AlGaN Quantum Dots for deep UV emission

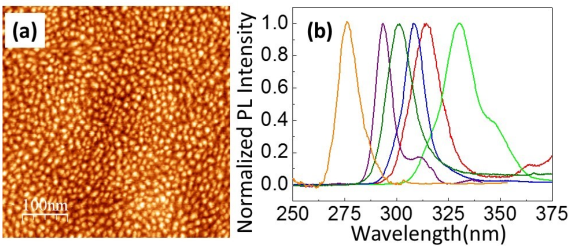

Fig (a) : *Atomic force microscopy image of AlGaN quantum dots grown by molecular beam epitaxy.*

Fig (b) : *Photoluminescence spectra of AlGaN quantum dots emitting in the UVC, UVB and UVA regions from 275 nm to 340 nm.*

High quantum efficiency ultra-violet emitters

As the replacement of mercury lamps by environmentally safe UV sources is required, AlGaN based LEDs are expected to fulfil this goal, in particular in the UVB (280-320 nm) and UVC (< 280 nm) regions where strategic medical and environmental applications are targeted. As lower cost processes should be privileged, monolithic growth approaches and thin layer structures could be well adapted for the development of UV LEDs. However, such a design leads to high dislocation densities (which are non radiative recombination centers) of 10^9— 10^{10} cm^{-2} and internal quantum efficiencies (IQE) below 1%. As a solution, we have grown AlGaN quantum dots (QD)— i.e. nanometer-sized islands (fig.(a))—active regions to efficiently confine the carriers and favour their radiative recombination. By varying the Al composition, the emission can be tuned from 340 nm to 275 nm (fig.(b)). The IQE, determined by combining temperature dependent and time resolved photoluminescence, has been shown to be higher for QD emitting between 276 and 308 nm, with a highest IQE value of 20% at 276 nm.

Breakthroughs

AlGaN QDs with highest internal quantum efficiency obtained in the UVB and UVC range have been fabricated by molecular beam epitaxy.

Perspectives

Quantum dots based LEDs with high internal quantum efficiency in the UVB and UVC regions for medical (dermatology) and environmental (water purification) applications.

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More information : J. Brault et al., Journal of Applied Physics 126, 205701 (2019)

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