Plasmonic Enhancement of Hydrogen from Water Splitting

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Project ID: 2228cd1391 (You will need this ID for your application)

Research Theme: Physical Sciences

UCL Lead department: London Centre for Nanotechnology (LCN)

Department Website

Lead Supervisor: Geoff Thornton

Project Summary:

The surface plasmon resonance of nanostructures enhances solar light harvesting using semiconducting substrates either by photo-induced charge transfer or near-field enhancement. Determining which of these mechanisms is most important for water splitting by Au nanoparticles on TiO2 is the main aim of the project. This model system has been studied extensively in connection with oxidation catalysis, and hence provides an excellent platform to explore plasmonic coupling.

This is an instrumental project that will employ low-temperature scanning tunnelling microscopy, and spectroscopy (STM, STS), XPS and UPS in the LCN, time-resolved photoemission in the Photon Science Hub (in collaboration with Helen Fielding) and XPEEM at Diamond (with Chris Muryn@Manchester).

It has been shown that there is a shape dependence of Au nanoparticle plasmon behaviour. It is therefore of interest to be able to control the shapes of nanoparticles. The first aim of this project will be to investigate the shapes of Au nanoparticles grown on TiO2 using STM. In particular, the project will examine whether Au nanowires can be grown by physical vapour deposition on rutile TiO2(110), similar to Pd nanoparticles. Characterisation of photocatalysis will investigate the influence of plasmon excitation on H2O and OH adsorbates. These measurements will be used to probe the surface before and after plasmonic enhancement using laser excitation of the nanoparticles. Varying the laser power and frequency as well as observing the directionality of the plasmonic response will shed light on the active mechanism of plasmonic enhancement of photocatalysis. Time resolved photoemission will examine the transfer of the plasmon excitation to the substrate and adsorbate on the fs timescale.

This project is suitable for a student with a background in condensed matter physics or chemical physics interested in a challenging instrumental project of relevance to climate change mitigation.

Thornton group website Fielding group website
