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Zn2SiO4:Mn2+ co-doped with Tm3+ and other Re ions (Re = Rare-earth): Synthesis, Structure and Optical Properties

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Zinc silicate (Zn2SiO4) is a good host lattice for luminescence centers such as rare-earth ions and transition metals (TM) to prepare light emitting materials (phosphors) that can emit blue, green and red light upon excitation with high energy electrons or photons. In this work, combustion method was used to prepare undoped and manganese (Mn2+) and thulium (Tm3+)–co-activated zinc silicate (Zn2SiO4:Mn2+,Tm3+) nanoparticulate powder phosphors. In addition, a selection of Re ions (rare-earth ions) were used for co-doping to tune the emission colour. The structure, morphology and luminescence properties were investigated by X-ray diffractometer (XRD) and Field-Emission Scanning Electron Microscopy (FE-SEM) respectively , while the optical and luminescent properties were examined by Fourier Transform Infrared Spectroscopy (FTIR), ultraviolet visible (UV-vis) spectroscopy, Varian Cary-eclipse fluorescence spectrophotometer and 325 He-Cd laser equipped photoluminescence system.

The XRD patterns matching with the willemite structure of Zn2SiO4 were observed. However, there was additional secondary peak assigned to (101) diffraction of the hexagonal wurtzite structure of ZnO, suggesting that our material was an admixture of ZnO and Zn2SiO4. ZnO was either formed from the reaction of Zn2+ and O2- during the combustion reaction in air or resulted from the incomplete decomposition of the precursors. A network of spherical (but faceted) agglomerated nanoparticles were observed from undoped, Mn2+-doped and Mn2+/Tm3+-codoped Zn2SiO4 powders. The PL spectra recorded from Zn2SiO4:Mn2+ nanophosphors with dopant concentration of Mn2+ ions ranging from 0.045 – 0.09 mol% show strong green-orange emission band at ˜ 562 nm and a shoulder at ˜523 nm and as the Mn2+ concentration increases the emission peak slightly shifted to the higher wavelength. This is a typical emission of Mn2+ in α-Zn2SiO4 and may be assigned to the electronic transition 4T1(4G) ⟶6A1(6S). Tuning of the emission colour by Tm3+ co-doping and other selected Re ions is demonstrated and will be discussed in detail. These nanophosphors have potential applications in nanoelectronics and optoelectronics.

Are you currently a postgraduate student? (Yes/No)

Yes

At what level of studies are you currently? (Hons/MSc/PhD)

PhD

Please provide the name and email address of your supervisor.

Dhlamini Mokhotjwa, dhlamms@unisa.ac.za

Primary author: Dr MBULE, Pontsho (University of South Africa)

Co-authors: Prof. MOTHUDI, Bakang (University of South Africa); Prof. NTWAEABORWA, Martin (University of the Free State); Prof. DHLAMINI, Mokhotjwa (University of South Africa)

Presenter: Dr MBULE, Pontsho (University of South Africa)

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