UC San Diego
JACOBS SCHOOL OF ENGINEERING
NanoEngineering

UCSD NanoEngineering/Chemical Engineering

Virtual **SEMINAR SERIES**

Wednesday Jan 26th, 2022

Seminar Presentation: 11:00am – 12:00pm PDT

"Carbon Nanotubes assembly and Nitrogen-doping or Plasmonic Nanoparticles anchoring for alternative energy applications."

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Abstract: The oxygen reduction reaction (ORR) can be harnessed for alternative energy applications in fuel cells or for on-site hydrogen peroxide (H_2O_2) generation in environmental remediation applications. Carbon-based materials, when doped with Nitrogen, have emerged as a suitable catalyst option, due to their earth-abundance, low cost, electrical conductivity and corrosion resistance, with a great electrocatalytic activity, long-term stability, and tolerance to gas poisoning.

Assembling N-doped carbon nanotubes (CNx-CNTs), we have evaluated the performance of the buckypaper architecture, showing a great cathodic current peak. This shows the CNx-CNTs buckypapers as efficient 3D electrodes for electrocatalytic applications [1].
Nitrogen can be incorporated into the graphitic carbon materials through different bonding environments, where the three most common nitrogen species correspond to pyridinic-N, pyrrolic-N, and graphitic-N. CNx-CNTs with high graphitic-N content favors the two-electron pathway for the ORR not only in basic media (pH = 13) but also in neutral media (pH = 7) [1], representing an attractive alternative for wastewater remediation through the on-site generation of H_2O_2. Moreover, supported by theoretical calculations, we have proposed an atomistic step by step ORR mechanism for the selectivity of the ORR as a function of the nitrogen species [2]. Then, aided by the modulation of the nitrogen species present in synthesized CNx-CNTs, we measured their ORR activity and selectivity, with experimental trends consistent with our DFT mechanism [2].
Seeking for alternative energy options, direct alcohol fuel cells (DAFCs) is an attractive energy conversion device where the alcohol oxidation reaction (AOR) plays a key role. The combination of Plasmonics and Electrochemistry at the nanoscale is emerging to accelerate electrochemical reactions. We show how the assembly of buckypapers using gold nanoparticles (AuNPs) and carbon nanotubes (CNTs) which results into a manageable material with good activity for the electro-oxidation of alcohols, revealing an important photo-increment when illuminated by light [3].
We end up this talk sharing our Plasmonic nanoparticles synthesis experience modifying size, shape and composition for tuning their optical properties.

Biosketch:

Born in Ensenada, Baja California, México; Jose M. Romo-Herrera is a Physicist with a Ph.D. in Nanoscience and Nanotechnology performed on topics related with Carbon nanotubes, under the supervision of Prof. Mauricio Terrones, Prof. Humberto Terrones and Prof. Vincent Meunier. Afterwards, he learned colloid chemistry synthesis methods for Plasmonic nanoparticles at the Colloid Chemistry Gruoup in Vigo Spain during the Posdoc stay. Currently, he is a faculty member of Centro de Nanociencias y Nanotecnologia of UNAM (CNyN-UNAM) located in Ensenada, Baja California, México.

Their current main research topics of interest involve the design and assembly of nanostructured materials from Nitrogen doped Carbon nanostructures and Plasmonic nanoparticles, including their electron microscopy analysis.