Thèse 1.1 : LEDs

Type de demande : Thèse partagée académique / PME

Sujet : Croissance et fabrication de LEDs semi- et non-polaires sur Si.

Participants:

Partenaires GANEX académiques: **CRHEA, LETI**
Partenaires GANEX industriels: **SILSEF**
Partenaires en-dehors de GANEX: **LTM**

Résumé:

Conventional GaN-based LEDs suffer two handicaps due to the growth along the polar *c*-axis: on the one hand, and due to the discontinuity of the polarization field across the MQWs interfaces, the resulting quantum confined Stark effect reduces the recombination radiative efficiency; on the other hand, the growth along the *c*-axis limits the efficient In incorporation into the InGaN QWs, thereby limiting the possibilities of fabricating green light-emitting diodes. The previously-described problems can be simultaneously solved by growing the associated LEDs along nonpolar or semipolar directions, in which the polarization-induced electric fields can be reduced (even completely removed) and along which a more efficient In incorporation has been observed, for equivalent growth conditions.

The objective of this PhD thesis will be the growth of semipolar or nonpolar GaN LEDs on silicon substrates. Traditionally, semi or nonpolar GaN growth has been achieved by using *r*- or *m*-plane sapphire substrates. However, in order to address the market of solid state lighting it would be desirable to use large-area and cheap substrates, in particular silicon. The encountered problem is that GaN growth on silicon substrates has been traditionally carried out on (111)-oriented silicon substrates, leading to GaN growth along the c-axis. In order to achieve a semipolar or nonpolar GaN growth, the strategy will be to employ other silicon orientations, in particular Si (100), with a patterned surface that will expose Si(111) facets. This step will be carried out at LETI/LTM, in Grenoble on substrates provided by SILSEF. Once the desired facets will be exposed, the growth of a GaN layer will be conducted at CRHEA by MOVPE. The growth will be continued until a flat and continuous semi or nonpolar GaN layer will be achieved. Then, the LED structure will be grown. In order to get a rapid feedback and modify accordingly the growth conditions, the student will process some of the LEDs structures within CRHEA's cleanroom, while more performant LED processing will be conducted by the student at LETI's facilities.

Plan de Travail: