Jordi Arbiol, J Nanomed Nanotechnol 2018, Volume:9
DOI: 10.4172/2157-7439-C2-069

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Free-standing nanostructures at atomic scale: From growth mechanisms to local properties at the nanoscale

Technology at the nanoscale has become one of the main challenges in science as new physical effects appear and can be modulated at will. Superconductors, materials for spintronics, electronics, optoelectronics, sensing, energy applications and new generations of functionalized materials are taking advantage of the low dimensionality, improving their properties and opening a new range of applications. As developments in materials science are pushing to the size limits of physics and chemistry, there is a critical need for understanding the origin of these unique physical properties (optical and electronic) and relate them to the changes originated at the atomic scale, e.g., linked to changes in (electronic) structure of the material. In the present work, I will show how combining advanced electron microscopy imaging with electron spectroscopy, as well as cathodoluminescence in an aberration corrected STEM will allow us to probe the elemental composition and electronic structure simultaneously with the optical properties in unprecedented spatial detail. The talk will focus on several examples in advanced nanomaterials for optical, electronics and energy applications. In this way, the latest results obtained by my group on direct visualizing and modeling materials at atomic scale will help to understand their growth mechanisms (sometimes complex) and correlate their physical and chemical properties at sub-nanometer with their atomic scale structure. The examples will cover a wide range of nanomaterials: quantum structures self-assembled in a nanowire: quantum wires (1D) and quantum dots (0D) and other complex nanowire-like morphologies for photonic and energy applications (LEDs, lasers, quantum computing, single photon emitters, water splitting cells and batteries).

Biography

Jordi Arbiol has completed his graduation in Physics at Universitat de Barcelona (UB) in 1997, where he also obtained his PhD (European Doctorate and PhD Extraordinary Award) in 2001. He was an Assistant Professor at UB. From 2009 to 2015, he was the Group Leader at Institut de Ciència de Materials de Barcelona, ICMAB-CSIC. Since 2017, he has been the President of Spanish Microscopy Society (SME). Since 2015, he has become the leader of the Group of Advanced Electron Nanoscopy at Institut Català de Nanociència i Nanotecnologia (ICN2). He has been awarded with the EU40 Materials Prize 2014 (E-MRS) 2014 EMS Outstanding Paper Award and the PhD Extraordinary Award in 2001.

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