Effect of varying La:S molar ratios in Eu$^{3+}$activated La$_2$O$_2$S synthesized by sol-combustion method

Abdub G Ali and Deanna L Mulvihill
TLI Meru University of Science and Technology, Kenya

Nanopowders La$_x$S$_x$:Eu$^{3+}$ with different La(1:x):Sx molar ratios (0.1<x<2.5) has been synthesized by facile sol-combustion method. The crystal structure and optical properties were investigated by X-ray diffraction (XRD) patterns, Scanning electron microscope (SEM), Fourier transform infrared (FTIR), Ultra-violet visible (UV-Vis) spectroscopy and Photoluminescence (PL). As the ratio of La: S is varied (from 1.0 to 2.5), the La$_x$S$_x$:Eu$^{3+}$ nanopowder exhibits a body – centred cubic structure of La$_x$S$_x$:O with formation of separated of EuO$_2$ and La$_2$O$_2$ phases which is confirmed by X-ray photoelectron spectroscopy (XPS). Fourier transform infrared also revealed the presence of La-S stretching mode, La – O and S-O vibration modes. UV-Vis reveals that the optical band gap of La$_x$S$_x$:O:Eu$^{3+}$ phosphors show red shift with increase in x. The PL spectra indicate several strong and narrow visible light emissions outspreading from 525 to 708 nm. The presence of Eu$^{3+}$ impurities in the La$_x$S$_x$:O structure induced the formation of recombination centres with lower emission energies and shows direct modulation of band gap. This method has proven to be ideal and simple to synthesize material for devices operating in the visible region as well as for developing heterojunction structures for optoelectronic device applications with desired efficiency.

aliabdub2016@gmail.com

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DOI: 10.4172/2169-0022-C8-114