Lanthanide-doped Luminescent Colloidal Nanocrystals: Towards light emitting, sensing and photocatalytic applications

Venkataramanan Mahalingam

Indian Institute of Science Education and Research (IISER) Kolkata, Mohanpur, Nadia, West Bengal 714246

mvenkat@iiserkol.ac.in

Introduction

There is a growing research interest towards developing lanthanides (Ln^{3+})-doped colloidal nanocrystals. This stems from their sharp intra *4f-4f* transitions which find ubiquitous applications in the development of laser crystals, phosphors for light emitting diodes (LEDs), authentication, probes for bio imaging, etc.[1-2] In addition to generally observed Stokes shifted luminescence, some Ln^{3+}-doped materials possess the ability to convert low energy light into high energy light, a process known as upconversion.[3] This talk is expected to provide an overview on the simple synthetic route to make these materials specific applications like sensing, light emitting and photocatalyst. For example, dinitrobenzoic acid (DNB) coated Er^{3+}/Yb^{3+}-doped $NaYF_4$ nanocrystals has been shown for the selective detection of melamine.[4] The strong interactions between DNB and melamine molecules led to the selective quenching of the upconversion luminescence efficiency. Similarly, I will provide examples of nanoparticles used for toxic metal ions like Pb^{2+}, Hg^{2+} and Fe^{2+} and Cu^{2+}.[5] In addition to metal ions, we have also developed materials to detect aromatic amino acid and H_2O_2.[6] The talk will also provide how strong single band blue emissions can be obtained for developing phosphor based blue light emitting diodes (LEDs).[7] Finally, examples will be provided how upconverting nanomaterials can be combined with wide band gap and semiconducting materials for photocatalytic applications.[8] Recently, we have shown near infrared (NIR) triggered superior photocatalytic applications from nanocomposites prepared using Er^{3+}/Yb^{3+}-doped $NaYF_4$ and 2D MoS_2 nanostructure.

References

Comentado [V1]: Add following refrences Prof. Sidney, L. Carlos and Fiore.

---

[1] G. Blasse, B. C. Grabmaier, *Luminescent Materials*, Springer, Berlin, **1994**; S. V. Eliseeva, J. C. G. Bünzli, *Chem. Soc. Rev.* **2010**, 39, 189; L. D. Carlos, R. A. S. Ferreira, V. de Zea Bermudez, S. J. Ribeiro, S. J. *Adv. Mater.* **2009**, 21, 509.

[2] J.-C. G. Bünzli, S. V. Eliseeva, Chem. Sci. 2013, 4, 1939; D. K. Chatterjee, M. K. Gnanasammandhan, Y. Zhang, *Small* **2010,** 6, 2781.

[3] Auzel, Chem. Rev. **2004**, 104, 139; b) M. Haase, H. Schafer, *Angew. Chem. Int. Ed.* 2011, 50, 5808; Sri Sivakumar, F. C. J. M. van Veggel, P. S. May, *J. Am. Chem. Soc.* **2005**, 127, 12464; F. Wang, Y. Han, C. S. Lim, Y. Lu, J. Wang, J. Xu, H. Chen, C. Zhang, M. Hong, X. Liu, *Nature* **2010**, 463, 1061; Quintanilla, M.; Cantarelli, I. X.; Pedroni, M.; Speghini, A.; Vetrone, F. *J. Mater. Chem. C* **2015**, *3*, 3108; S. Sarkar, B. Messaragandla, C. Hazra, V. Mahalingam, *Adv. Mater.* **2013**, 25, 856.

[4] C. Hazra, Venkata N. K. B. Adusumalli and V. Mahalingam, *ACS Appl. Mater. & Interfaces* **2014**, 6, 7833

[5] M. Chatti, S. Sarkar, and V. Mahalingam, *Microchim. Acta*, 2016, 183, 133; S. Sarkar, M. Chatti and V. Mahalingam, *Chem. Eu. J.*, **2014**, 20, 3311.

[6] C. Hazra, T. Samanta and V. Mahalingam, *J. Mater. Chem. C*. **2014**, 2, 10157.

[7] Venkata N. K. B. Adusumalli, S. Sarkar and V. Mahalingam, *ChemPhysChem*., **2015**, 16, 2312

[8] M. Chatti, Venkata N. K. B. Adusumalli, S. Ganguli and V. Mahalingam, *Dalton Trans.*, 2016 (accepted)