

Visiting date: 7–8 July 2016

Seminar Time: 7 July (Thu) 4:20 ~5:50 pm (E208)

~ SEMINAR ~

**Uncovering Structure-Property Relationships:  
From Studies Of Pure And Supported Metal Clusters And Colloids  
To Their Use In Catalysis And Sensing**

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Insight into the nature of pure and support-immobilized atomically precise metal clusters and well-defined colloids is of fundamental importance since such metal nanoparticle precursors are useful for the development of better catalysts and sensors.

Our detailed DFT studies of the ligated clusters allowed systematic identification of bands observed in the far-IR spectra (obtained at the Australian Synchrotron) as well as better understanding of their deligation and interpretation of the ultra-high resolution electron microscopy images of clusters supported on titania nanosheets.

Results of recent synchrotron XPS/XAS studies of pure and supported clusters and colloids reveal their unique electronic properties and highlight the importance of support chemistry, which could be tuned by pre-treatments, in controlling aggregation of clusters.

Our catalytic studies highlight the effects of support and gold particle size in electrocatalytic oxidation of glycerol, initiator- and solvent-free aerobic oxidation of cyclohexene, and effects of the nature of the cluster/colloid precursors and activation treatments in the aerobic oxidation of benzyl alcohol. We have also demonstrated that green catalytic process of aerobic oxidation of amines to nitriles can be driven by the visible light using hydrous ruthenium oxide nanoparticles on TiO<sub>2</sub>.

The Au-WO<sub>3</sub>-based composites fabricated using clusters (Au<sub>9</sub>) and colloids (Au<sub>101</sub>) demonstrate excellent performance as optical and conductometric sensors for hydrogen, providing evidence that ultra-small clusters outperform large NPs. We have also demonstrated sensing (including size effect) of important toxins and viruses at nanomolar concentrations by the surface-modified Au colloids.

**Dr. Vladimir Golovko**

Senior Lecturer Above the Bar, University of Canterbury, New Zealand

After earning a PhD in cluster chemistry from the University of Cambridge (UK) in 2003, he continued as a postdoc in the group of Professor Brian F.G. Johnson, FRS focusing on applications of clusters and metal nanoparticles in controlled nanofabrication and catalysis. In 2007, he was appointed as a Lecturer at the Department of Chemistry, University of Canterbury, New Zealand. He has been promoted to a Senior Lecturer Above the Bar in 2015.

His research interests have strong emphasis on precise fabrication and detailed structural characterization of nanomaterials (metal colloids and atomically precise clusters, metal oxide nanostructures *etc.*), their applications in heterogeneous (electro/photo)catalysis and catalytic nanofabrication, sensors and biotechnology. Since 2002 he has published 54 papers in prestigious international journals (Nature, Angew. Chem. Int. Ed., Chem. Comm. with his most recent paper in the ACS Catalysis highlighted on the front cover in January 2015) that have attracted over 1100 citations.

