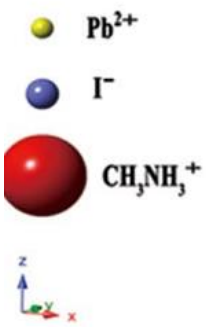
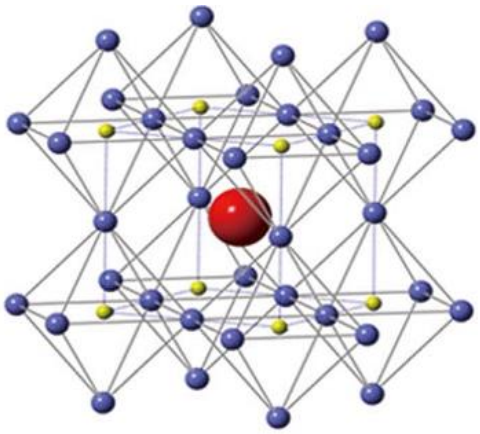
Organic-inorganic cubic perovskites





$CH_3NH_3PbI_3$

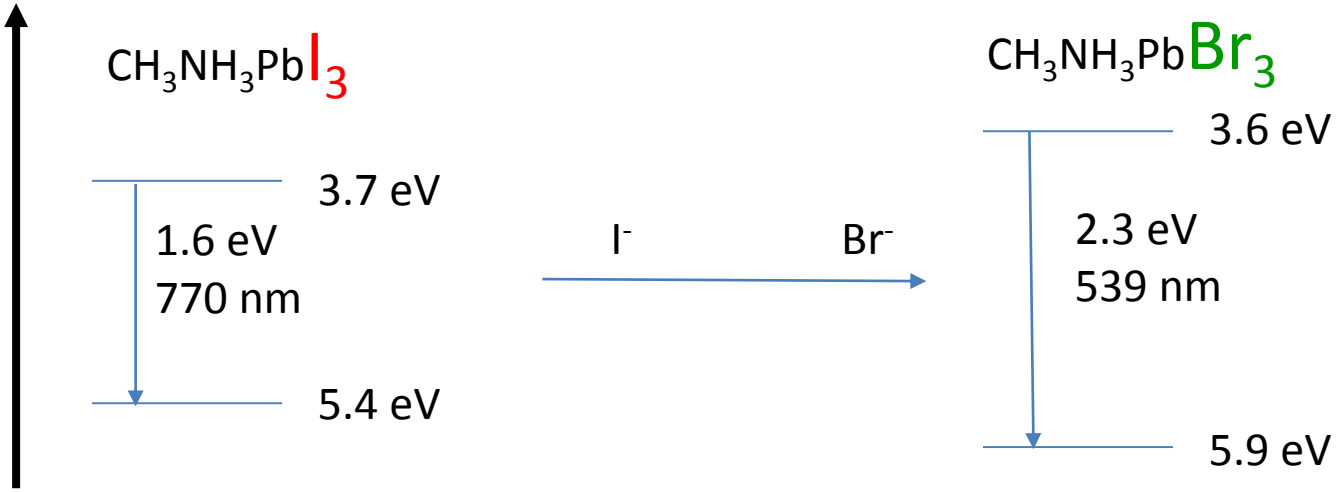
Corner sharing lead halide octahedra

(**PbX_2**)

+

Methylammonium lead halide

(**CH_3NH_3X**)



L- Gil-Escrig, G. Longo, A. Pertegas, C. Roldan-Carmona, A. Soriano, M. Sessolo and H. J. Bolink, *Chem. Commun*, 2015, **51**
K. Tvingstedt, O. Malinkiewicz, A. Baumann, C. Deibel, H. J. Snaith, V. Dyakonov and H. J. Bolink, *Sci. Rep.*, 2014, **4**.

Why high photoluminescence?

