

Hamilton Undergraduate Scholarship Programme 2010
PROJECT NO. 1

Supervisor: Dr. Dorota Wencel

Co-supervisors: Prof. Colette McDonagh

Project Title: High-brightness fluorescent silica-based nanoparticles

Duration of Project

From: 7 June 2010

To: 13 August 2010

Project Description:

Sol-gel-based fluorescent silica nanoparticles (NPs) have demonstrated a great potential for use in a broad range of applications such as cellular biology and ultrasensitive immunoassays for cell staining and visualisation [1, 2]. In addition, they have been used as optical nanosensors in the intracellular environment [3, 4]. Silica NPs exhibit interesting properties that make them a unique matrix for incorporating fluorescent dye molecules. The key features of the silica NPs include the ease of surface functionalisation, biocompatibility, stability and ability to tailor NPs physical and chemical properties in order to suit the application. A significant increase in NP fluorescence can be achieved compared to a single molecule fluorescent label [5].

This project will focus on the synthesis and optimisation of the high-brightness silica NPs using the sol-gel Stober and microemulsion methods. The NPs will be characterised using techniques such as UV spectroscopy, Scanning Electron Microscopy (SEM) and Dynamic Light Scattering (DLS). The fluorescent dye will be entrapped within a wide range of sol-gel NPs and the influence of NP composition and size on the brightness will be investigated.

References

1. P. Sharma, S. Brown, G. Walter, S. Santra B. Moudgil, "Nanoparticles for bioimaging", *Adv. Colloid Interface Sci.*, Vol. 123-126, 2006, p. 471
2. L. Wang, W. Zhao, W. Tan, "Bioconjugated Silica Nanoparticles: Development and Applications", *Nano Res.*, Vol. 1, 2008, p. 99.
3. Y. Lee, R. Smith, R. Kopelman, "Nanoparticle PEBBLE Sensors in Live Cells and In Vivo", *Annu. Rev. Anal. Chem.* Vol. 2, 2009, p. 57.
4. S. M. Borisov, I. Klimant, "Optical nanosensors—smart tools in bioanalytics", *Analyst*, Vol. 133, 2008, p. 1302.
5. R I. Nooney, C. M. N. McCahey, O. Stranik, X. Le Guevel, C. McDonagh, B. D. MacCraith, "Experimental and theoretical studies of the optimisation of fluorescence from near-infrared dye-doped silica nanoparticles", *Anal. Bioanal.Chem.*, Vol. 393, 2009, p. 1143.