NANOSCIENCE AND NANOTECHNOLOGY PROGRAM

Francisco Javier Rodríguez-Varela, PhD

Research interests:

- Novel energetic materials
- Electrocatalysis
- Fuel cells
- Hydrogen technologies

PhD, École polytechnique de Montréal (2004). Posdoctoral Fellow at the same institution (2004-2005). Joined Cinvestav in 2006 (category 3 since 2009). Has lead several projects funded by Conacyt (two international: China and India). Has been co-leader of several projects with industry (PEIs). Co-editor of a Book to be published by Springer in 2018. Has published 55 works in international Journals. Has graduated 4 PhD (3 in progress), 6 MSc (5 in progress) and 6 undergraduate students. Has been co-editor of two books related to hydrogen technologies and fuel cells.

Member of: International Society of Electrochemistry, Sociedad Mexicana del Hidrógeno, Sociedad Mexicana de Electroquímica and Electrochemical Society. Has been guest editor of Journal of New Materials for Electrochemical Systems and Journal of Applied Electrochemistry.

Selected Honours and Awards

President of the Mexican Hydrogen Society (2012-2014).

General coordinator of the National Network for Hydrogen Energy of Conacyt (2015).

Member of Advisory Board and Guest Editor of Journal of New Materials for Electrochemical Systems.

Guest Editor of Journal of Applied Electrochemistry

Funding

Conacyt-Ciencia Básica

Conacyt-Secretaría de Economía

Research Project: Synthesis and evaluation of nanostructured alloys, core-shell and metal-metal oxide materials with high catalytic activity for fuel cell applications

In Dr. Rodríguez-Varela`s Lab the research is oriented to the development of nanocatalysts and the study of electrochemical reactions in energy systems (fuel cells, electrolyzers). Anode and cathode carbon-supported nanomaterials based on Pt and Pd have been developed, with enhanced catalytic activity for several reactions in acid and alkaline media: Oxygen Reduction Reaction (ORR); Hydrogen Oxidation Reaction (HOR); Hydrogen Evolution Reaction (HER); Oxidation of several organic molecules (methanol, ethanol, ethylene glycol, glycerol). Different structures have been successfully developed: monometallic, alloys, metal-metal oxides, core-shell. The most recent developments in the Lab demonstrate that the surface chemical functionalization of carbon nanostructures (Vulcan, graphene, biocarbon) with Ru organometallic compounds create Ru metallic sites (along with functional groups), which in turn promote the formation of Pt-Ru alloyed phases. This way, Pt/C_{Ru} nanocatalysts are obtained. As a result, nanocatalysts of the $Pt/C_{Ru\text{-}dim}$ type show a higher catalytic activity for the Methanol, Ethanol and Ethylene Glycol Oxidation Reactions (MOR, EOR and EGOR, respectively), than conventional Pt/C.