ZnO Nanowire emitters for tunable near-UV-Blue Light emitting diodes

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Nanowire (NW) based light emitting diodes (LEDs) have drawn large interest due to many advantages compared to thin film based devices. Marked improved performances are expected from nanostructured active layers for light emission. Nanowires can act as direct waveguides and favor light extraction without use of lens and reflectors. Moreover, the use of wires avoids the presence of grain boundaries and then the emission efficiency is boosted by the absence of non-radiative recombinations at the joint defects. The presentation will focus on the electrochemical deposition and hydrothermal techniques two cost-effective, low-temperature electrochemical or aqueous solution methods for growing zinc oxide (ZnO) nanorods on *p*-electrode of GaN-LEDs. ZnO is a promising wide band gap alternative material due to its many advantageous properties such as direct bandgap at 3.37 eV, large exciton binding energy of 60 meV at room temperature, instead of 25 meV for GaN base materials, and easy nanostructuration. Wires of high structural and optical quality have been epitaxially grown on p-GaN single crystalline substrates in order to produce low cost new LEDs.

After integration of the heterostructure in a LED device, a rectifying behaviour has been found with a forward current onset at 3V. The diodes emitted a unique UV-light peak centered at about 397 nm for either as-prepared or annealed samples. The emission turn-on voltage was 3.9 V for the hydrothermal and 4.2 V for the electrodeposition. Then the UV-emission was very bright at very low applied forward bias leading to a new generation of UV LEDs.

We have shown that the emission wavelength could be tuned and shift toward the violet-blue region by up to 40 nm by doping with Cu or Cd [3]. Our results clearly state the remarkable quality of the pure and doped-ZnO electrochemical materials and high quality of the ZnO-NWs/*p*-GaN interface. Near-UV and violet-blue sources can be combined with efficient phosphors for solid-state lighting in order to replace fluorescent light sources with long lifetimes and high energy saving.

REFERENCES

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