21 de MAYO de 2024

12:30 h
Aula del edificio I+D+i

INMA
INSTITUTO DE NANOCIENCIA Y MATERIALES DE ARAGÓN

A mathematical journey from molecular electronics to bioelectricity

Jorge Trasobares Sánchez

Universidad Complutense de Madrid

In this talk I will addresses the issue of reproducibility in molecular devices and proposes a solution through operando characterization. Our research focuses on hybrid molecular graphene field effect transistors (m-GFETs) that integrate 11-(Ferrocenyl)undecanethiol micro self-assembled monolayers with high-quality graphene in a back-gated configuration. Among some particularities this innovative approach not only enables redox electron transfer and prevents molecular degradation but also facilitates operando spectroscopy, shifts the graphene Dirac point to neutrality and generates photocurrent. This latest work will allow me to review some mathematical models employed and stress similarities with macroscopic biological phenomena. Then, I will introduce the concept of Cellular Automata, originally discovered in the 1940s by Stanislaw Ulam and John von Neumann, further developed in the 1980s by Stephen Wolfram and the most advanced version, the Neural Cellular Automata recently published by Alexander Mordvintsev. Finally, I will show some results on the use of artificial neural networks for the treatment of bacterial cultures images showing bioelectricity. By bridging the gap between molecular electronics and cellular automata based models, this talk aims to highlight the interdisciplinary nature of research and its potential for addressing complex scientific challenges.

In 2012, I began investigating Molecular Electronics, covering nanofabrication, surface science, modeling, and electronics. At Zaragoza University, we proposed using reduced graphene oxide in molecular devices. In 2013, I started a doctorate at the University of Lille and IEMN-CNRS (France). We analyzed ambient effects on Electrostatic Force Microscopy (2014), developed a new process for nanofabricating gold nanocrystal arrays using high-speed e-beam lithography (2014), demonstrated a molecular diode operating at 17.8 GHz(2016), explored π-π intermolecular interactions (2017), presenting single nanoparticle electrochemistry (2017). As a postdoc at the National University of Singapore, I focused on the EGaIn technique (2019). In 2018, I joined Imdea Nanoscience to develop a scalable transistor based on molecular graphene junctions (2023). In 2019, I became an Associate Professor at Complutense University of Madrid and since March 2023 as Assistant Professor, certified as Associate Professor by ANECA.

INMA
INSTITUTO DE NANOCIENCIA Y MATERIALES DE ARAGÓN

CSIC
CONSEJO SUPERIOR DE INVESTIGACIONES CIENTÍFICAS

Universidad Zaragoza
1542