Photoluminescence of core-shell quantum dots stabilized in water with a peptidomimetic gemini surfactant

M. A. Izquierdo, J. Rubio, M. I. Burguete, F. Galindo, S. V. Luis

[1] *Departmento de Química Inorgánica y Orgánica, Avd/ Sos Baynat s/n, Universitat Jaume I, 12071, Castellon, Spain*

e-mail: mizquier@qio.uji.es

Semiconductor nanocrystals (quantum dots, QDs) have found numerous applications as fluorescent bioprobes due to their narrow emission bands, size-dependent tunability and resistance to photobleaching [1]. One of the main challenges for the biological application of QDs is the synthesis of water-soluble derivatives. Two main strategies are usually followed to prepare water soluble quantum dots: ligand exchange and encapsulation. The first strategy implies replacing the hydrophobic ligands by hydrophilic ones imparting water solubility [2]. The second strategy consists on the encapsulation of the hydrophobic QDs with a protective shell of a hydrophilic material [3]. Silica and hydrophilic polymers have been investigated as wrapping materials for this purpose. In the case of polymeric materials, one well-stablished mechanism is the interdigitation of chains between the inner hydrophobic ligand and the outer hydrophilic polymer [4]. However, the use of low molecular weight molecules utilizing this intercalation mechanism has been less investigated [5].

In this work, we investigated the capability of peptidomimetic gemini surfactant **1a** to transfer hydrophobic QDs to pure water. Compound **1a** could intercalate its long alkyl chains into the hexadecylamine ligands. The pseudopeptidic part of the compound along with the amine present in the bridge could impart the aqueous solubility to the system. The solubilised QDs have been characterized by steady-state and time resolved fluorimetry, FT-IR and transmission electron microscopy. The long fluorescence lifetime in water and the resistance to dynamic quenching by chloride ions are the most remarkable of this new type of nanomaterials.

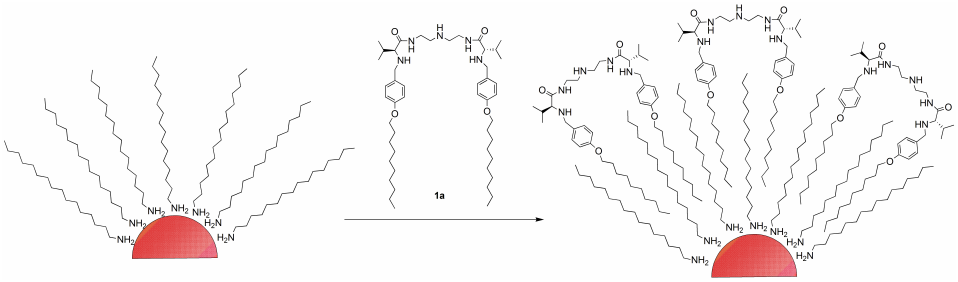

Figure 1.. Schematic representation of the interdigitation process occurring between the hydrophobic ligands of the QDs and the alkyl chains of the peptidomimetic compound **1a**.

[1] X. Michalet, F. F. Pinaud, L. A. Bentolila, J. M. Tsay, S. Doose, J. J. Li, G. Sundaresan, A. M. Wu, S. S. Gambhir and S. Weiss, *Science*, **307**, 538-544 (2005)

[2] W. Liu, S. C. Hak, J. P. Zimmer, E. Tanaka, J. V. Frangioni and M. Bawendi, *J. Am. Chem. Soc.* **129**, 14530-14531 (2007)

[3] D. Gerion, F. Pinaud, S. C. Williams, W. J. Parak, D. Zanchet, S. Weiss and A. P. Alivisatos, *J. Phys. Chem. B*, **105**, 8861-8871 (2001); T. Pellegrino, L. Manna, S. Kudera, T. Liedl, D. Koktysh, A. L. Rogach, S. Keller, J. Rädler, G. Natile and W. J. Parak, *Nano Lett.*, **4**, 703-707 (2004)
[4] V. Patil, K. S. Mayya, S. D. Pradhan and M. Sastry, *J. Am. Chem. Soc.*, **119**, 9281 - 9282 (1997)
[5] H. Fan, E. W. Leve, C. Scullin, J. Gabaldon, D. Tallant, S. Bunge, T. Boyle, M. C. Wilson and C. J. Brinker, *Nano Lett.*, **5**, 645-648 (2005); H. Li, X. Wang, Z. Gao and Z. He, *Nanotechnology*, **18**, 205603 (2007)

Acknowledgement: Financial support from Spanish MICINN (CTQ2008-02907-E, CTQ2009-09953 and CTQ2009-14366-C02-01), GV (ACOMP/2010/258, ACOMP/2010/282), Fundació Caixa Castelló-UJI (project P1-1B-2009-59, P1·1B2009-58) is acknowledged. J. R. thanks MICINN (FPU fellowship). F.G. thanks MEC (Ramon y Cajal Program).