UV Electroluminescence from ZnO Nanoparticles based p-ZnO/n-ZnO homojunction LEDs

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Zinc oxide (ZnO) has large exciton binding energy of 60 meV and it is one of the most promising materials for short wavelength light-emitting diode (LED) applications. Nanoparticles (NPs) based devices are innovative technologies to develop the new generation low cost LEDs, because these devices can be fabricated by simple solution processable deposition methods without single crystal substrates. Fujita et al reported ZnO NPs based LEDs (nitrogen doped ZnO NPs on GZO films) with sharp near UV electroluminescence (EL) and confirmed the high density hole injection from nitrogen doped ZnO NPs [1]. This indicates that nitrogen doped ZnO NPs act as p-type. We had also reported the remarkable enhancement of EL intensity by inserting p-ZnO active layer to reduce the photo quenching by p-electrode as shown in Fig.1(a) and Fig1(b) [2]. This is an improvement of p-type layer. In this work, we tried to enhance the EL by modifying n-type layer.

The nitrogen doped ZnO NPs are synthesized by dc arc plasma gas evaporation method [1]. p-ZnO NPs (active layer) by spray method put coated on the GZO films and nitrogen doped NPs and binder (Silsesquioxane) were mixed and coated on the (p-ZnO NPs/n-ZnO/GZO) films by simple spin coating (hole transporting layer). And these films were sintered at ~300 °C. Finally, gold electrodes with 30 nm thickness were evaporated on both ZnO NPs layer and GZO layer as shown in Fig. 2.

The enhancement of EL intensity will be expected by inserting n-ZnO active layer because GZO layer has very high carrier concentration and weak luminescence. We will report the results of the effect of n-ZnO active layer.

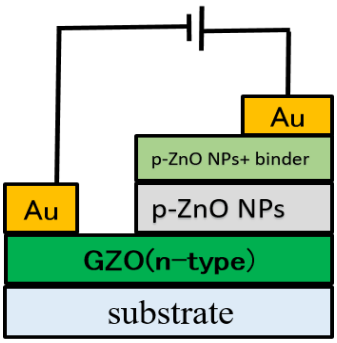

Figure-1(a)

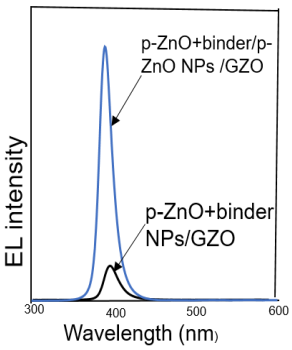

Figure-1(b)

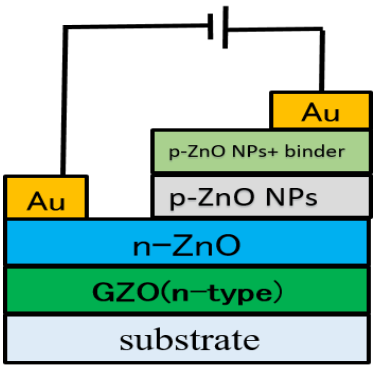

Figure-2

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References

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[2] Y. Fujita, I. M. Shafiqul, J. Lin, T. Yoshida, The 78th JSAP Autumn meeting 2017, 8a-PA4-3.