Università di Roma Tor Vergata

Department of Industrial Engineering

CHEMICAL NANOENGINEERING ERASMUS MUNDUS MASTER

Invited scholar CNE#5

Prof. José Ramón Galán-Mascarós

Group Leader, ICREA Research Professor
Catalan Institution for Research and Advanced Studies (ICREA)
Institute of Chemical Research of Catalonia (ICIQ)
The Barcelona Institute of Science and Technology
Tarragona (Spain)

Nanostructures and electrocatalysis for green hydrogen production

In the near future, fossil fuels must be substituted by renewable energy sources, following the decarbonization plans established and supported by multiple international institutions and agencies. However, renewable energy sources are by definition intermittent, and thus appropriate storage media will be required for their deployment. The opportunity to store electrical energy as hydrogen obtained from water splitting opens a real alternative. Is water electrolysis ready for the challenge? Hydrogen is produced at the industrial level from fossil fuels, mostly natural gas. Indeed, methane reforming accounts for over 96% of the global hydrogen production, emitting ≈ 7 Kg of CO_2 per kilogram of H_2 produced. The very low price point of this fossil hydrogen (now called “grey hydrogen”), precluded the evolution of electrolytic hydrogen. Electrolyzer technology remained small and niche for special applications, with intrinsic significantly higher costs. An urgent technology development is now required for water electrolysis to become a reliable, cost effective and large scale technology to foster the energy transition to renewables and the industrial decarbonization plans.

This course will introduce water electrolysis, focusing on the state-of-the-art and future challenges highlighting the need for nanoscience, as a technology enabler. We will divide the course in these lectures:

1- History of water electrolysis: Invention and deployment of the industrial water electrolyzer. Evolution through the centuries, and current trends.
2- Water electrolysis: Current technologies. Materials, separators and membranes. Basic concepts and challenges for the energy transition towards green hydrogen.
3- Hydrogen evolution reaction (HER): Cathodes in current technologies. Weaknesses and challenges. Future developments and prospects.
4- Oxygen evolution reaction (OER): Anodes in current technologies. Weaknesses and challenges. Future developments and prospects.
5- Renewable energy sources and water electrolysis: matching and mixing. From modular approaches to the artificial leaf.

Tuesday 7, 11.30-13.00
Wednesday 8, 14.00-15.30
Thursday 9, 14.00-15.30
Tuesday 14, 11.30-13.00
Wednesday 15, 14.00-15.30
Thursday 16, 14.00-15.30