Enhancing power of ZnO nanoparticle LEDs using silica coated silver Nano-particles

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In the digital and multimedia era, light emitting diodes (LEDs) has vast potential use in solid state lighting for their high efficiency, low power consumption, low heat output, and long lifetime. Currently, gallium nitride (GaN) based LEDs are used for lighting, but these devices have a problem of high cost (epitaxial film growth technologies are costly). Therefore, we need to develop the low-cost LEDs. On the other hand, Zinc oxide (ZnO) is abundant resource and inexpensive. Now we can produce p-type ZnO nanoparticles (NPs) by nitrogen doping and succeeded to make the coated LEDs by using ZnO nanoparticles. These coated type LEDs do not require an expensive single crystal substrate, so it is possible to produce a low-cost LEDs. But the emission intensity has not reached a practical level [1].

In this study, we tried to enhance luminescence by localized surface plasmon resonance by mixing silver nanoparticles whose resonance wavelength is close to the emission peak of ZnO nanoparticle LED. Figure 1 shows a 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 hole transport layer, p-type ZnO nanoparticles and a binder were mixed with a silica-coated silver nanoparticle dispersion and applied by spin coating [2]. Finally, a gold electrode was deposited. The size of the electrode was 1mm X 1mm. The light output was measured by placing the device on a photodiode and measuring the light passing through the glass substrate. Figure 2 shows the light output comparison between using silica coated silver nanoparticles and without using silica coated silver particles. We will report the detailed results of the LEDs.

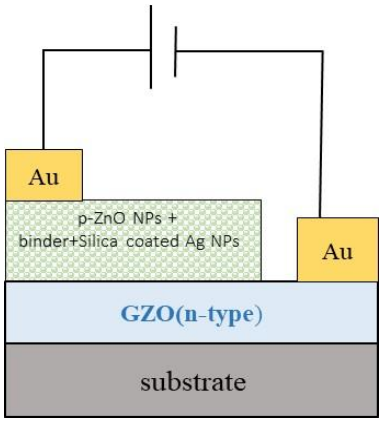

Figure 1

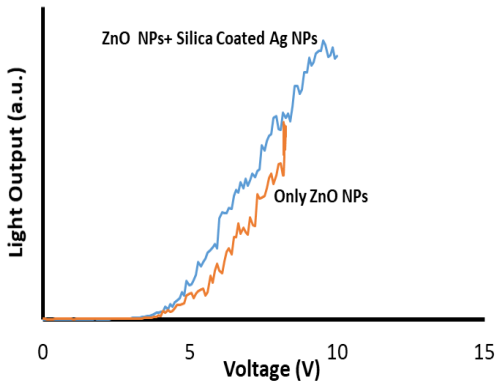

Figure 2

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Reference

[1] Y. Fujita, et al., Phys. Status Solidi C11 (7,8), 1260-1262 (2014).
[2] Kenta Odawara, et al., 9th IWZnO TP39, Taipei, Taiwan, Nov. 2016.