Infrared absorption of Nickel Sulphide Complex of Gum Arabica

S.S. Pradhan, Moumita Burman, A. Sarkar
Dept. Of Physics, B.K. Girls' College, Howrah,India
Pradhansourav1@gmail.com

Abstract

Aim of this work is to develop a biopolymer based composite material which can absorb and harvest the radiation in infrared region. In this work Nickel sulphide (NiS) is developed by chemical process and used to developed biopolymeric complex. The developed complex is found to exhibit sensitivity and absorption of infrared (IR) radiation.

1. Introduction

About 45%of the solar energy reaching earths surface lies in the near infrared region of the spectrum. Most existing solar panel have only effectively harnessed light energy while allowing nearly half of the energy in spectrum (in the form of infrared waves) to passed by mostly unused because conventional silicon based solar cell are unable to harness the infrared radiation. The need to develop inexpensive renewable energy sources stimulates scientific research for efficient, low-cost photovoltaic devices. The biopolymer-based photovoltaic elements have introduced at least the potential of obtaining cheap and easy methods to produce energy from light. The possibility of chemically manipulating the material properties of biopolymers combined with a variety of easy and cheap processing techniques has made biopolymer-based materials present in almost every aspect of modern society. In earlier studies [1,2] it has been found that NiS is a magnetic semiconductor although its nature of magnetism in the form of present nano composite is complicated. Nickel Sulfide is a photo-sensitive [3] material and may be used in photo-energy generation. A series of recent activity [3] demonstrating controllable fabrication of magnetic semiconductors and their incorporation into hetero-structures has led to several additional device suggestions. In this study NiS has been used to harness the infrared region of the light wave. The experimental details and results are discussed in the following sections.

2. Sample preparation

In present work we deal with a natural self assembly of NiS nano-cluster in conducting background of biopolymer. The biopolymer Gum Arabica [4] powder is used as a capping medium for the preparation of experimental specimen. At first we take Ni salt i.e Nickel Crbonate of $NiCO_3$,$2Ni(OH)_2$,$4H_2O$ from E-mark India and boiled in amoniacal water at temparature about 100C Filtering the sample, mixed with liquid Amonia (NH_3) solution and gum acacia powder heated in magnetic sterier and slowly passing H_2S gas throught it .Henc . The formation of NiS nanocluster by natural self assembly in the background of Gum arabica biopolymers

3. Experiment

In this work both d.c I-V characteristics and a.c measurements are carried out. In earlier study[2] it has been found that the developed particle size by using is almost between 4 – 9 nm. The overall nature is amorphous due to background bio-polymeric material. The dc I-V characteristics are recorded at room temperature with voltage step 10mV between -0.2 to +0.2V. The measurement is carried with the specimen exposed to IR radiation from IR diode MLED 930. I-V data for the specimen was also recorded under exposure to IR from enclosed radiator at 60 C. The dc measurements are carried out using PC interfaced Keithley 2400 series source meter. The investigation of total electrical conduction of the developed NiS complex of Gum Arabica specimen was carried out, between frequency range 1 Hz to 100 KHz HIOKI 3522 LCR/Z Analyzer (Japan).

4. Result & Discussion

Figure 1 shows dc bulk I-V character of NiS composite specimens under IR radiation about 930 nm from IR diode. The figure 1 also compared the irradiated result to that at near dark condition. The recorded current is small in magnitude due to small specimen area that exposed to irradiation. Figure 2 compares the result of dc I-V on the NiS complex specimen under exposure to IR from enclosed radiator at 60 C to that of with no additional IR radiation. The figure 2 shows that conductivity in presence of radiation increases by about 10 times over without radiation.

The results of ac investigation are in figure 3 in the form of Cole - Cole plot. The overall nature of the curve show an effective mix conducting (ionic and electronic contribution) nature of NiS specimen.

The increase in current seen from figure 1 and figure 2 is due to the presence of nano particle in the material. The NiS nano particle is capable to absorb energy in the infrared part of the spectrum. In the earlier work [2] it has been reported that the estimated direct Band Gap NiS at 0.28eV. The current enhancement due to selective IR radiation of 930 nm is too small (figure 1) however the same is substantial (figure 2) when a broad spectrum continuous IR radiation is used.

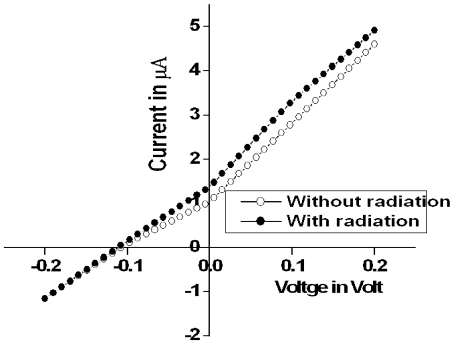

Figure 1. DC I-V characteristics of NiS complex (SampleThickness-1.04mm, Area exposed to radiation =0.13sqcm) at 930 nm IR radiation and without infrared radiation

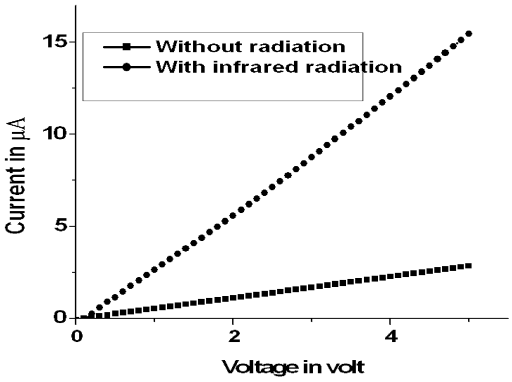

Figure 2. D.C I-V characteristics of the developed material with infrared radiation corresponding to 60 C and without infrared radiation. (Thickness-1.74mm. Area-1.32sqcm)

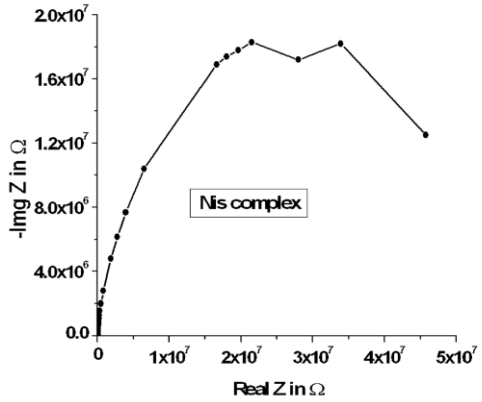

Figure 3. Cole-Cole plot of NiS complex (applied p.d=1v r.m.s)

The overall IR absorbance of the developed NiS complex is observed to be good and encouraging.

5. Conclusion

NiS nano particles can take in energy from both sunlight and the earth's heat radiation with higher efficiency than conventional solar cell. The developed NiS composite successfully exhibits the mentioned property. The overall IR absorbance of the developed NiS complex is observed to be good and encouraging.

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