Fully-funded 3 Year PhD Studentship: Hydrogen Production for Clean Energy

Supervisors: Prof. Geoff Thornton (University College London, UCL), Prof. Masahiko Tomitori, Dr. Akira Sasahara (Japan Advanced Institute of Science and Technology, JAIST)

Closing Date for Applications: May 2014
Start Date: September 2014

Topics: Fuel Cells, Hydrogen, Clean Energy, Surface Science, Nanoscience/Nanotechnology, Scanning Probe Microscopy, Scanning Tunneling Microscopy Atomic Force Microscopy, Model Catalysis

Location: London (UK), Kanazawa (Japan)

Gold-ceria systems are very active for several reactions of industrial importance including the production of hydrogen, key to many alternative energy devices, including fuel cells. Gold nanoparticles when they are dispersed on a support such as cerium dioxide have the ability to catalyze these reactions, yet the reason for this is not yet known. One suggestion is that there is a transfer of electrons from the cerium dioxide to the gold nanoparticles making them negatively-charged and therefore particularly active. In this new collaboration, we will measure the charge transfer directly using atomic-resolution imaging techniques based on scanning tunneling microscopy (STM) and atomic force microscopy (AFM).

STM and AFM have revolutionized our understanding of surfaces by providing real space images with atomic resolution. These techniques will be used to investigate the adsorption of Au atoms and nanoparticles on CeO2. In particular, scanning tunneling spectroscopy (STS) measurements at each point of an STM image can be used to measure the local densities of state of the sample. Similarly in AFM, by operating in a special mode known as Kelvin probe force microscopy (KPFM), we can measure the charge at each point of the AFM image. Both these measurements will provide information about any charge transfer that occurs between the CeO2 support and the Au atoms and nanoparticles. Very few methods are capable of directly visualizing charge transfer processes so the results from the PhD are extremely important.

In Year 1 and Year 3, STM/STS measurements will be made in UCL (UK) and in Year 2, AFM/KPFM measurements will be made in JAIST (Japan).

Due to funding restrictions, the studentship is open to UK/EU nationals who have or expect to gain a 2:1 or first class MSci or MChem degree or 2:2 minimum BSc plus stand-alone master's degree with merit (or an equivalent qualification) in Chemistry, Physics, Engineering or Materials Science. The studentship will pay a stipend (£15,863 for the 2014/2015 academic year) and fees at the rate applicable for UK/EU students for three years. The student will be registered for a PhD at UCL where they will spend the first and third years. The second year of the PhD will be spent at JAIST.

For further information and application please contact Prof. Geoff Thornton g.thornton@ucl.ac.uk

Further reading

D. C. Grinter, R. Ithnin, C. L. Pang, and G. Thornton, J. Phys. Chem. C 114, 17036 (2010) http://pubs.acs.org/doi/abs/10.1021/jp102895k
A. C. Papageorgiou, N. S. Beglitis, C. L. Pang, G. Teobaldi, G. Cabailh, Q. Chen, A.J. Fisher, W.A. Hofer, G. Thornton, Proc. Nat. Acad. Sci. USA, 107, 2391 (2010) http://www.pnas.org/content/107/6/2391
A. Sasahara, C. L. Pang, and H. Onishi, J. Phys. Chem. B 110, 17584 (2006) http://pubs.acs.org/doi/abs/10.1021/jp063665h

Thornton Group http://www.ucl.ac.uk/chemistry/research/group_pages/nano/
Tomitori Group
https://www.jaist.ac.jp/ms/english/labo/tomitori.html