Seminario del vincitore della procedura valutativa a PA ex. art. 24 L.240/2010 SSD FIS/03 SC02B1- Dr. Marco Felici

Titolo:

Spatially Selective Hydrogen Irradiation/Removal: A Versatile Nanofabrication Tool for Photonic Applications

Abstract:

Nanophotonics investigates the coupling of light and matter at sub-wavelength scales. As such, it requires a nm-level control of the spatial distribution of the confined electromagnetic field, as well as a similar precision in the positioning of single nano-emitters within the field.

As we review here, a very promising route towards the achievement of these goals exploits the effects of the incorporation of hydrogen in *dilute-nitride semiconductors* (*e.g.*, GaAsN). Following H irradiation, indeed, the formation of stable N-H complexes fully neutralizes the effects of N on the electronic, optical and structural properties of these materials. This enables, for example, the fabrication of site-controlled, single-photon emitting quantum dots, either by spatially selective H *irradiation*—by low-energy (100 eV) H irradiation of lithographically pre-patterned samples—or *removal*—using the hot spot generated by a SNOM tip or by a plasmonic nanoaperture to locally break the N-H bonds in a fully hydrogenated GaAsN:H layer.

In addition, we present compelling new evidence on the effects of H irradiation on a completely different class of materials, *i.e.*, *transition-metal dichalcogenides* (TMDs). In bulk TMDs, H irradiation results in the formation of monolayer-thick domes. These domes host strong, non-trivial strain fields that cause unprecedented major changes in the band structure of the material, including a hitherto unobserved direct-to-indirect band gap transition on going from the dome's edge to its top. The domes can be produced with well-ordered positions and sizes tunable from the nm to the μm scale, with important prospects for nanophotonics