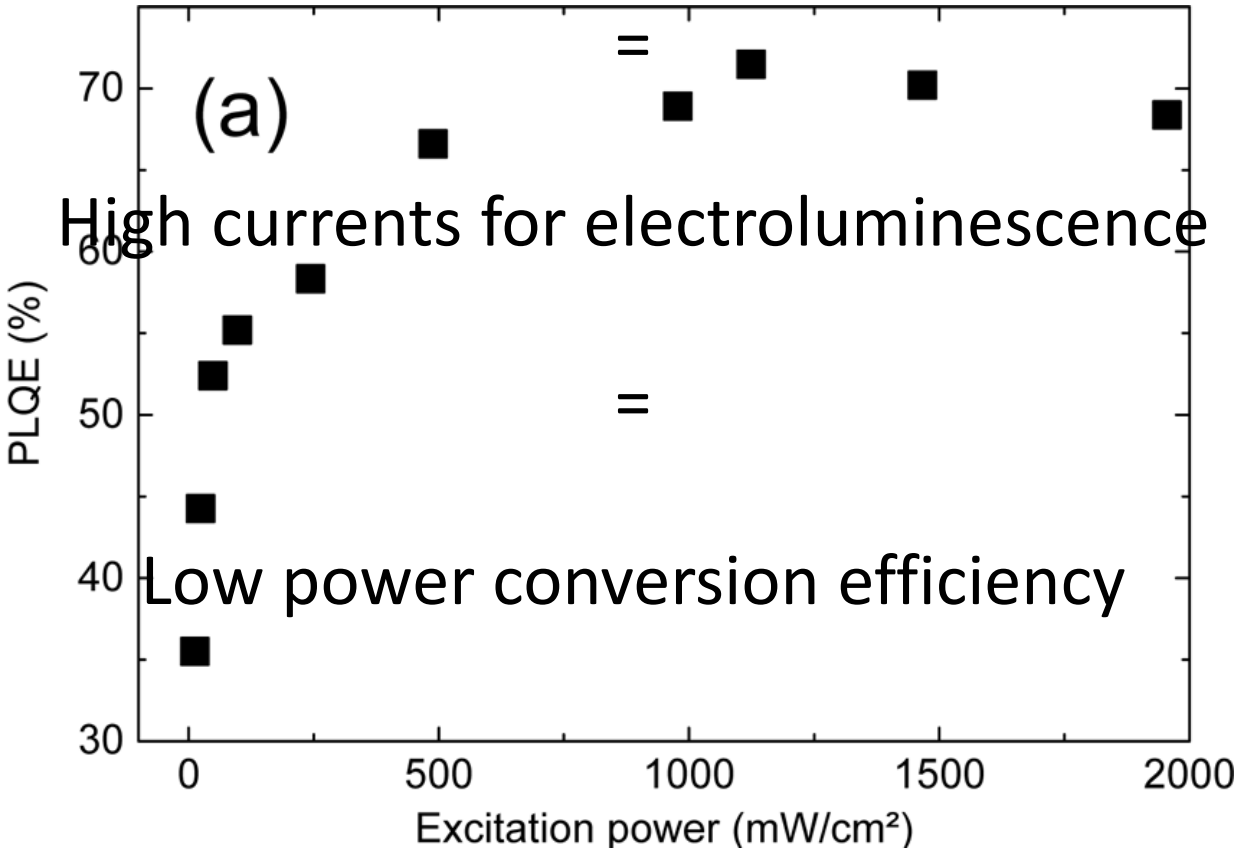
High PL with high excitation intensities

=

High currents for electroluminescence

=

Low power conversion efficiency



F. Deschler, M. Price, S. Pathak, L. E. Klintberg, D. D. Jarausch, R. Higler, S. Huttner, T. Leijtens, S.D. Stranks, H. J. Snaith, M. Ataure, R. T. Phillips and R. H. Friend et al. *J. Phys. Chem. Lett.*, 2014,**5**

