Leakage current reduction in ZnO nanoparticle based near UV-LEDs

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GaN-based light-emitting diodes (LEDs) have been widely accepted as efficient solid-state light sources. However, their fabrication process is expensive as it involves epitaxial growth of GaN by metal-organic chemical vapor deposition (MOCVD) on single crystalline sapphire wafers. To address these issues, alternative techniques need to be developed. Our group has demonstrated nitrogen-doped ZnO nanoparticles (NPs) based near UV-LEDs by coating p-ZnO NPs on GZO film [1]. These nanoparticles based LEDs are prepared by facile spin coating method and have potential to reduce the fabrication costs of the LEDs. It was found that the existence of leakage current limits the power of our LEDs, thus we studied the mechanism and addressed the issues of leakage current in ZnO NPs based UV-LEDs using different binding material.

Figure 1 shows the schematic diagram of the fabricated device. Gallium-doped zinc oxide (GZO) was deposited as an n-type layer on a glass substrate by sputtering. For the p-type layer, mixture of nitrogen doped ZnO nanoparticles and a binder were deposited by spin coating. Finally, a gold electrode was deposited [2]. From the *I-V* curve (figure 2), suppression of the reverse leakage current in new LED was observed when sodium silicate binder was used instead of silsesquioxane binder. The electroluminescence (EL spectra) was plotted (figure 3) and found that the significant improvement with sodium silicate as the binder. This result enables a practical application of nanoparticle based ZnO LEDs and also the technological revolution of semiconductor processes. The mechanism of improvement and detailed results will be discussed.

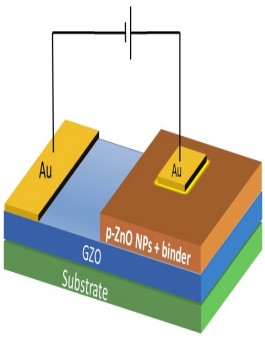

Figure 1. Device structure.

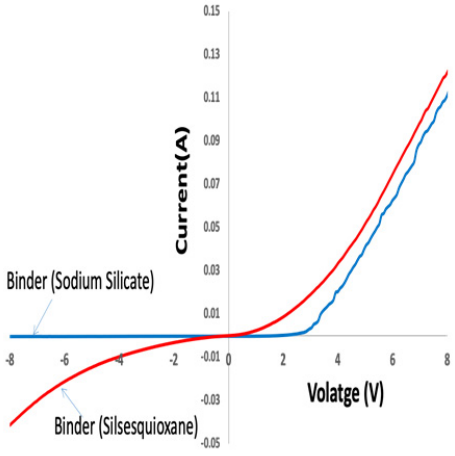

Figure 2. *I-V* curve.

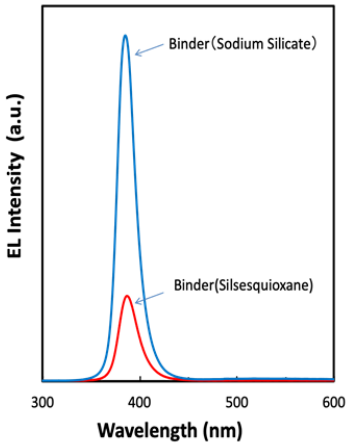

Figure 3. EL spectra.

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References

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