Development of UV-EL/PL Full-Color Display Device

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Recently, a ZnF_2:Gd Ultraviolet Electroluminescent device has been developed. In this research, a series of systematic investigation have been carried out on a full-color flat-panel display devices combining UV-EL device as a light source with visible-light phosphors.

For the improvement of luminance of UV-EL/PL devices, both the high UV light output EL device and highly efficient phosphor materials are required. At the first step, insulating layer with high dielectric constant and good electric stability are investigated. As a result of optimization of rf sputtering condition, Ta-Sn-O insulating layer with the relative dielectric constant of 22 and breakdown electric field of more than 3MV/cm are obtained. Secondly, electron beam deposition condition of ZnF^2:$GdCl^3$ active layer are systematically examined and optimized. The investigation for optimizing fabrication condition of PL layer has also been carried out. Considering the matching of energy transfer from UV to visible-light sensitivity and color-quality of phosphors, we have selected red, green and blue primary-color phosphor materials.

In addition, a remarkable improvement of UV emission intensity in the UV-EL device has been made by rapid thermal annealing heat treatment. The maximum luminance of UV-EL/PL devices annealed at 300°C/1min has been reached 70cd/m_2 (red), 100cd/m_2 (green) and 17cd/m_2 (blue), respectively. At the same time, interesting bluish white and red EL spectra from annealed UV-EL devices is observed. It is also found that the device employing ZnS or MgF_2 buffer layer showed good electrical stabilities. The UV-EL/PL device, so-called "Solid-State-PDPs", is a new type of full-color flat-panel display since its wide variety of potential. Therefore, significant market expansion is expected in the near future.