Harnessing Solar Energy through Nano-Catalysis for Fuel and Chemical Synthesis

Rose Amal

School of Chemical Engineering, UNSW, Sydney, NSW 2052, Australia.

Email address of presenting author: r.amal@unsw.edu.au

In this presentation, I will explore the role of nano-catalysts in harnessing solar energy for the sustainable synthesis of chemicals and fuels. These catalysts, due to their unique intrinsic properties—including modified optical and electronic behaviours—greatly enhance the efficiency and selectivity of solar-driven chemical processes.

Our research leverages the entire solar spectrum, utilising UV and visible light for photocatalytic reactions and infrared radiation for thermal catalysis. These processes drive crucial reactions such as water splitting to generate H2, CO_2 reduction, NO_x reduction, and CO_2 hydrogenation. I will highlight recent advancements in our work, particularly how we use nanocatalysis to enhance both the efficiency and selectivity of these solar-driven processes.

Our study has led to significant developments in photocatalysis, where we've engineered systems to concurrently produce hydrogen and selectively oxidise organics. Our investigations into $Zn_xIn_2S_{3+x}$ photocatalysts have provided insights into the relationship between structure, activity, and selectivity optimising the reforming of furfuryl alcohol into hydrogen and hydrofuroin, a jet fuel candidate

The integration of a solar-thermal reactor with a PV-electrolyser has enabled us to optimise the solar-driven reduction of CO_2 with hydrogen to methane. This innovative system, installed atop our building, exemplifies the practical application of our research.

Overall, our findings demonstrate the versatility and potential of solar energy in the production of clean fuels and the value-added transformation of organics, signifying a leap forward in the application of nano-engineered materials for solar energy conversion. This body of work contributes to global energy sustainability by providing alternatives to fossil fuels and advancing nano-catalysis technologies.

Short Biography

Professor Rose Amal is a Scientia Professor in the School of Chemical Engineering, UNSW, Sydney. She is Co-Director of ARC Training Centre for the Global Hydrogen Economy and Lead of NSW Powerfuel including H_2 Network.

Her current research focuses on designing catalysts for solar and chemical energy conversion applications, making solar chemicals and fuels (such as H_2).

Professor Rose Amal has received numerous prestigious awards including CHEMECA medalist (2021) and named as 2019 NSW Scientist of the Year. She is a Fellow of Australian Academy of Technology and Engineering (FTSE), a Fellow of Australian Academy of Science (FAA), Fellow of Royal Society NSW (FRSN), Fellow of IChemE, and Honorary Fellow of Engineers Australia. She has received the nation's top civilian honour – the Companion of the Order of Australia - for her service to chemical engineering, particularly in the field of particle technology, through seminal contributions to photocatalysis, to education as a researcher and academic, and to women in science as a role model and mentor.

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