Supplemental Material

Role of Laser Excitation Wavelength and Power on the Fano Resonance Scattering in \( \text{RFe}_{0.5}\text{Cr}_{0.5}\text{O}_3 \) (R = Sm, Er, Eu): A Brief Raman Study

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A. XRD data for the prepared series of samples:

1. SmFe\(_{0.5}\)Cr\(_{0.5}\)O\(_3\):

\[ \text{XRD pattern} \]

\[ \text{SmFe}_{0.5}\text{Cr}_{0.5}\text{O}_3 \]

\[ \text{Intensity (arb. unit)} \]

\[ \text{2θ (deg)} \]

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\[ \text{Figure S1: X-ray diffraction pattern collected for SmFe}_{0.5}\text{Cr}_{0.5}\text{O}_3 \text{ mixed orthoferrite.} \]
2. **EuFe\textsubscript{0.5}Cr\textsubscript{0.5}O\textsubscript{3}:**
   JCPDS Card no. 74-1475 [Popkov et al., Journal of Alloys and Compounds 859, 157812 (2021)]

![XRD pattern](image)

*Figure S2: X-ray diffraction pattern collected for EuFe\textsubscript{0.5}Cr\textsubscript{0.5}O\textsubscript{3} mixed orthoferrite.*

3. **ErFe\textsubscript{0.5}Cr\textsubscript{0.5}O\textsubscript{3}:**
B. Optical absorption spectra of doped orthoferrites:

The absorption spectra of the samples are provided in the figure-S4, it is clear that many features dominate in absorption spectra for the prepared samples. The interesting feature centered around 730 nm (~1.7 eV) is attributed to crystal field d-d transitions, the linear region around 590 nm (~2.1 eV) corresponds to optical band gap region and another interesting feature related to this spectrum is the exciton line shapes. Also, there is negligible absorption in the 785 nm range, suggesting the maximum penetration depth. The wavelength 633 nm (~1.95 eV) are close to the charge transfer gap (~2 eV) from Cr$^{3+}$ (d$^3$) and Fe$^{3+}$ (d$^5$) ions and hence the values of absorption is maximum for 633 nm, suggesting the penetration depth is minimum for lower excitation wavelength laser, which is consistent with the fact that the intensity of Raman modes of Pnma space group is stronger for 785 nm than 633 nm.

Figure S3: X-ray diffraction pattern collected for ErFe$_{0.5}$Cr$_{0.5}$O$_3$ mixed orthoferrite.
Figure S4: The representative optical absorption spectra for the samples SmFe$_{0.5}$Cr$_{0.5}$O$_3$, ErFe$_{0.5}$Cr$_{0.5}$O$_3$, EuFe$_{0.5}$Cr$_{0.5}$O$_3$. 