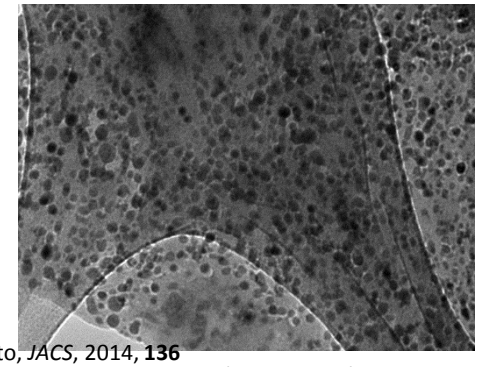
Increasing the PL by size control

Low photoluminescence from bulk material

Formation of nanoparticles

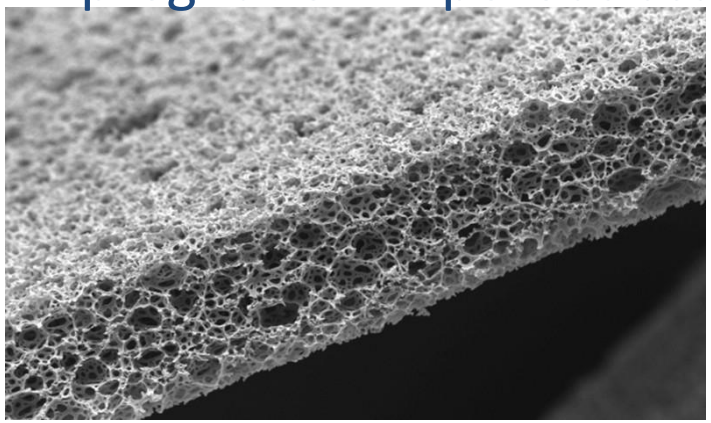
L.C. Schmidt, A. Pertegás, S. González-Carrero, O. Malinkiewicz, S. Agouram, G. Mínguez Espallargas, H.J. Bolink, R: E. Galian, J.Pérez-Prieto, *JACS*, 2014, **136**

