GaN-based LED Excitation of Phosphors

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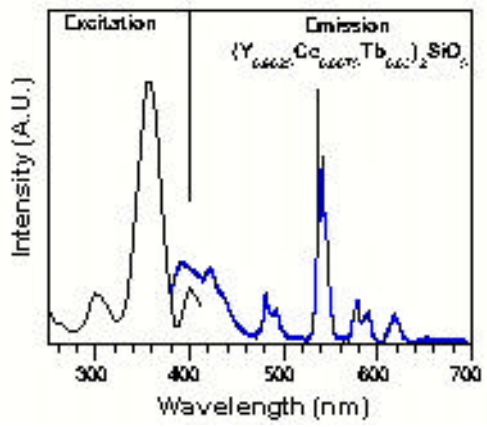
Solid-state lighting involves the use of blue- or UV-emitting gallium nitride (GaN) light emitting diodes (LEDs). The photon energy generated is used to activate inorganic light emitting materials (phosphors) to produce light in the visible spectrum. There are two main technologies to generate white light: color mixing (red, green, and blue-emitting phosphors) or the use of a single composition broadband-emitter. We have developed both mixtures of three compositions (red, green and blue) and a single-phase white-emitting phosphor. These blends and compositions can be activated efficiently with GaN-type radiation. The figure below shows the excitation and emission of a single composition, white-emitting phosphor.



This material is based on Ce^{3+} activated Y_2SiO_5, a well-known blue emitting material. The blue emission arises from the $5d \rightarrow {}^2F_{5/2}$ and ${}^2F_{7/2}$ transitions of Ce^{3+}. Co-activating with Tb^{3+}, a green emitter with the main peak at ~555 nm (${}^5D_4 \rightarrow {}^7F_6$), also produces desirable satellite peaks in the blue and red portions of the visible spectrum. The blue emission arises from the ${}^5D_3$ and ${}^5D_4 \rightarrow {}^7F_5$ levels of Tb^{3+} and the red emission arises from the ${}^5D_4 \rightarrow {}^7F_0$ level of Tb^{3+}. Also of importance, the maximum absorption of this material occurs between 350-380 nm, within the range of the GaN-based UV diodes. We have also investigated a tri-blend consisting of Ce^{3+} activated Y_2SiO_5 and rare-earth activated aluminates, which will be further discussed.