# Synthesis and Dielectric Studies on Euf$_3$: Gd @ Alanine Having Luminescence Properties

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Abstract: *$EuF_3$: Gd @ alanine was synthesized via aqueous solution route at room temperature. The XRD studies shows hexagonal phase of synthesized nanoparticles with lattice parameters a = b = 6.920 ($A^0$), c = 7.085 ($A^0$). The lattice parameter values are in good agreement with (JCPDS card no 32-0373).The particle size of nanoparticles was calculated using Debye-Scherer formula and it is found to be 43 nm. The variation in dielectric constant $\varepsilon'$, dielectric loss $\varepsilon''$ and tangent loss (tan δ) with frequency (100 Hz – 5 MHz) was studied at room temperature. The dielectric constant and dielectric loss are found to decreases exponentially with frequency. The low value of dielectric loss at higher frequencies indicates its use in electronic industry. Under excitation $EuF_3$: Gd @ alanine nanoparticles shows emission at 654 (red) upon suitable excitation.*

**Keywords:** *alanine, aqueous solution, dielectric constant, dielectric loss, tangent loss.*

## 1. INTRODUCTION

Rare earth-based nanoparticles find wide applications in different fields. Rare earth material plays a vital role as catalysts, in manufacture of permanent magnet and also in the field of optics [1]. Because of sharp emission peak lanthanide used as an component of many light emitting devices [2], in lasers to enhance optical signal [3] and optical fibers[2,3].The use of europium as red phosphor in CRT tubes of computers and television is already reported[1]. In microcircuits the dielectric material plays an important role [4]. The dielectric properties depend upon particle size and shape of it. The dielectric properties can be used in capacitors, electronic memories, and optical filters [5]. Nanomaterials with high dielectric permittivity and low loss factor over wide frequency range have great interest. The frequency dependence behavior of dielectric materials provides information about this conduction phenomena [6]. In the present work we have reported frequency dependence of dielectric constant, dielectric loss and dielectric loss factor of $EuF_3$: Gd @ alanine.

## 2. EXPERIMENTAL

$EuF_3$ nanoparticles were synthesized via chloride route and to reduce agglomeration microwave irradiation used. To prepare solution distilled water is used and reagents used are $EuCl_3.6H_2O$ (0.064 mol, 1.65 gm), $GdCl_3.6H_2O$ (0.064 mol, 0.8435 gm), $C_3H_7NO_2$ (0.064 mol, 0.057 gm) and $NH_4F$ (0.576 mol, 3.200 gm). All chemicals are water soluble. Ammonium fluoride forms 3 parts where other reagent form 1 part, thus they are in molar ratio of 1:3[13]. In 100 ml beaker to prepare solution first 7 ml of europium chloride ($EuCl_3.6H_2O$) is taken then 1.5 ml of Gadolinium Chloride ($GdCl_3.6H_2O$) and 1.5 ml of L-alanine $C_3H_7NO_2$added in it.10 ml of Ammonium fluoride ($NH_4F$) swiftly injected into the mixture. A white precipitate appears after few seconds of stirring. A beaker containing white precipitate is kept under microwave oven for 30 min for drying. Nanocrystals obtained are washed with distilled water several times and kept for drying each time in oven. For drying 800 W, 24L sharp microwave oven is used. Here we employed bottom-up approach method for the preparation of nanoparticles. Nanocrystals formed in synthesis were found to be stable during characterization.

