Project Title: Control of Selectivity in Photoreforming Process for Converting Organic Waste Products into Useful Chemicals.

Supervisors: Rose Amal

Abstract: Photoreforming is a process that utilizes the redox ability of photocatalysts to simultaneously drive the reduction reaction of H^+ into hydrogen gas and oxidation of organic compounds. While most of the photoreforming studies focus on enhancing the efficiency of hydrogen gas production, this project aims to tune the selectivity of the oxidation reaction to promote the generation of valuable chemical feedstocks.

Novelty and Contribution: For the past few decades, titanium dioxide (TiO_2) has received significant attention in photoreforming reaction, owing to its deep valance band that allows the degradation of various harmful organic compounds. Among many different strategies, metal-deposition has been demonstrated as one of the most promising techniques to enhance the hydrogen production efficiency of TiO_2. Our previous studies have also shown that co-catalyst deposited TiO_2 (Pt, Au and Cu) exhibited enhanced photocatalytic performance in hydrogen generation.[1-4] With the increased hydrogen production rate, the tuning of selectivity of oxidised organic species is essential for overall optimisation of the photoreforming system, thus should not be neglected. This research proposed to deposit oxidative co-catalyst such as cobalt, nickel or manganese on TiO_2, which could potentially change the oxidation pathways, thereby, alters the organic products formed.

Research Environment The successful TOR student will have the opportunity to work in the Particles and Catalysis Research Lab at the School of Chemical Engineering, under supervision of Scientia Professor Rose Amal (https://www.createdigital.org.au/magazines/rose-amal-people-see-chemical-engineering-new-light/) and Dr Cuiying Toe. The student will have access to state of the art experimentation facilities, mentorining opportunities, fun and nurturing environment to gain or accelerate career in research or equip one with hands on experience. Further information is available by emailing r.amal@unsw.edu.au

Expected Outcomes: The project will allow students to work with other research staffs and students in Particles and Catalysis Research Group, to develop a photoreforming system with good hydrogen generation efficiency and tuneable selectivity of desired chemical products. Students that undertake this project will receive guidance in catalyst synthesis, characterisation, performance test, data analysis and reporting (i.e. progress report, research publication and poster/oral presentations).

Reference Material Links:

1. Wang, F., Wong, R. J., Ho, J. H., Jiang, Y., & Amal, R. (2017). Sensitization of Pt/TiO2 using plasmonic Au nanoparticles for hydrogen evolution under visible-light irradiation. *ACS applied materials & interfaces*, *9*(36), 30575-30582.
2. Wang, F., Jiang, Y., Lawes, D. J., Ball, G. E., Zhou, C., Liu, Z., & Amal, R. (2015). Analysis of the promoted activity and molecular mechanism of hydrogen production over fine Au–Pt alloyed TiO2 photocatalysts. *ACS Catalysis*, *5*(7), 3924-3931.
3. Jung, M., Hart, J. N., Scott, J., Ng, Y. H., Jiang, Y., & Amal, R. (2016). Exploring Cu oxidation state on TiO2 and its transformation during photocatalytic hydrogen evolution. *Applied Catalysis A: General*, *521*, 190-201.
4. Jung, M., Hart, J. N., Boensch, D., Scott, J., Ng, Y. H., & Amal, R. (2016). Hydrogen evolution via glycerol photoreforming over Cu–Pt nanoalloys on TiO2. *Applied Catalysis A: General*, *518*, 221-230.

NOTE: Possibility to continue project for Thesis A.