Enhancement of UV luminescence yield by n-ZnO/i-NiO/p-GaN LEDs

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ZnO's wide band gap and large excitonic binding energy make it attractive for optoelectronics. n-ZnO/p-GaN heterojunction, can be a wonderful system to utilize the ZnO properties in optoelectronic applications as p-type conductivity in ZnO is still not achievable. It has been observed that electroluminescence (EL) of the n-ZnO/p-GaN heterojunction LEDs mainly from the p-GaN side rather than the n-ZnO side. An introduction of a NiO layer between ZnO and GaN enhances the barrier for electrons from ZnO crossing to GaN. NiO films of different thicknesses are grown on p-(0001)GaN/(0001)sapphire substrates before depositing the ZnO layer on top using pulsed laser deposition (PLD) technique. The study suggests that (0001)ZnO/(111)NiO/(0001)GaN epitaxial heterostructures can indeed be obtained by this growth method. Interestingly, the morphology and the conductivity of the ZnO top layer is found to depends strongly on the thickness of the NiO layer. With the increase of the NiO layer thickness, both the roughness and the electrical resistivity of the ZnO top layer rises. However, rectifying current-voltage characteristics could be observed in all these devices. Increase of the NiO layer thickness has also been found to result in a rise in the knee voltage and a reduction in the leakage current. These findings are suggestive of the fact that NiO layer forms a barrier for the electrons at the interface as expected. The study further reveals a substantial enhancement of the UV emission related to the ZnO near band edge transitions in the room temperature EL for these devices.