InP/MS core/shell nanocrystals (M = Zn, Cd) : synthesis, surface chemistry and luminescence

CROS-GAGNEUX Arnaud[1, 2], CORNEJO Alfonso[1, 2], DELPECH Fabien[1, 2], NAYRAL Céline[1, 2], et CHAUDRET Bruno[3]

[1] Université de Toulouse, UPS, INSA, LPCNO (Laboratoire de Physique et Chimie des Nano-Objets), 135, avenue de Rangueil ; F-31077 Toulouse, France
[2] CNRS, LPCNO (Laboratoire de Physique et Chimie des Nano-Objets), UMR 5215, F-31077 Toulouse, France
[3] CNRS, LCC (Laboratoire de Chimie de Coordination), UPR 8241, 205 route de Narbonne, F-31077 Toulouse, France
Contact: a_cros@insa-toulouse.fr, cnayral@insa-toulouse.fr, fdelpech@insa-toulouse.fr

Semi-conductor nanocrystals have attracted much attention in the last years because of their unique optical properties. In particular, they have emerged as valuable alternative to organic dies in bioimaging applications and cancer detection. Among them, II-VI semi-conductor type such as CdSe quantum dots (QD) are the most documented ones [1] but a widespread replacement of organic fluorophores is hindered by (i) the inherent cytotoxicity of the individual ions [2] and (ii) the strong absorption of organic tissues and blood of the emitted QD photons (UV–vis spectral range). In this context, III-V type materials appear as potential better candidates because they could offer near infrared emission suitable for in vivo bioimaging without intrinsic toxicity.

We present here, the InP QD synthesis using an organometallic route that involves indium carboxylates as precursors and fatty acids as stabilizers in non-coordinating solvent [3]. The NMR study of these QDs will be detailed, allowing a comprehensive description of their surface state that play a determining role in the size control and photoluminescence (PL) properties of these objects.

The second part deals with the coverage of the InP core with a II-VI semi-conductor shell (CdS or ZnS) [4]. This modification sensibly enhances the PL quantum yield and a shift of the PL wavelength.

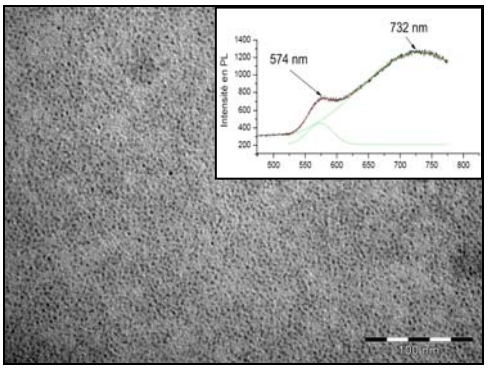

Fig 1. Transmission electronic microscopy image and photoluminescence spectrum of InP QDs.

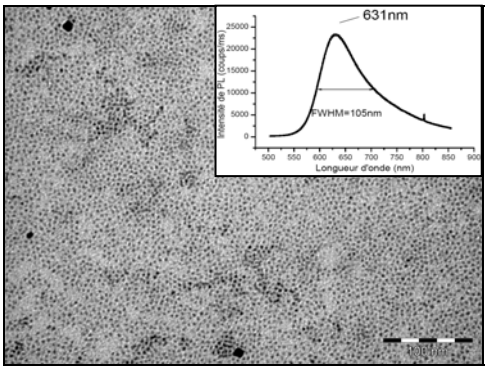

Fig 2. Transmission electronic microscopy image and photoluminescence spectrum of InP/CdS QD.

The water-soluble version of InP/CdS has been obtained by substitution of the surface ligands by mercapto-acetic acid [5] while keeping preserved the PL properties.

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[1] A.M. Smith, S.D. Dave, S. Nie, L. True, X. Gao, *Exp. Rev. Mol. Diag.*, **6(2)** (2006), 231.
[2] A.M. Derfus, W.C.W. Chan, S.N. Bhatia, *Nano Lett.*, **4** (2004) 11.
[3] a) D. Battaglia, X. Peng, *Nano Lett.*, **2** (2002), 1027. b) D. Battaglia, X. Peng, *J. Am. Chem. Soc.*, **129** (2007), 15432.
[4] D.W. Lucey, D.J. Macrae, P.N. Prasad, O.T. Beachley, *WO2005/002007A2.*
[5] N. Pradhan, D.N. Battaglia, Y.C. Liu, X.G. Peng, *Nano Lett*, **7** (2007), 312.