Group-III nitride nanowire arrays made by sublimation for nanophotonic

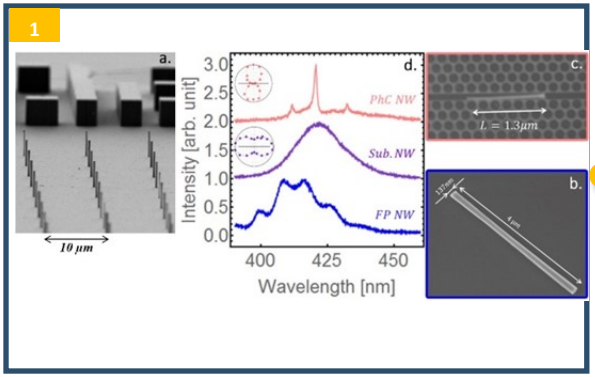

Fig 1 : SEM images of (a) bird's eye view of a NW array obtained after selective-area sublimation. (b) A NW transferred on SiN. (c) A subwavelength NW embedded in a slotted photonic crystal. (d) Room-temperature µPL spectra of the NW shown in panel b (blue line), a subwavelength NW transferred on SiN (purple line) and the subwavelength NW embedded in a photonic crystal shown in panel c (pink line)

High yield top-down fabrication of InGaN/GaN NWs

We have demonstrated that selective-area sublimation (carried out in a MBE chamber) together with electron beam lithography or displacement Talbot lithography can be a powerful and versatile method to realize precisely defined GaN-based NW arrays in a top-down approach. We have shown that it not only allows for high yield and homogeneity on a macroscale but also for a fine nanoscale control in terms of position, shape, and dimensions.

Despite this top-down approach, we have been able to demonstrate the high material and optical quality of these NWs. The existence of intrinsic Fabry–Pérot resonances in thick NWs (4-7 µm) lead to room-temperature lasing in the near-ultraviolet range. We have shown that subwavelength NWs including precisely positioned InGaN quantum disks can be integrated into a hybrid nanophotonic platform.

Breakthroughs

First demonstration of InGaN/GaN NW-induced nanocavities in slotted SiN photonic crystal.

Perspectives

Taking advantage of the ultrahigh vacuum environment in which the sublimation is carried out to realize more complex NW designs, including core–shell and hollow-core structures as well as radial heterostructures.

Collaborations : NTT, **Japan**. University of Bath, UK.
More information : S. Sergent, B. Damilano, S. Vézian et al. ACS Photonics (2019). B. Damilano, S. Vézian et al. APEX 12, 045007, (2019). P.M. Coulon, B. Damilano, et al. Microsyst. Nanoeng., 5 (2019).
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