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# Thermal and laser irradiation effects on dielectric properties of zinc ferrite

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ABSTRACT

Spinel zinc ferrite (ZF) nanomaterial was synthesized by using sol–gel auto-combustion route. Resulted ZF nanomaterial was characterised by synchrotron x-ray diffraction (S-XRD), energy dispersive x-ray (EDX) and field emission scanning electron microscope (FE-SEM). S-XRD pattern confirms the 'F-d3m space group' cubical spinel structure, EDX reveals the composition and FE-SEM gives morphological properties. ZF in the form of pellet was irradiated by pulsed Nd:YAG laser with 1.2 W power and $\lambda = 1064$ nm. Dielectric constants ($\varepsilon'$ & $\varepsilon''$) and dielectric loss ($\tan\delta$) have been plotted with frequency at different temperatures ranging from 303 K to 750 K. Dielectric constants decreased with the increase in frequency as the exchange of electrons among $Fe^{3+} \leftrightarrow Fe^{2+}$ does not follow the frequency of applied alternating field beyond certain frequency. Decrement in $\tan\delta$ is more prominent for irradiated pallet at low frequencies while it becomes nearly equitable at high frequencies. AC conductivity ($\sigma_{ac}$) increases with the increase in temperature exhibiting the semiconducting behavior. Measured $\sigma_{ac}$ was fitted with Jonscher power law and DC conductivity ($\sigma_{dc}$) was extracted from the fitting at different temperatures ranging from 303 K to 750 K. Activation energy (E), calculated from ln $\sigma_{dc}$ versus 1000/T plots increased slightly for ZF-2 than that of ZF-1. The changes in dielectric properties occur because of electrons hopping among $Fe^{2+}$ and $Fe^{3+}$ and oxidation states due to thermal treatment and laser irradiation.



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