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PHOTOCATALYTIC WATER SPLITTING – A GREEN ROUTE TO HYDROGEN: FE_2O_3 BASED BIPHASIC JANUS NANOPARTICLES FOR ENHANCED VISIBLE LIGHT WATER SPLITTING

Michael E A Warwick, Charles W Dunnill and **Andrew R Barron**
Swansea University, UK

There is a rapidly increasing need for green hydrogen for use as an energy vector, a raw material in industrial processes and for the utilization of captured CO_2. Despite making up 70% of the mass in the universe hydrogen is not abundant on the earth in its gaseous di-hydrogen (H_2) form. This is due to its low mass and buoyancy allowing it to escape the Earth's gravitational pull and dissipate into the Universe. Currently 96% of the hydrogen produced and used in the world derives from fossil fuels and as a result leads to the production of substantial amounts of CO_2. While carbon capture can be used to mitigate this, it is preferable to discover new green routes for H_2 production, especially if it is to be used as a precursor for CO_2 conversion and utilization. As a key constituent of water, hydrogen atoms are highly abundant in our oceans, allowing for vast hydrogen reserves. Obtaining hydrogen from water is an energy intensive process requiring an electrical charge, either from an electrical supply or a photocatalytic reaction. The use of photocatalysts for the splitting of water provides a direct route from solar energy to hydrogen. In this work a novel approach using soluble substrates and sequential layering processes to produce Fe_2O_3 based Janus nanoparticles is considered. The method allows the combination of two materials with suitable band gaps to be combined giving a single particle with dual functionality. It is hoped that this approach can be developed to produce a viable photocatalyst for the splitting of water. The particles are produced by dip coating and a carefully characterized for their structural, optical and compositional properties through a range of techniques and the photocatalytic properties are tested by gas chromatography of the evolved gases on exposure to visible light.

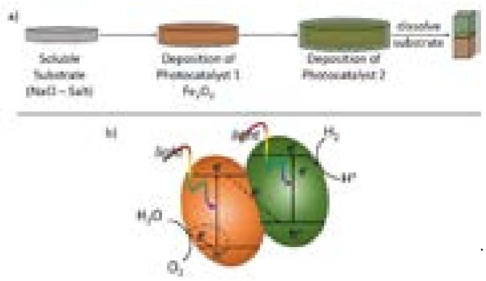

Figure 1: a) M… splitting mechanism us…

Recent Publications

1. W Wu, C Jiang and V A L Roy (2015) Recent progress in magnetic iron oxide-semiconductor composite nanomaterials as promising photocatalysts. Nanoscale 7:38-58.
2. X Zou and Y Zhang (2015) Noble metal-free hydrogen evolution catalysts for water splitting. Chemical Society Review 44:5148-5180.
3. J C Bear V Gomez, N S Kefallinos, J D McGettrick and A R Barron and C W Dunnill (2015) Anatase/rutile bi-phasic titanium nanoparticles for photocatalytic applications enhanced by nitrogen doping and platinum nano-islands. Journal of Colloid and Interface Science 460:29-35.
4. Y Attia and M Samer (2017) Metal clusters: new era of hydrogen production. Renewable and Sustainable Energy Reviews 79:878-892.
5. X J She, J J Wu, H Xu, H Xu, J Zhong, Y Wang, Y H Song, K Q Nie, Y Liu, Y C Yang, M T F Rodrigues, R Vajtai, J Lou, D Du, H M Li and P M Ajayan (2017) High efficiency photocatalytic water splitting using 2D α-Fe_2O_3/g-C_3N_4 z-scheme catalysts. Advanced Energy Materials 7:1700025.

Biography

Michael E A Warwick is an Inorganic Materials Chemist. His research focuses on the development of novel materials for photocatalytic water splitting for the production of hydrogen. He has spent two years researching photoactive semiconductor materials at University of Padova, Italy focusing primarily on the synthesizing Fe_2O_3 nanostructures and analyzing their potential for water splitting. His current research focuses on the production of biphasic Janus type nanocomposites for solar energy harvesting.

M.E.A.Warwick@Swansea.ac.uk