# AlN :Ga dilute alloy : a new type of multi- and single UV-C photon emitter

Due to the quantum dot-like behaviour of sub-nanometric Ga-rich local composition fluctuations acting as carrier localization centres, AlN:Ga dilute alloy (Ga content in the 0.1-1% range) appears as a new system, unexplored to date, for the realization of both UV-C LEDs and single UV photon emitters, depending on the Ga content. The main applications of such UV-C (200-280 nm) emitters include water, air and surface disinfection as well as short distance encrypted communication. Specifically, in a context of short-term banning of mercury containing devices motivated by sanitary and environmental considerations, the market of UV-C light emitting diodes (LEDs) is expanding rapidly with the prospect of covering these applications in the foreseeable future. To overcome the current efficiency limitations of conventional AlGaN layer-based UV LEDs (limited p-type doping, extended structural defects in layers, light extraction issues) we propose to develop a new strategy by using AlN nanowires (NWs). As a matter of fact, the absence of extended defects in NWs, the higher limit solubility of both Si and Mg electrical dopants, the eased light extraction intrinsically related to the large "roughness" of an ensemble of NWs make them particularly suitable to the realization of efficient UV LEDs. The active region will consist of an AlN:Ga dilute alloy (*patented*), taking advantage of the emission stability inherent to quantum dot-like sub-nanometric Ga-rich local composition fluctuations. By engineering the emission properties of this active region, it will be possible to realize efficient UV-C LEDs and single UV-C photon emitters for encrypted short distance communication. It will be the goal of this PhD project to amplify the preliminary results already obtained by investigating the optical and structural properties of AlN:Ga NW heterostructures, with the purpose of controlling their growth and single/multiple photon emission properties.

The growth of the structures will be performed by plasma-assisted molecular beam epitaxy in CEA-Grenoble IRIG/DEPHY/PHELIQS-NPSC, the opto-electrical characterization being made in Institut Néel.

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