Blending with polymers



G. Li, Z.K. Tan, D. Di, M.L. Lai, L. Jiang, J.H.W Lim, R.H. Friend, N.C. Greenham, *Nano Lett.*, 20

Impregnation in porous scaffold

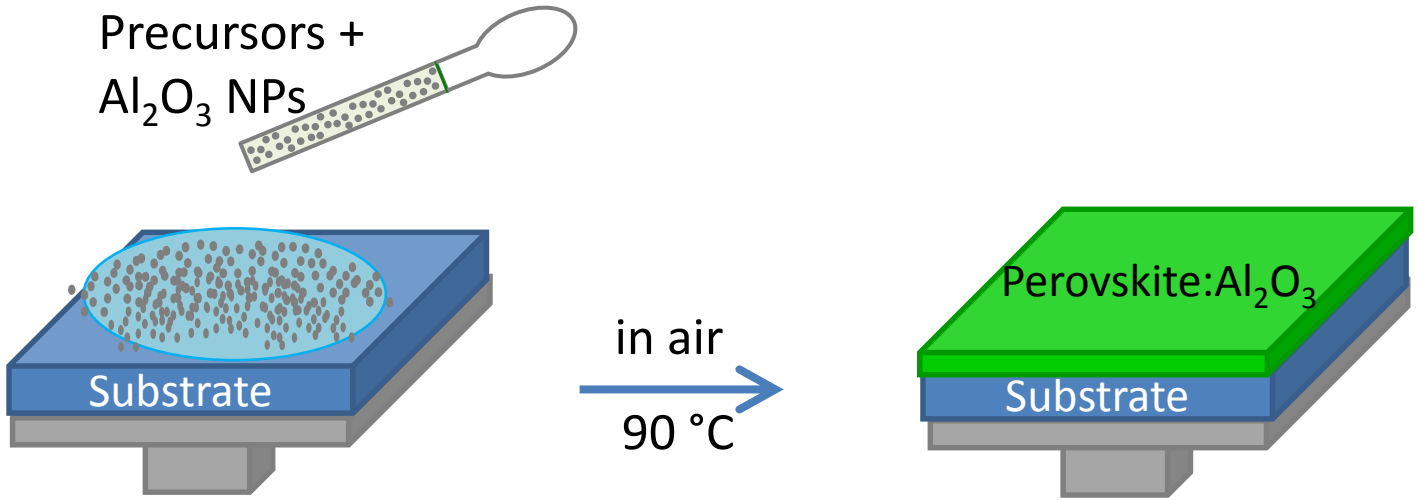


A. Kojima, M. Ikegami, K. Teshima, T. Miyasaka, *Chem. Lett.*, 2012, **41**.

Our results

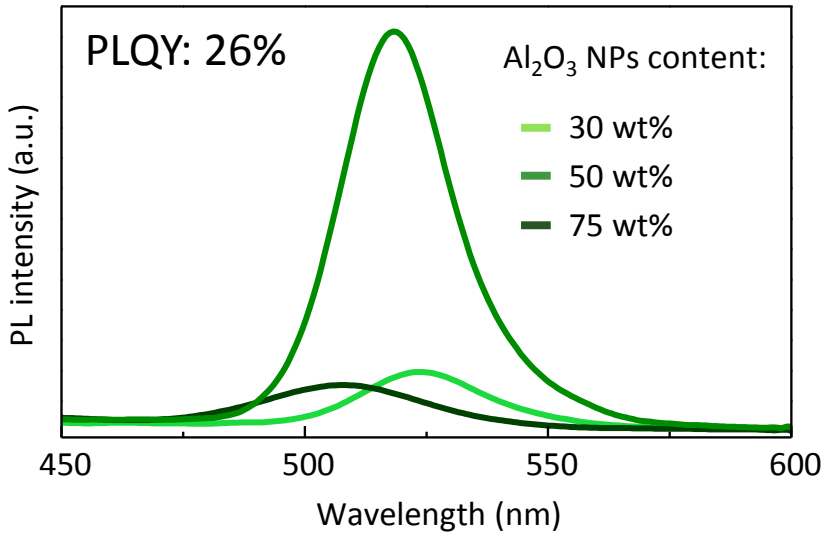
Blending Al_2O_3 NPs with perovskite.

Porous scaffold formed at low temperature



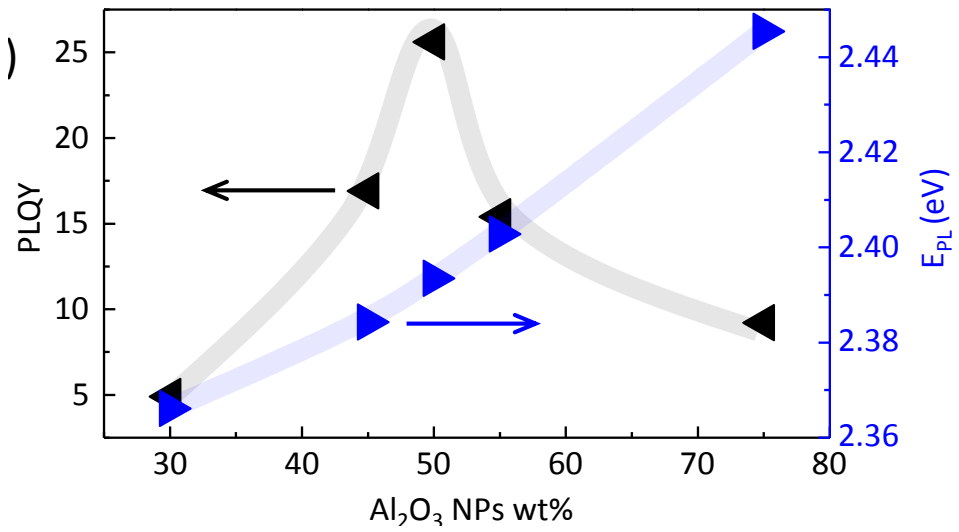
Photoluminescence

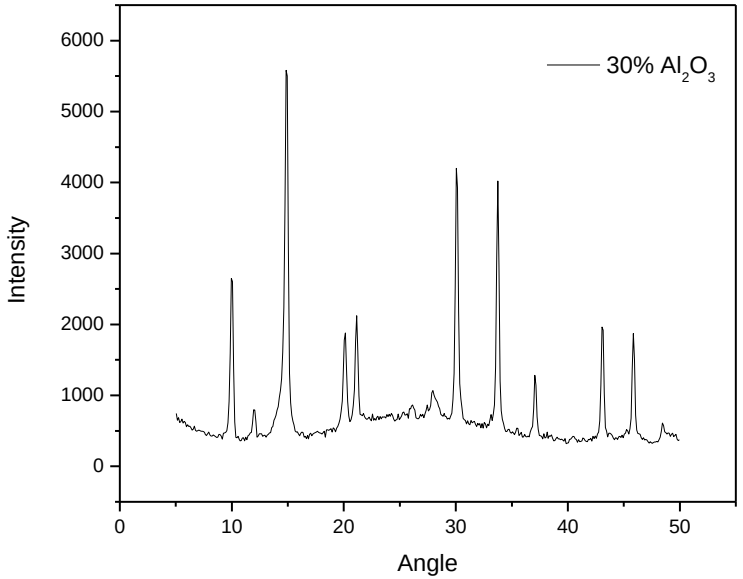
Spin coating of the blend on quartz.
Annealing at 90C for 1h



