Photonic 1D nanomaterials: Correlation between Optical Properties at sub-nanometer scale with its structure at atomic scale

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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. Superconductors, materials for spintronics, electronics, optoelectronics, chemical sensing, 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.

During the seminar, 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 seminar will focus on several examples in advanced nanomaterials for optical and plasmonic applications. In this way the latest results obtained by my group on direct correlation between optical properties at sub-nanometer scale and structure at atomic scale will be presented. The examples will cover a wide range of nanomaterials: quantum structures self-assembled in a nanowire: quantum wells (2D),[1,2] quantum wires (1D) [3] and quantum dots (0D) [4,5] for optical applications (LEDs, lasers, quantum computing, single photon emitters) [6,7]; as well as metal multiwall nanoboxes and nanoframes [8] for 3D plasmonics.

References

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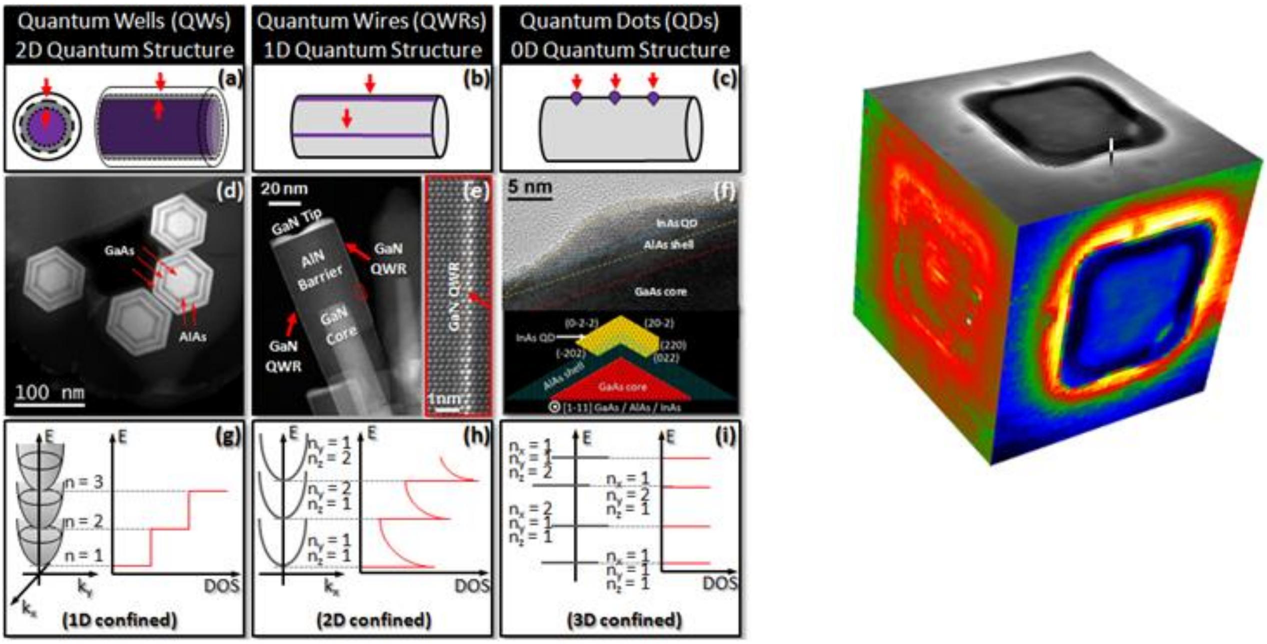

Figure 1. left) Sketches of different quantum structures classified by their dimensionality: (a) Quantum Wells or 2D structures (QWs); (b) Quantum Wires or 1D structures (QWRs); (c) Quantum Dots or 0D structures (QDs). (d-f) Experimental STEM and HRTEM images of the quantum structures, QWs, QWRs and QDs, respectively [6,7]. (right) Sub-nanometer Plasmon analysis on a 3D Au/Ag nanobox.