Epitaxial Lateral Overgrowth (ELO) of GaN layers is hampered by the fact that the coalescence of crystallites originating from adjacent mask apertures results in the creation of coalescence defects. This results in an inhomogeneous defect distribution in the overgrown layer and is detrimental for efficient optoelectronic devices.

To tackle this coalescence problem we propose a method based on pendeo-epitaxial processes, whereby growth proceeds laterally from a patterned epitaxial layer. Pendeo-epitaxy is well documented in the literature, but here we want to start from epilayers grown onto nano-patterned SOI substrates to try and exploit the soft mechanical properties of SiO2 at high temperatures. The method relies on using a 2D AlN/GaN stack grown onto an SOI substrate. This 2D stack is then patterned down to the SiO2 (BOX) but above the BOX/bottom Si interface, resulting in SiO2 nano-pillars capped with the Si/AlN/GaN stack. The AlN/ GaN stack serves as a seed for subsequent pendeo growth. At the coalescence stage, we expect the SiO2 pedestals to deform, if of sufficiently small diameter, which will prevent/limit the formation of coalescence defects due to lattice dis-registry between adjacent crystallites. We have already demonstrated the validity of the approach in terms of defect reduction at the coalescence boundaries through TEM and cathodoluminescence. The samples were obtained through e-beam lithography and the pitch/diameter parameters were varied to better determine the optimum values of these coupled parameters. Preliminary thermomechanical modelling confirmed the validity of the concept. We could also demonstrate that the epitaxial layers grown onto a square array of nano-pillars could be easily detached from the underlying substrate, opening the way to easy transfer processes. Our new post-doc Roy Dagher will be in charge of bringing the idea a step further. Since we now have a rather clear idea of the required diameter / pitch values for the nano-SOI pattern, nanoimprint instead of e-beam lithography will be used for fabricating the pattern. The number of pedestals will be chosen so as to make square arrays of nano-pillars, the overall dimension of which will correspond to the dimension of the LED dies to be realized, i.e. typically from 10µm to 500µm. Epitaxial growth will concern multi-quantum well p/n heterostructures for blue to red emission. The so-defined LED dies will be transferred to a host substrate and detached, further using the Vertical Thin Film process (die transfer for vertically injected LEDs). The work will be carried out in CNRS / CRHEA for what concerns epitaxy and optical characterization and in LTM for technological processes associated to nanoimprint on the PTA. The electro-optical properties of the transferred dies will be characterized. in LETI.