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Optical, Electrical and Photoconductivity Nature of Pure and Acid Doped Polyaniline Pellets for Rectification Behavior

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Abstract

Pure, organic and inorganic acids doped polyaniline (PANI) were prepared by the chemical oxidative polymerization method at room temperature. TEM morphology shows the formation of a well aggregate in non-uniform clusters dodecyl benzene sulfonate (DBSA) doped PANI. UV-visible spectra were confirmed that absorption peaks at 270 and 340 nm is due to the π-π* transition of the benzenoid rings. The strong absorption peak around 603 nm showed extension of polymer chains. The D.C conductivity measurements were carried out the prepared polyaniline's pellets. The current voltage characteristics of doped PANI showed weak rectifying behavior with the non-linear nature. The I-V curves of In/PANI-DBSA/Ag composites are p-n hybrid structure diode. It concludes that the DBSA doped polyaniline is better solubility and most suitable for conducting applications.

Keywords: Rectifying Effect; Photoconductivity Response; Schottky Junctions

Introduction

Intrinsically conducting polymers (ICPs) have potential applications in various electronic devices such as electro chromic displays, photodiodes, light emitting diodes, solar cells, biosensors etc. [1] Nanoscale particles as fillers are attractive due to their intriguing properties arising from the nanosized and resulting large surface area. The doping of nanoscale materials may improve the electrical and dielectric properties of the host polymers. Recently, several methods have been developed to improve the processability of PANI by increasing its solubility in various organic solvents such as chloroform and xylene. Long Yun-Ze have been prepared polyaniline and polypyrene doped with β- naphthalene sulonic acid (NSA) synthesis by self-assembly. Polymer powders were formed to fabricated Schottky diodes by In/PPY/Ag and In/PANI/Ag were also measured and discussed in comparison with heterojunction Al/PANI/Ag [2].

It is well known that metals with low work functions such as Ag (~4.08 eV) have been used to build Schottky barriers and that ohmic contacts are formed with high work function metal as in (~4.5 eV) [3]. In our previous work, we have reported a comparison of optical property of polyaniline using various dopants by chemical oxidation method. There are only a few reports concerning photoluminescent and photoconductivity of polyaniline. In this present work, our aim to fabricate the device In/DBSA-PANI/Ag and In/HCI-PANI/Ag hybrid-structure diodes.

Experimental Technique

PANI was synthesized using chemical oxidative polymerization method. In/PANI's/Ag Pellet fabrication. The electrical transport properties of the PANI pellets were measured by using Keithley 6517B programmable current source between electrodes A and B (Figure 1). When a bias is applied across the capacitor one is positive charge and other one is negative charge. The samples were sandwiched between copper electrodes with the help of a pressure contact. The amount of charge that the capacitor can store (Q) is proportional to the bias (V) times how good the capacitor is the capacitance (C). The calculated capacitance of the capacitor value is 16.68x10-15F.

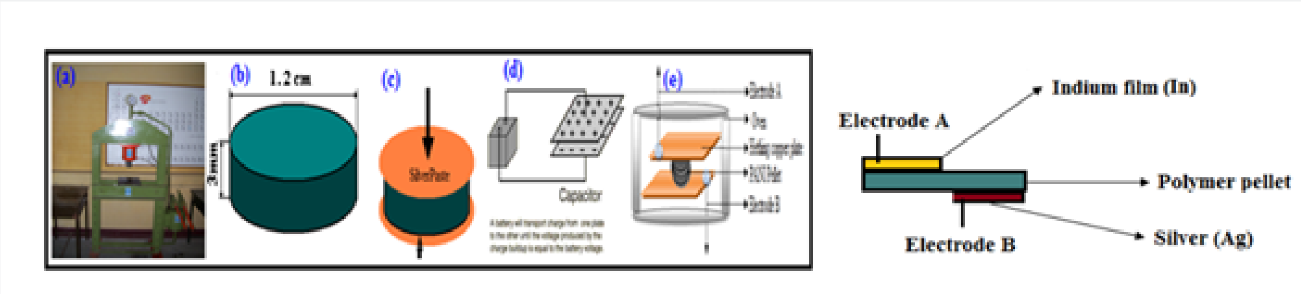

Figure 1: Schematic diagram of (a) Pelletizer (b) PANI pellet (c) Electrodes (d) Capacitor Circuit (e) oven setup.