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## 3. RESULTS & DISCUSSIONS

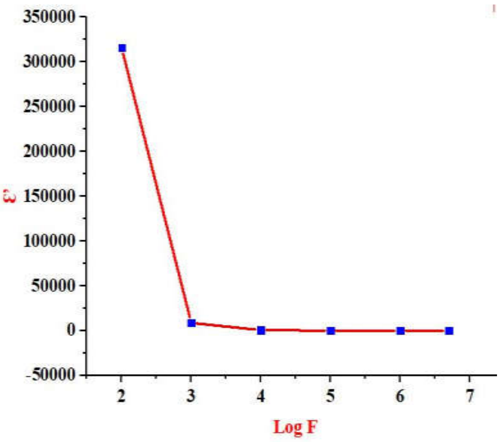


Figure 1.Variation of Dielectric constant with log frequency

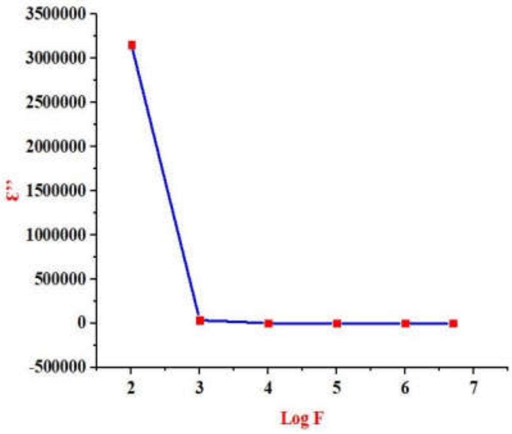


Figure 2. Variation of Dielectric loss verses log of frequency

The variation in dielectric constant with the frequency from 1 KHz to 5 MHz is shown in figure 1. In low frequency range, the dielectric constant decreases rapidly and remains constant at higher frequency which is independent of frequency. The high value at low frequency is due to polarization in the nanomaterial [6-7]. The high value of dielectric constant at low frequency is due to space charge polarization [6-9]. The variation in dielectric loss with the frequency from 1 KHz to 5 MHz is shown in figure 2.As shown in figure 3 the imaginary part of dielectric loss has higher value in lower frequency range which decreases rapidly at higher frequencies. This due to the fact that for nano sized particles the loss from electrical conductivity is low and becomes negligible at higher frequencies [5].

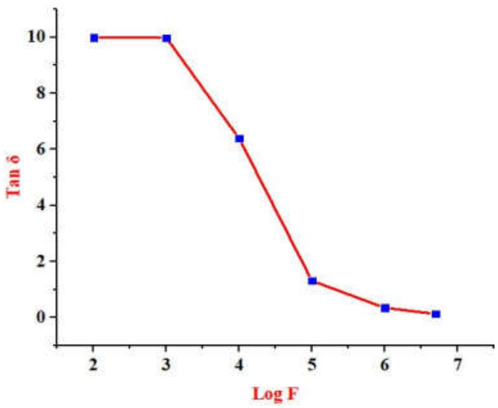


Figure 3.Variation Plot of log ε'' verses log frequency

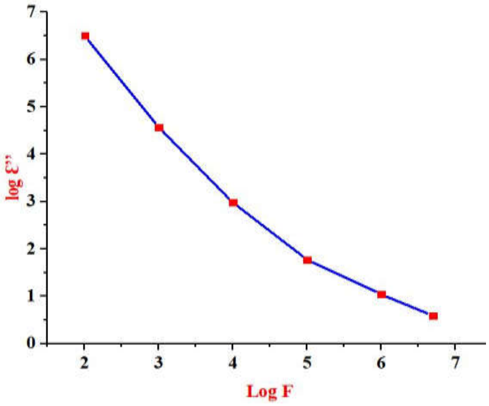


Figure 4.Variation Plot of tan δ verses log frequency

The plot of log ε'' verses log frequency (figure 4) shows nearly a straight line with slope lying between -0.79 to -1.92 indicating d.c conduction in the synthesized nanoparticles. The plot of tan δ verses log frequency shows relaxation peak at frequency of 100 KHz.

This implies the role of real part of dielectric constant in the process of polarization.The high value of tan δ at lower frequency is due to dipolar polarization of nanoparticles and decreases at higher frequency region due to space charge polarization of synthesized nanomaterials. For low value of frequency the dielectric loss is constant. For higher frequency the dielectric loss gradually decreases. This is due to the fact that at higher frequencies dipole follows the variation in the field the dielectric loss decreases [4].

## 4. CONCLUSION

Holmium doped $EuF_3$ nanoparticles were successfully synthesized in the presence of alanine as modified. Microwave irradiation is used to reduce agglomeration. The synthesized nanoparticles show hexagonal shaped morphology with lattice parameter a = b = 6.920 ($A^0$), c = 7.085 ($A^0$) which is in agreement with (JCPDS card no 32-0373). The particle size of nanoparticles was calculated using Debye-Scherer formula and it is found to be 43 nm. The dielectric study shows sharp decrease in value at lower frequency which is independent at higher frequencies. The dielectric loss gradually decreases at higher frequencies. This is due to the fact that at higher frequencies dipole follows the variation in the field and dielectric loss decreases. Under excitation $EuF_3$: Gd @ alanine nanoparticles shows emission at 654 (red) upon suitable excitation

## 4. ACKNOWLEDGEMENTS

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