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

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Technology at the nanoscale has become one of the main challenges in science as new physical effects appear and can be modulated at will. 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, we will show how combining advanced electron microscopy imaging with related spectroscopies 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 especially for energy and quantum technology applications. In this way the latest results obtained on direct visualization and modeling of the materials at atomic scale will help to understand their growth mechanisms (sometimes complex) and also correlate their physical properties (electronic and photonic) at sub-nanometer with their atomic scale structure. As an example we will study complex nanowire-like morphologies for photonic, quantum computing and energy applications.

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