Synthesis of N-doped P-type ZnO nanostructures by MOCVD method and formation of homo and hetero junction diode

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The major hurdle for the development of ZnO-based devices is the lack of good and reproducible p-type doping technology [1]. Taking the strain effect, lattice mismatch and energy levels into account, N is a suitable acceptor for p-type ZnO owing to its small size mismatch with O [2]. We have synthesized and studied the micro-structural, optical and electrical properties of N doped p-type ZnO nanostructures grown by MOCVD technique by using NH₃ as N source. Both homo junction and hetero junction with this N doped p-ZnO were formed by taking undoped ZnO and GaN as n side.

Figure 1: (a-c) FESEM image and (d-f) XRD pattern of samples. (a and d are for undoped and b, c, e and f are for doped ZnO samples).

The microstructures of N doped ZnO were highly influenced due to N doping (Figure 1). The XRD (Figure 1 d-f) shows that with introduction of NH₃, more diffraction peaks arise and their relative intensities also

increase. The width and intensity of PL peaks are strongly influenced with increase of NH₃ concentration during deposition. O substitution by N increases and more N_O defects appear in PL spectrum. The effect of oxygen vacancies was compensated by the effect of defect levels appears due to N doping, which causes the p-type nature of N-doped ZnO. I-V characteristic of both type of junction (Figure 2) shows rectifying nature with high threshold voltage (~5V) and high reverse saturation current (~50 μA).

Figure 2: I-V characteristics of (a) homo junction (b) hetero junction of ZnO (inset shows corresponding SEM images)

References

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