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The effects of Cd²⁺ concentration on the structure, optical and luminescence properties of MgAl₂O₄:x% Cd²⁺ nanophosphor prepared by sol-gel method

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Cadmium doped magnesium aluminate (MgAl₂O₄:x% Cd²⁺) powders with different cadmium concentrations were prepared by the sol-gel method. Energy dispersive x-ray spectroscopy (EDS) analysis confirmed the presence of the expected elements (Mg, Al, O and Cd). The x-ray diffraction (XRD) analysis revealed that the powders crystallized into the cubic spinel structure. Cd²⁺ doping influenced crystallinity of the powder samples. The crystallite size and particle morphology were not affected by variation in the Cd²⁺ concentration. Ultraviolet-visible spectroscopy (UV-vis) measurements revealed that the band gap of the MgAl₂O₄ was influenced by Cd²⁺ doping. Un-doped and Cd²⁺-doped MgAl₂O₄ nanophosphor exhibit the violet emission at 392 nm. There was no evidence on the emission peak shift, which suggests that all emissions originated from the defects within the host material. Increasing the Cd²⁺ concentration up-to 0.88 mol% lead to luminescence intensity enhancement, while further increase of Cd²⁺ concentration lead to concentration quenching. The critical energy transfer distance (R_c) between the neighbouring donors and acceptors was found to be 5.21 Å, suggesting that the multipole-multipole interaction (M-MI) is the major cause of concentration quenching. CIE colour coordinates confirmed non-tuneable violet emission whose intensity was dependent on the Cd²⁺ concentration.

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Primary author: Dr MOTLOUNG, Setumo Victor (Sefako Makgatho Health Science University)

Co-authors: Dr SITHOLE, Enoch (Sefako Makgatho Health Science University); Prof. DEJENE, Francis (University of the Free State); Prof. SWART, Hendrik (University of the Free State); Mr KOAO, Lehlohonolo (UFS (Qwa Qwa Campus)); Dr HATO, Mpitloane (University of Limpopo); Prof. NTWAEABORWA, Odireleng (University of the Free State); Prof. MOTAUNG, Tswafo (University of Zululand)

Presenter: Dr MOTLOUNG, Setumo Victor (Sefako Makgatho Health Science University)

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