ZnO-based thin film double heterostructured-ultraviolet light-emitting diodes grown by vapor cooling condensation technique

P.C. Wu and C.T. Lee*, Institute of Microelectronics, Department of Electrical Engineering, National Cheng Kung University, Tainan, Taiwan, Republic of China

Recently, with the increasing demands of the ultraviolet light applications, low cost and high performance ultraviolet light-emitting diodes (ULEDs) have been intensively investigated. Zinc oxide (ZnO)-based semiconductors were promising candidate for the ULEDs due to their wide direct band gap and large exciton binding energy. Furthermore, the energy bandgap of the ZnO-based semiconductors can be modulated by doping various magnesium contents as the magnesium-zinc-oxide (MgZnO) film to construct the heterostructured devices. In this work, the vapor cooling condensation system was proposed to deposit the high quality ZnO and MgZnO films, and to fabricate the high performance MgZnO/ZnO/MgZnO double heterostructured-p-i-n ULEDs. By measuring the electroluminance (EL) spectra of the double heterostructured-p-i-n ULEDs, the peak intensity and total emission
power of the double heterostructured-\textit{p-i-n} ULEDs were 3.08 times and 1.82 times higher than the conventional \textit{p-i-n} ULEDs. Besides, the EL emission intensity at the visible region induced by the oxygen vacancy in the \textit{i}-ZnO layer was negligible. It was attributed to the very low defect concentration resided in the \textit{i}-ZnO active layer deposited by the vapor cooling condensation system. The associated mechanisms will be presented.