ESONN' 2020 European School On Nanosciences and Nanotechnologies

Virtual practicals & on-line tutorials

N°14:
Chemical synthesis of perovskite nanocrystals, their microscopic and spectroscopic characterization.

Teachers:
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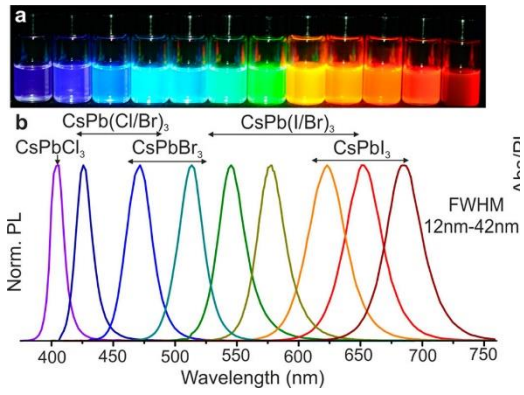
Colloidal nanocrystals (NCs) are small, soluble crystals, which comprise a few hundred to several thousands of atoms. They are prepared by interrupting the crystal growth at a very early stage and can be synthesized for a wide variety of materials, ranging from semiconductors to metals to oxides. They are dispersed in solution and can be produced in large quantities, they are versatile and robust enough to be manipulated after the synthesis step for their integration with existing technologies.[i] Two major reasons are at the basis of the peculiarity of NCs: the significant fraction of atoms at the surface, as compared to that found in the corresponding bulk counterparts, and the restriction of charge carrier motion to a small material volume. Metal halide perovskite nanocrystals (HPNCs) are a newly emerging research field. Fully inorganic HPNCs such as $CsPbBr_3$ have first been reported by Kovalenko et al.[ii] The most intriguing feature of HPNCs is their very strong photoluminescence reaching quantum yields close to unity with no necessity for surface passivation other than by pristine ligand coverage. Another striking feature distinguishing them from other NCs is that color tuning is most easily achieved not by size variation but via solution phase anion exchange, with a reduction of the band gap energy in the order Cl > Br > I. Due to their versatility, colloidal HPNCs offer a wide spectrum of possible applications, such as fabrication of photovoltaic devices, LEDs, lasers etc.



To obtain high quality NCs with competitive physical and chemical features, inorganic or organometallic precursors are injected in a mixture of surfactants that are held at a temperature sufficient to cause thermal decomposition of the precursors and hence to induce homogeneous nucleation of nanoparticles.
During the virtual practical we will make in an introduction on the HPNCs followed by a video from our lab of the synthesis of $CsPbBr_3$ nanoparticles, the anion exchange and of their optical and microscopic characterization. The video will be followed by an interactive discussion session. Studies level requested to follow this practical: Master of Science in Chemistry or Material's Science.

[i] Aldakov, D.; Reiss, P. J. Phys. Chem. C 2019, 123 (20), 12527-12541.
[ii] Protesescu, L.; Yakunin, S.; Bodnarchuk, M. I.; Krieg, F.; Caputo, R.; Hendon, C. H.; Yang, R. X.; Walsh, A.; Kovalenko, M. V. *Nano Lett.* **2015,** *15*, 3692-3696.