Nanowire ZnO/GaN heterostructures prepared by chemical bath deposition

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Motivated by the high exciton binding energy, ZnO has been largely investigated as a suitable material for efficient light-emitting diodes operating at room temperature or at above room temperature. Nevertheless, despite plenty of efforts, reliable and reproducible p-type doping has not been achieved, which prevents ZnO from use in p-n homojunction structures. As an alternative to ZnO homojunctions, thin-film n-ZnO/p-GaN hererojunctions were broadly investigated. However, several factors reduce the efficiency of electroluminescence in thin-film heterojunction structures. First, a large strain at the interface deteriorates the quality of heterojunctions; second, potential barriers at the interface lower the carrier injection efficiency due to band offsets; and third, thin-film structures suffer from poor light extraction efficiency related to Fresnel and total internal light reflections. These factors can be eliminated or suppressed when the size of the interface is reduced to the nanoscale [1].

We report on the growth of ZnO nanowires (NWs) by chemical bath deposition (CBD) on p-type GaN epitaxial layers and on NW arrays grown by plasma-assisted molecular beam epitaxy (PAMBE) and on the electrical characterization of individual NW to disentangle the impact of extended defects on charge transport in ZnO/GaN heterojunctions.

The ZnO nanowires were prepared by CBD at very low supersaturations to nucleate from screw dislocations and develop by screw dislocation-driven growth [2]. The dislocations are known to strongly enhance the leakage current in GaN; however, reports are missing about their behavior in ZnO/GaN nanoscale heterojunctions. The electrical characteristics of individual NWs grown from screw dislocation were compared with the characteristics of NWs grown by spontaneous nucleation on dislocation-free areas and those grown on lithographically patterned substrates [3]. The electrical measurements of individual NW heterojunctions were carried out inside the SEM chamber equipped with nanomanipulators [4].

References

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