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Highly efficient orange-red emitting lumino-magnetic nanophosphor for biomedical applications

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Abstract: There is a stringent global need for a unique nanophosphor system that is capable of emitting efficient photoluminescence together with magnetic property. In the current study we report a detailed synthesis mechanism, structural, morphological, magnetic and optical properties of ultra-violet (~311 nm) excitable samarium doped gadolinium yttrium orthovanadate, $Gd_xY_{1-x}VO_4:Sm^{3+}$, nanophosphors. The X-ray diffraction studies confirmed the tetragonal structure with space group 141/amd. Enhanced photoluminescence intensity of $Gd_xY_{1-x}VO_4:Sm^{3+}$ is compared to the existing $YVO_4:Sm^{3+}$ bulk phosphor. The energy transfer occurring between VO_4^{3-} and Sm^{3+} via sensitization of ^6P_J energy level of Gd^{3+} ions has been discussed in detail. The optical band gap was estimated using UV-VIS-NIR absorption spectroscopy that revealed a slightly higher band gap (3.75 eV) for YVO_4 as compared to (3.50 eV) for $GdYVO_4$. Furthermore, luminescence decay parameters and chromaticity coordinates (x = 0.591, y = 0.368) have supplemented our studies, which established the suitability of these nanophosphors for achieving orange-red (~610 nm) emitting nanophosphor. The magnetic property associated with $Gd_xY_{1-x}VO_4:Sm^{3+}$ investigated by Vibrating Sample Magnetometer (VSM) showed paramagnetic nature, which establishes the suitability of the lumino-magnetic nanophosphor for biomedical related applications. A detailed clinical case study has also been performed on mice and the results are presented.

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