Abstract

Influence of the Polymeric Matrix Type on the Optical Properties of YAG:Ce,Gd Phosphor †

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The development of nanocomposites by incorporating YAG:Ce,Gd particles in different types of polymeric matrices aims to ensure the dispersion of phosphors in suspension medium to allow deposition on LED chips while maintaining luminescent properties or even improving them. Type of composite, uniformity, thickness, density of the deposited phosphor layer, concentration, distance to the blue chips, geometry, and so forth are important factors in order to obtain high-quality lighting sources. However, the biggest problem remains the agglomeration tendency of phosphor particles, regardless of the chosen matrix. Due to this inconvenience, problems can appear related to the control of the thickness of the deposited layer and the dispersion of phosphor in the matrix. Usually, a solution of polymer or oligomers containing nanoparticles is deposited on the chips, followed by a final heat treatment after which a polymerized and cross-linked composite film is obtained. The polymers used as matrix in the development of the devices must be transparent and not absorb in the visible field. For this purpose, we have studied the possibility of using epoxy resin, PDMS, and PMMA and their influence on the emissive properties of phosphor. The ex situ method used is based on the formation of a homogeneous mixture between YAG:Ce,Gd phosphor and the selected polymeric matrix. The structural characterization highlighted the incorporation of phosphor in the polymeric matrix while maintaining the structural YAG:Ce,Gd parameters. In the excitation PL spectra, no position variation of the bands was found, confirming that the polymers do not influence the excitation capacity of the composite. The emission spectra of the composites based on YAG:Ce,Gd polymers indicate a behavior similar to that of phosphor, confirming the existence of the same emission centers and maintaining the optical properties characteristic of phosphor in the polymeric matrix. The absence of absorption bands in the spectral domain above 600 nm confirms the maintenance of the spherical morphology of phosphor particles.

A decrease in the emission intensity was observed as a result of the lower refractive index of the polymer than of the phosphor and by the use of the substrate for the study of the optical properties. The decrease in emission intensity was found to be directly proportional to the increase of the thickness of the composite layer. In order to obtain composites with improved properties, we have found at least 5% phosphor concentration in the polymer matrix is sufficient. The obtained results
highlighted an increase in quantum yield of up to 79%. This observation is supported by the decrease in the agglomeration tendency.

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**References**


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