Gadolinium Oxysulfide (Gd_2O_2S) doped with Dysprosium for X-Ray Scintillator application

Sreejith V.S
Pooja Prakash, Abhisek Choudhary, Muralidharan M.N, Seema A*
Centre for Materals for Electronics Technology (C-MET), Athani (PO) M.G. Kavu, Thrissur - 680 581
*E-mail: seema@cmet.gov.in

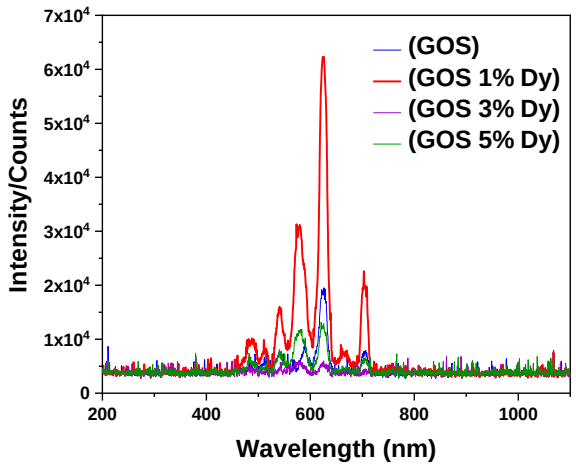
Abstract

X-ray detectors play a vital role in applications such as medical imaging, industrial inspection, and security screening [1]. Gadolinium oxysulfide (Gd_2O_2S), commonly known as GOS, has gained prominence as an efficient scintillating material for X-ray detection due to its superior X-ray absorption efficiency (High atomic number, Z=64), tailored luminescence (can be doped with Tb^{3+}, Dy^{3+} etc.) and chemically stable [2]. GOS can be synthesized through various chemical methods, including solid-state reactions, hydrothermal synthesis, and sol-gel techniques [3]. The current study focuses on the synthesis and characterization of pristine and Dy^{3+} doped GOS. In the present work, GOS is synthesized by solid state sulfurization of Gadolinium oxide at elevated temperature (900°C – 950 °C) under controlled atmosphere. Key parameters such as temperature, annealing duration, and gas flow play a critical role in obtaining phase-pure GOS. Highly crystalline phases of GOS, having hexagonal crystal structure, was obtained as confirmed by X-ray diffraction studies. Raman spectroscopy was carried out using GOS powder samples to examine its structural and vibrational properties. Doping of GOS with Dysprosium (Dy^{3+}) enhances its scintillation properties by improving emission characteristics, enabling tunable luminescence, and offering better energy transfer efficiency compared to undoped GOS. Scintillation efficiency was evaluated with an 80 keV incident X-ray source. A very low amount (<1 wt%) of Dysprosium-doped Gadolinium Oxysulfide showed better scintillation properties compared to pristine Gadolinium Oxysulfide . Further improvement in scintillating properties of doped GOS is under progress.

References

[1] A. Datta, Z. Zhong, S. Motakef, Sci Rep, 10(2020) 1.
[2] B. Ortega-Berlanga, L. Betancourt-Mendiola, C. Del Angel-Olarte, L. Hernández-Adame, S. Rosales-Mendoza, G. Palestino, Crystals 11(2021) 1.
[3] G. Xu, H. Qin, T. Huang, F. Liu, J. Lian, Optoelectron Adv Mater Rapid Commun, 11(2017) 703.

Figures



Figures: Scintillation studies on Gadolinium oxysulfide(GOS) and Dysprosium(Dy) doped GOS