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Faculty Colloquium Report

Date: 29-08-2026

Title of the Presentation	:	Tuning structural, magnetic, and photocatalytic properties of erbium orthoferrite nanoparticles via co-substitution of Gd^{3+} and Ti^{4+}
Date:	:	29-08-2026
Presented by	:	Dr. Kumara Raja Kandula Associate Professor, Division of Physics, FED
No. of Faculty attended	:	32

Abstract: Erbium Orthoferrite ($ErFeO_3$) nanoparticles are well-known for magnetic and photocatalysis applications, however the crystallite size will play more crucial role to design for particle applications. Scientists were trying to reduce the crystallite size by adopting different synthetic routes or substitution/co- substitution of appropriate atoms or concentration. In these aspects we prepared the $ErFeO_3$ (EFO) nanoparticle through sol-gel method using EDTA as chelating agent by substitution of isovalent ion (Gd^{3+}) at A-site and higher valence ion (Ti^{4+}) at B-site, i.e., $Er_{1-x}Gd_xFe_{1-x}Ti_xO_3$ (where $x = 0$, 2.5, 5 and 7.5 mol%) to tune the chemical and physical properties. The optimized concentration of substitution and co-substitution ion concentration was 5 mol%, which is confirmed through X-ray diffraction (XRD) studies convoyed through structure refinement method (Rietveld). The synthesized samples up to 5 mol% were found to be single phase with orthorhombic crystal structure of space group of *Pnma.* space group. The scanning electron microscopy (SEM) was utilized to observe the morphology and also calculate the crystallite size the synthesized materials. BET measurements confirm that the synthesized nanomaterials possess a mesoporous structure, with specific surface areas ranging from 15.978 to 41.465 m^2/g. The X-ray photoelectron spectroscopy (XPS) analysis was carried out to check the Fe oxidation number and to estimate the oxygen vacancy concentration. Nearly two times higher saturation magnetization (M_S) value was observed for 5 mol% substituted and co- substituted sample when compared to un-substituted sample. These results indicate that nanomaterials substituted with 5 mol% Gd and co- substituted with Ti have strong potential for use in gas sensing and photocatalytic applications.

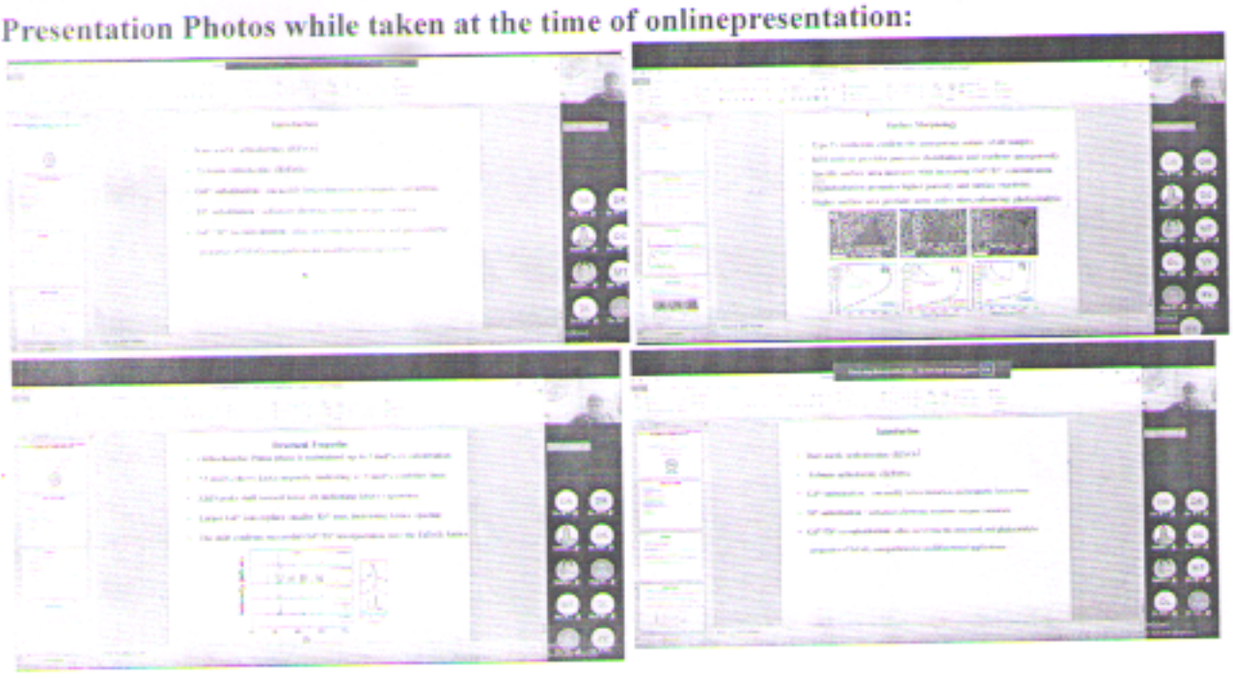
Outcomes:

- Successful co-substitution: Gd^{3+} at the Er^{3+} A-site and Ti^{4+} at the Fe^{3+} B-site were successfully incorporated using the EDTA-assisted sol–gel method.
- Structural stability: XRD and Rietveld refinement confirmed an orthorhombic Pnma structure without detectable secondary phases up to 5 mol%.
- Enhanced surface properties: BET analysis confirmed a mesoporous structure with surface areas of 15.978–41.465 m^2/g.
- Defect engineering: XPS revealed changes in Fe chemical states and oxygen-vacancy concentration induced by co-substitution.
- Improved magnetism: The 5 mol% co-substituted sample showed nearly twofold higher saturation magnetization than pristine $ErFeO_3$, indicating enhanced multifunctional potential.

Link to the video recording:

https://lbrcemy.sharepoint.com/:v:/g/personal/t332_lbrce_ac_in/IQDHxWFz94bkRp3O74vK89_OATrplpVAQrxNCJ4Q_pLpKK4?e=ZMV7Yw&nav=eyJvZWZlcnJhbEluZm8iOnsicmVmZXJyYWxBcHAiOiJTdHJlYW1XZWJBcHAiLCJvZWZlcnJhbFZpZXciOiJTaGFyZURpYWxvZv1MaW5rIiwicmVmZXJyYWxBcHBQbGF0Zm9vbSI6IldlYiIsInJlZmVycmFsTW9kZSI6InZpZXcifX0%3D

Presentation Photos while taken at the time of onlinepresentation:



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31/8/26
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