Inorganically Coated Colloidal Quantum Dots in Polar Solvents Using a Microemulsion-Assisted method

María Acebrón,[ab] Facundo C. Herrera,[c] Martín Mizrahi,[c] Cristina Navío,[b] Ramón Bernardo-Gavito,[‡b] Daniel Granados,[b] Félix G. Requejo*[c] and Beatriz H. Juarez*[ab]

[a] *Applied Physical Chemistry Department, Universidad Autónoma de Madrid, Cantoblanco, 28049, Madrid, Spain*
[b] *IMDEA Nanoscience, Faraday 9, Cantoblanco, 28049, Madrid, Spain*
[c] *Instituto de Investigaciones Fisicoquímicas Teóricas y Aplicadas (INIFTA), CONICET and FCE, UNLP, CC/16, suc 4, 1900 La Plata, Argentinay*
‡ *Present address: Physics Department, Lancaster University, LA1 4YB, UK.*

The dielectric nature of organic ligands capping semiconductor colloidal nanocrystals (NCs) makes them incompatible with optoelectronic applications.[1,2] For this reason, these ligands are regularly substituted through ligand-exchange processes by shorter (even atomic) or inorganic ones.[3,4] In this work, an alternative path is proposed to obtain inorganically coated NCs. Differently to regular ligand exchange processes, the reported method produces, in a single step, the formation of core–shell NCs and the removal of the original organic shell. The procedure combines the Successive Ionic Layer Adsorption and Reaction (SILAR method) with water-in-oil microemulsions of spherical NCs produced by hot injection leading to the formation of connected NCs resembling 1D worm-like networks. The developed procedure improves the optical properties of the initial NCs according to type-I or quasi type-II core–shell structures, reduces their solubility in non-polar media and increases the sample stability in polar media such as isopropanol, ethanol, and formamide.[5] The nature of the inorganic shell has been elucidated by X-ray Absorption Near Edge Structure (XANES), Extended X-ray Absorption Fine Structure (EXAFS), X-ray Photoelectron Spectroscopy (XPS) and Electron Energy Loss Spectroscopy (EELS). The 1D morphology along with the lack of long insulating organic ligands and the higher solubility in polar media turns these structures very attractive for their further integration into optoelectronic devices.

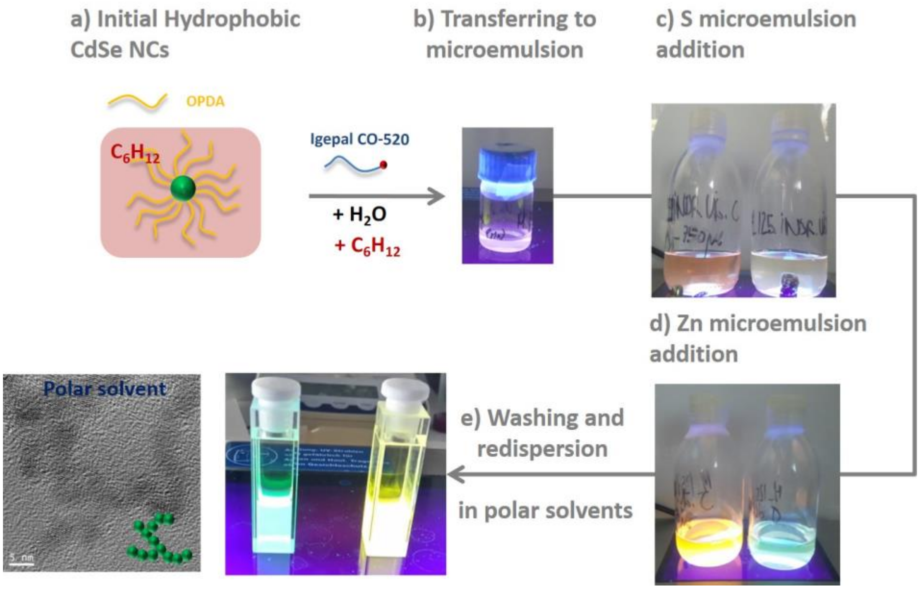

Fig. 1 Sketch of the methodology that combines SILAR with water-in-oil microemulsions. CdSe NCs produced by hot injection (a) are included in a microemulsion (b), where different S (c) and Zn precursors (d) are added. Finally, the samples were washed and redispersed in polar solvents (e).

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2) D. V. Talapin *et al.*, *Chem. Rev.*, **2010**, 110, 389..
3) M. A. Boles *et al*, *Science*, **2014**, 344, 1340.
4) K. J. Schnitzenbaumer *et al.*, *J. Phys.Chem. C*, **2015**, 119, 13314
5) María Acebrón *et al.*, *Phys. Chem. Chem. Phys.*, **2017**, 19, 1999--2007