Structural analysis and photoluminescent study of thin film rhombohedral zinc orthosilicate doped with manganese

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In this study, structural properties and photoluminescent characteristics of thin film rhombohedral zinc orthosilicate doped with manganese (Zn$_2$SiO$_4$:Mn) were investigated. The Zn$_2$SiO$_4$:Mn films showed a pronounced absorption edge in the near ultraviolet wavelength region and a high optical transparency in the visible spectral range. The maximum transmittance reached 0.922 at 597 nm, which was very close to the transmittance of the fused quartz substrate alone (0.935). The Zn$_2$SiO$_4$:Mn films were composed of rhombohedral polycrystalline grains with random crystallographic orientation. The broad-band photoluminescence emission peaked at around 525 nm was observed from the Zn$_2$SiO$_4$:Mn films, which was ascribed to the radiative relaxation from the $^4T_1$ lowest excitation state to $^6A_1$ ground state of 3$d^5$ electrons in divalent manganese ion. The excitation band exhibited a peak maximum at 259 nm in the near ultraviolet region, which was considered to be associated with the charge transfer transition of divalent Mn ion in the Zn$_2$SiO$_4$ system.