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Studying the surface morphology, optical and nonlinear optical properties of epoxy resin doped nickel nitrate film

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ABSTRACT

An epoxy resin doped nickel nitrate film was prepared by a casting method. By using an optical microscopy, Image J and origin 2008 software the surface morphology of the film was obtained. UV-vis spectrophotometer were used to obtained the absorbance and transmittance data of the prepared sample. These data were used to evaluate the reflectance, the extinction coefficient, the linear refractive index, the real and imaginary parts of the dielectric constant, the linear susceptibility, the third order susceptibility, and nonlinear refractive index, of the sample. The single-oscillator Wemple–DiDomenico model was used to determine the dispersion energy and the single oscillator energy. Due to the high values of the third order susceptibility, and nonlinear refractive index shown by the sample at wavelengths range 400–900 nm, it is expected that it might be used in various optoelectronics devices.

1. Introduction

During the last thirty years there has been continuous interests in the development of new nonlinear optical materials [1–22] from the point of view of research and industry. The important parameters of a matter are the refractive index, n , the nonlinear refractive index, n_2 , the third-order nonlinear optical susceptibility, $\chi^{(3)}$, etc. Materials with high n_2 and $\chi^{(3)}$ values have found number of photonic applications [23–31]. Nickel based compounds have received intense research for various reasons, such as novel neutral unsymmetrical nickel dithiolene complex [32], DA-Salen-type nickel (II) complexes [33], $\text{Ba}(\text{Ti}_{1-x}\text{Ni}_x\text{O}_3$ thin films optical properties [34], α -nickel sulphate hexahydrate single crystal [35], nickel-doped zinc sulfide nanoparticle optical properties [36] and nickel based electrospun with tuned morphology and composition [37]. Metallic nickel nanoparticles [38], nickel thin film on silicon [39], ablated nickel nanoparticles [40] and nickel nanorods [41]. It is used in the synthesis of novel thiourea derivatives and their complexes [42], nickel alloys structure and properties control [43], its addition effect on the structure and mechanical properties of aluminum bronze (cu-10 % al) alloy [44], its effect on the mechanical properties of powder forged Fe-Cu-C [45], in the Zinc-nickel alloy electrodeposition [46], Cu(II) and Ni(ii) complexes with new tridentate nns thiosemcarbazones [47], impact of varied factors on nickel concentrations in the knee joint [48] and on the mechanical properties of 3d printed maraging steel [49]. The nickel oxide third order nonlinearity [50], nonlinear refraction [51], optical density change [52], effect of calcination temperature on the structural and optical properties [53], synthesis of its nanoparticles by sol-gel technique [54–56], structural, thermal and optical properties [57], nanocrystals [58], thin films [59,60] and capacitance performance have been studies during the period 2017–2019. The effect of preparation on the structural, optical and magnetic properties of nickel ferrite nanoparticles were studied by Khan et al., [61] while Thukur et al. [62], and Vinayagamoorthy et al. [63] have studied the partial molar volumes of nickel nitrate in water and

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