**INVESTIGATION OF CATHODOLUMINESCENCE EMISSION FROM Si AND Au/Si NANOSTRUCTURES**

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**Abstract**

Both high refractive index dielectric and plasmonic materials have proved being able to confine and direct light in the nanoscale. Thus, a detailed investigation and comprehension of the plasmonic and optical excitation behaviors from the nanostructures has become an essential field of investigation to further innovate and improve the nowadays technology, e.g. in sensing, information storage and medicine. In this project it is presented the study of optical properties and resonances for a Si sample containing Silicon (Si) nanostructures [nanorods and nanopillars] accounting different sizes and gratings. Afterwards, the Si sample is recovered by a 35 nm-thick gold (Au) layer, which will enable us to study both plasmonic and optical resonances arising for similar parameters. We will use Cathodoluminescence Spectroscopy (CL) to analyze the resonances and excitations within the visible wavelength and we will develop a model in COMSOL Multiphysics to simulate and predict them.

**Cathodoluminescence (CL) Spectroscopy**

Cathodoluminescence (CL) spectroscopy is a technique based on a 30 keV electron beam excitation that collects the CL light generated from the sample.

**Silicon “isolated” nanorods**

![Silicon “isolated” nanorods](image)

- D = 320 nm
- D = 400 nm
- D = 500 nm

**CL maps, normalized CL spectra and simulated outflow power displayed for different nanorods.**

**Au/Si “isolated” nanopillars**

![Au/Si “isolated” nanopillars](image)

- Resonant modes obtained in CL spectroscopy for different nanopillar’s sizes, constant height (300 nm).
- Red-shift in wavelength peak resonances for increasing sizes.

**Au/Si coupled nanopillars**

![Au/Si coupled nanopillars](image)

- Fano resonances observed using Visible spectroscopy.
- CL intensity maps show the directionality of light in the array for λ = 450 nm.

**Conclusions and Perspectives**

- Detailed explanation and analysis of the optical resonances arising in the visible for different Si and Au/Si geometries and sizes.
- Similar responses obtained for Si and Au/Si nanostructures, the Au/Si ones present red-shifted wavelength peaks with respect to the Si ones.
- The COMSOL model proposed represents quite faithfully the resonant peaks obtained experimentally for Si but it does not represent the correct resonant peak wavelengths in the case of Au/Si owing to presumably bad Au layer deposition suppositions in the lateral Si surface of the nanorods.
- Future implementations of the COMSOL model for different geometries, gratings and Au layer thicknesses covering Si nanostructures.