

Synthesis, DSC Properties, Surface Morphology and the Third-Order Behavior Studies of a Conducting Polymer

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Abstract—In this study, the compound polyaniline (PANI) with three different concentrations of (H₂SO₄) sulfuric acid has been synthesized by the chemical polymerization method and characterized by FTIR spectrophotometer to detect effective group, field emission scanning electron microscopy (FE-SEM) and UV–vis absorption spectroscopic. They performed a differential calorimetric scan to describe the behavior of the compound as it measures the thermal energy that circulates from or to the polymer reported. The endo-thermic transition, due to structural adjustment, is a characteristic of the PANI. Casting has been a suitable method for preparing PANI films on FTO glass. The third order non-linear optical (NLO) properties of thin films were investigated using the Z-scan technique. The experimental data recorded resulted in the calculation of the nonlinear optical absorption coefficient, the nonlinear refractive index. PANI at various concentrations of sulfuric acid has a significant optical nonlinearity. Such material could expect new photon applications. The polymer samples with different concentrations exhibits high nonlinear reflective index under continuous wave laser at the experimental wavelength. Reverse saturable absorption is the dominating mechanism for the observed absorption nonlinearities. Therefore, compound polyaniline emerges as a potential candidate for photonic device applications. The synthesized thin film structures of PANI with three different concentrations of (H₂SO₄) sulfuric acid shows the response to NH₃ gas sensing in the range 20–250 ppm and can be used for NH₃ sensing application.

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INTRODUCTION

A conductive polymer is a polymer that has semi-conducting or even conductive properties by chemically or electrochemically doping its vertebral column with a double conjugated bond. The main conductive polymers, such as Poly(p-phenylene vinylene) (PPV), Polypyrrole (PPy) and PANI, are applied to a wide range of areas, including phototherapy, EMI shielding, photovoltaic solar cell, long life battery storage, membrane gas separation, microwave absorption, sensitive chemical sensors and corrosion protection [1–4]. Among the class of conductive polymers PANI, which is one of the important polymers, PANI is a unique conductive polymer compound that has unique linear optical and electrical properties and offers the benefits of simple synthesis, stability of the environmental, affordability and flexible control of electrical characteristics through doping and load-transfer protonation [5–8]. The compound has been of interest since 1980, which is thermally and environmentally stable where PANI is found in a basic (insu-

lating) form or in the form of a conductive salt and it is in various of shapes that differ in its physical and chemical properties [9, 10]. Negative permeability [11] and physical properties of giant magnetoresistance [12] have been studied for PANI. As a result of the exceptional qualities that it has, it has applications in a variety of fields, including electrochromic lenses [13], solar cell applications [14], light-emitting machines [15], optical, thermal, and bio-sensors [16, 17], supercapacitors [18], neural prosthesis/biotic-abiotic interfaces [19], pigments [11], distribution systems [20–22], separating membrane gases [23–25] and medicine [12]. The redox feature of PANI has been used in the creation of a large variety of innovative devices such as biotransistors, for instance [26, 27]. In addition to a broad variety of desired electrical, electrochemical, and optical qualities, PANI has outstanding environmental and thermal stability, and it can be readily formed into films, gels, and fibers [28]. PANI also possesses a wide range of desirable electrical properties, including high conductivity and low resis-