This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 101035813

Nanostructuration of GaN: A Promising Route to Quantum Single-Photon Sources

Antouman Sallah[1], Giacometta Mineo[1], Stefano Boscarino[1], Vincenzina Strano[2], Salvatore Mirabella[1,2], Elena Bruno[1,2], Riccardo Reitano[1], Paolo Musumeci[1], Francesco Ruffino[1,2], Maria Grazia Grimaldi[1,2]

[1]*Dipartimento di Fisica e Astronomia "Ettore Majorana", Università degli Studi di Catania, Via Santa Sofia 64, 95123 Catania, Italy.*
[2]*CNR-IMM, Via Santa Sofia 64, 95123 Catania, Italy*

Single Photon Sources (SPSs) can generate coherent streams of single photons with well-defined quantum properties such as high-degree of coherence and precisely controllable quantum correlation. This makes them essential building blocks for various quantum technologies and quantum sensing applications. Beyond its well-known uses in power electronics and lasers/LEDs applications, GaN is attracting interest as a material for quantum technologies, thanks to the unique electro-optical properties of its nanostructured counterparts which have been shown to produce SPSs operating in the blue and visible range close to the roomtemperature regime. Nanostructuration of GaN, including the formation of nanoporous morphologies, and the synthesis of nanowires and nanoparticles, was carried out using Photo-Electroless Etching (PEE) and Pulsed Laser Irradiation in Liquid (PLIL). The morphological evolution of the etched GaN nanoporous substrate was investigated using Atomic Force Microscopy (AFM) and Scanning Electron Microscopy (SEM). The latter was also employed to characterize the size and morphology of the nanoparticles produced by PLIL as a function of irradiation parameters. The crystallographic phase and orientation of the synthesized nanostructures were detected by X-ray Diffraction (XRD). The optical properties of the nanostructures were assessed using room-temperature Cathodoluminescence (CL) and low-temperature photoluminescence (PL) spectroscopy. The link between the emission features and the nanostructures is discussed. This work is supported by PNRR MUR project PE0000023-NQSTI the PNRR - NQSTI "National Quantum Science and Technology Institute" Spoke 5.