Results and Discussion

The prepared samples were characterized to elucidate the morphological, optical and electrical properties employing various characterization techniques. I-V characteristics curve of the fabricated In/PANI-HCI/Ag and In/PANI-DBSA/Ag hybrid devices are shown in Fig.2b. As compared to the rectifying effect of diode In/PANI-DBSA/Al and In/PANI-HCl/Al are shown in Figs. 2 (a & b), the rectifying ratio is γ = 2:5 at ±5V bias. The turn on voltage of the devices was found to be -2 to 2V for In/PANI-HCI/Ag and In/PANI-DBSA/Ag hybrid structure diodes, respectively. This difference can be attributed to the different dopant anions (Cl- and SO4-) which can influence the electronic properties of the polymer interface. From the (Figure 2b), the fabricated PANI-DBSA hybrid structure diode attains low turn-on voltage of ~1.5 V and delivers reasonably high current of ~0.08 μ A at 298 K. In general, the leakage current is determined by the density of the minority charge carriers in organic/inorganic acid doped device. The minority charge carriers have high mobility and could move along the polymer (PANI) chain through the conjugation of the bonding. The zero-bias capacitance-frequency (C-F) characteristics of the In/PANI/Ag hybrid structure diodes are shown in (Figure 2c). In all cases, the capacitance decreases as the measuring frequency is increased and then stabilizes. Such a frequency is dispersion of localized states in the band gap of the amorphous polymer [4] (Figure 2d).

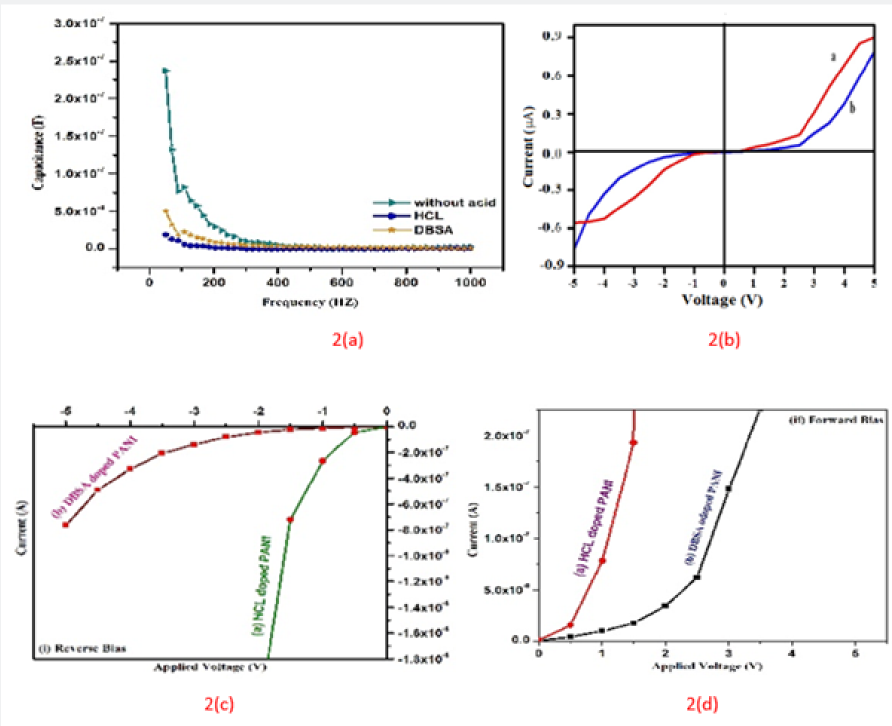

Figure 2: Morphological, optical and electrical properties employing various characterization techniques.

Conclusion

The electrical characteristics of the p-n hybrid structure diodes depend on the supporting electrolytes used in the synthesis of the polymer-based diodes. Thus, we conclude that PANI-DBSA composites were more suitable for conducting applications.

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