With annealing optimization of the 50% composite we reached 39% of PLQY

Blueshift





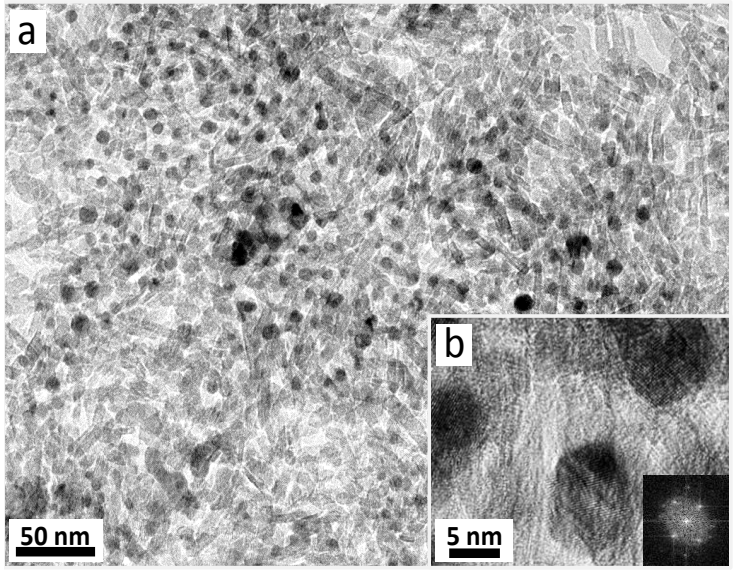
Scherrer equation: 20 nm

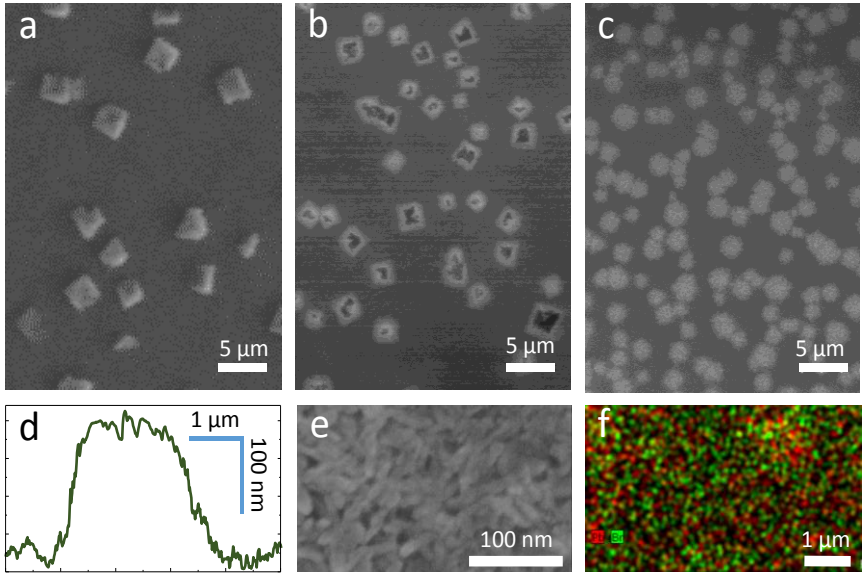
Teorethical bohr radii: 2.2 nm

Br-Pb-Br distortion

V. D'Innocenzo, *Tuning the Light Emission Properties by Band Gap Engineering in Hybrid Lead Halide Perovskite,* **2014**, *136,* 17730

Morphology





Presence of two type of perovskite crystals: nanocrystals and capping crystals

- Nanocrystal: visible by TEM, and confirmed by the energy dispersive X-Ray analysis (EDXA)
  Responsible of light emission

- Capping layer: visible by TEM and AFM. Big crystals that are not responsible to the light emission.

Acknowledgments

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Thank you for your attention!