Introduction to Nanophotonics and Nanofabrication

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Nanoscale and nanopatterned materials show peculiar physical and chemical properties due to the size confinement. In particular strong light matter interaction phenomena can be observed when matter is confined at the nanoscale, as in the case of one-dimensional nanowires or atomically thin two-dimensional materials, thus enabling the study of novel optical and electronic effects. The capability to control the fabrication processes at the nanoscale has recently allowed to investigate and control the material response thus enabling applications in a variety of fields such as nanophotonics, plasmonics, biosensing, photodetection, nanoelectronics and photocatalysis. Very recently, the possibility to control material response from the nano- to the atomic- scale is investigated in view of the unique opportunities available in quantum-technologies.

The objective of this course of study is to introduce fundamental concept of light matter interaction phenomena in nanomaterials confined at the sub-wavelength scale. The optical behavior of dielectric and metallic nanostructures will be discussed as well as the peculiar optoelectronic properties of atomically thin two-dimensional materials. In parallel, the nanofabrication methods that currently enable the fundamental investigation and the optoelectronic applications will be described. Top-down and bottom-up nanofabrication approaches will be presented highlighting their potential in optoelectronics, biosensing and photodetection applications.