Title of The Thesis- Study on the Charge Transport Properties of Organic and Herbal Dye based Photovoltaic Cell in Presence of Different Nano Particles (**Index No : 36/18/Phys./25),** submitted by **Swapan Bhunia**

ABSTRACT

The work embodied in the thesis entitled "Study on the charge transport properties of organic and herbal dye based photovoltaic cell in presence of different NP" is mainly concerned with studying conductivity and charge transport parameters of Turmeric, SY and PSF dye-based devices in the presence of NP. Our society is updated with electronic goods. We are purchasing new electronic goods, and the old ones go to the white dustbin. So white dustbin fills up with old electronic goods. This is called electronic waste. To meet the enormous electronic waste, the use of nonconventional electronic material has become essential. Most electronic goods are generally made of inorganic materials. They are not biodegradable. People are looking for non-conventional biodegradable electronic materials. Different organic, polymer, and natural dyes are becoming an attractive area for the present research. But they too have their share of difficulties and hurdles, which has motivated us to pursue this research in this field.

For studying the electrical characteristics of the organic and natural dye-baseddiode, dark I-V measurements have been done by changing various parameters such as dye concentration, changing electrodes, incorporating NP, and cell fabrication techniques, etc. Attempts have been made to study the internal features such as charge carrier density, trap energy, series resistance,and alsobarrier height which gives an idea of the conduction mechanism of the device.Attempts have been made to address some of the problems both experimentally and theoretically so that the vast possibility of using nonconventional electronic materials may be explored.

In this work, we have studied mainly the Turmeric dye. Typical conductivity of this dye is quite low. Different NPs are used to enhance the conductivity. The conductivity of this dye in presence of different NP such as Titanium Oxide (TiO_2), Zinc Oxide (ZnO) has been studied. The effect of the concentration of the dye has also been studied. In this thesis, we have studied the conductivity, charge carrier density, bandgap energy, and Hall mobility ofTurmeric dye in solid thin film by using Hall Experiment.We have also studied few other dyes such as Phenosafranin, Sunset Yellow.From the dark I-V characteristics it is observed that Barrier height (Φ_b), Trap Energy (E_c), and Series Resistance (R_s) of Turmericdye-based cells get changed in presence of NP. The data are studied by considering the SCLC model in presence of exponentially distributed trap states and the relation between Φ_b, R_s and total trap density H_n is discussed.It is expected that due to the addition of TiO_2 and ZnO, there occurs a change in the distribution of trap states, and the trap energy and total trap charge density gets reduced. This also reduces the Series Resistance (R_s). Lowering of both Series Resistance (R_s) and Trap Energy(E_c) helps in better charge conduction and enhances the overall performance of the devices.The study in the field of organic and herbal dye-based photovoltaic devices is relatively new and although few works are being done, but there is no established theory to explain the charge transport mechanism of these systems. A theory that fits a certain system may deviate a lot in the case of another system. So, further study is required for a better understanding of these problems.The outcome of this work will be extremely helpful to develop and understand the nonconventional electronic device.

Signature of the Supervisor With Date and Seal

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Dr. NABIN BARAN MANIK
Professor
Department of Physics
Jadavpur University
Kolkata - 700 032

Swapan Bhunia

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