Centre de Nanosciences et de Nanotechnologies

Soutenance de thèse

Vendredi 12 octobre

14h 00

Salle 44 –C2N site Orsay

Nan GUAN

“ *Nitride nanowire light-emitting diode*”

Jury members :

Dr. Jean-Yves Duboz (rapporteur)
Dr. Jean-Paul Salvestrini (rapporteur)
Dr. Bernard Gil (examinateur)
Dr. Jean-Christophe Harmand (examinateur)
Dr. Christophe Durand (examinateur)
Dr. François H. Julien (encadrant)
Dr. Maria Tchernycheva (co-encadrant)

Abstract :

Nitride nanowires exhibit outstanding opto-electronic and mechanical properties and are considered as promising materials for light-emitting diodes (LEDs), thanks to their high crystalline quality, non-polar facets, good mechanical flexibility, high aspect ratio, etc.
This Ph.D. thesis addresses the growth, the device fabrication, the optical and electrical characterizations and the optical simulations of III-nitride NW devices, with a special emphasis on the LED applications.
First, this thesis presents the growth of m-plane InGaN/GaN quantum wells with different In concentrations in self-assembled core-shell nanowires by metal-organic chemical vapor deposition. Then, by using these nanowires, LED devices based on two different integration strategies (namely, in-plane and vertical integration) are demonstrated.
The in-plane integration is based on the horizontally dispersed single nanowires. I have proposed a basic integrated photonic platform consisting of a nanowire LED, an optimized waveguide and a nanowire photodetector. I have also developed a nanowire alignment system using dielectrophoresis.
The vertical integration targets the fabrication of flexible LEDs based on vertical nanowire arrays embedded in polymer membranes. Flexible monochromatic, bi-color, white LEDs have been demonstrated. Their thermal properties have been analyzed.
The nanowires grown on 2D materials by van der Waals epitaxy are easy to be lifted-off from their native substrate, which should facilitate the fabrication of flexible nanowire devices. With this motivation, in the last part of this thesis, I have investigated the selective area growth of GaN NWs on micro- and nano- scale graphene by molecular beam epitaxy.

UMR9001 CNRS-UPSUD
Avenue de la Vauve
91120 Palaiseau