INDIAN ASSOCIATION FOR THE CULTIVATION OF SCIENCE
2A&B, Raja S.C. Mullick Road, Jadavpur, Kolkata-700032, India

Seminar Notice

Speaker: Prof. A. E. H. Wheatley, Department of Chemistry, University of Cambridge, UK

Title of the talk: Advances in the synthesis and protection of zero-valent metal nanoparticles

Date & Time: 6th April 2018, at 3.00 PM

Venue: C. V. Raman Seminar Hall

Abstract:
There is great interest in the controlled synthesis of heterostructured nanomaterials, and 'core@shell' bimetal or metal oxide nanoparticles (NPs) respresent one significant subset of these. Such structures are often proposed based on bulk analysis techniques that, in reality, offer limited evidence for structure and composition; bulk methods often fail to differentiate between coating, heat-induced coalescence and alloying [1]. Moreover, nanomaterial stability is vital to applications development, and the structural/compositional evolution of NPs can be responsible for undesireable phenomena such as catalyst deactivation. Case studies are presented here in which preformed magnetic NPs are coated with iron oxide [2] and the core@shell structure and composition of the resulting NPs thoroughly determined [3]. State-of-the-art microscopy enablesthe mapping of individual NPs by EFTEM and EELS, and the evolving role of multivariate statistical analysisin isolating NPs from the background signal is identified [4]. Interestingly, data reveals NPs comprising a metal(0) seed separated from an Fe_3O_4 shell by a discrete intra-particle carbon-based layer.
In more recent work, the fabrication of core@shell Fe@Fe_3O_4 is refined from a two-pot scenario in which seeds are isolated and then coated, to an easier and more efficient direct one-pot scenario. In both cases, the monodisperse product reveals a carbonaceous interface between the Fe core and oxide shell [5]. Meanwhile for the one-pot synthesis, the surfactant conditions significantly influence both the morphology and dispersity of the product. This is interpreted in terms of competing interactions of the ligands with the iron precursor. Superparamagnetism is observed, and microscopic studies reveal oxidative stability of the Fe(0) cores for >6 months. It is proposed that the carbonaceous interface is critical to this sustained oxidative stability.
[1] C. Altavilla, E. Ciliberto, *Inorganic Nanoparticles: Synthesis, Applications and Perspectives*, CRC Press, 1st Ed., 2011.
[2] S. Sun, C. Wang, S. Peng, L.-M. Lacroix, *Nano. Res.*, 2009, 2, 380.
[3] B.R. Knappett, P. Abdulkin, E. Ringe, D.A Jefferson, S. Lozano-Perez, C. Rojas-Ruiz, A. Fernández and A.E.H. Wheatley, *Nanoscale*, 2013, 5, 5765.
[4] D. Rossouw, P. Burdet, F. de la Peña, C. Ducati, B.R. Knappett, A.E.H. Wheatley, P.A. Midgley, *Nano Lett.*, 2015, 15, 2716.
[5] J.P. Mehta, B.R. Knappett, G. Divitini, E. Ringe, P.A. Midgley, D. Fairen-Jimenez, A.E.H. Wheatley, submitted.

All are cordially invited to attend the seminar