EXPLORING THE OPTICAL CHARACTERIZATION OF CARBON NANOTUBES / REDUCED GRAPHENE OXIDE NANOPARTICLES DOPED WITH POLYVINYL ALCOHOL FOR OPTOELECTRONIC DEVICES AND PHOTONIC APPLICATIONS.

Project Reference No.: *45S_MTech_114*

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Keywords:
Carbon Nano tubes, reduced Graphene Oxide, PL spectra, FTIR spectra, XRD, SEM, AFM and UV-visible Spectroscopy.

Introduction:

Light is a dual property known as the duality of wave-particles. This is because it has the properties of both continuous electromagnetic waves and photons. Light-wave technology refers to the technologies and systems that are used in optical communication and signal processing.

Optics is a well-established subject concerned with the creation, propagation, and detection of light. The term photonics, coined by analogy with electronics, rejects the expanding connection between electronics and optics due to the rise of various application roles of semiconducting materials and semiconductor devices. And photonics include photonic control. Because electrons normally govern the flow of photons and photons usually control the flow of electrons, these two zones overlap extensively. Comparing photons and electrons in the field of transmission, photons do not interact directly with each other, but charged electrons show a strong interaction due to the Coulomb force acting between them. Polymers, especially thin film polymers, are a very important family of materials as they are used in a variety of materials, from films and filters to household items, clothing and many other products. Polymers are large carbon-containing molecules composed of multiple repeating molecular units that are repeatedly bonded to form large chains. As with all molecules, the exact composition and structure of each molecule determines its properties. To summarize the applications of thin films, the technological applications are in various biomedical and industrial sectors which is related to functional and protective coatings, separations and advanced membranes, microfluidics, adhesion, frictional modification, sensors, biocompatibility of medical plants and non-fouling bio-surfaces. Knowing what a particular polymer film does or can do based solely on its structure is very beneficial to those who use these films.

As the need for a replacement of the traditional materials in terms of efficiency, availability and cost effectiveness for photocatalytic and optoelectrical rises, thus the search for newer materials for obtaining the better properties has increased.

The recent studies have proven that even by surface modifications of those materials also yield better results. Thus, by the surface modifications on top of the devices using texture techniques like sol-gel method, spray pyrolysis, Laser deposition method, etc., and thereby better properties can be obtained.

Objectives:

1. Thin film coating of nanoparticles doped with PVA on glass slides
2. Characterization and Analysis of Nanoparticles
3. Use of Nano crystalline thin films in photonic and optoelectronic device applications.
4. To study the mechanistic information regarding the photocatalytic process.
5. Analyse the film using all optical characterization techniques.

Methodology:

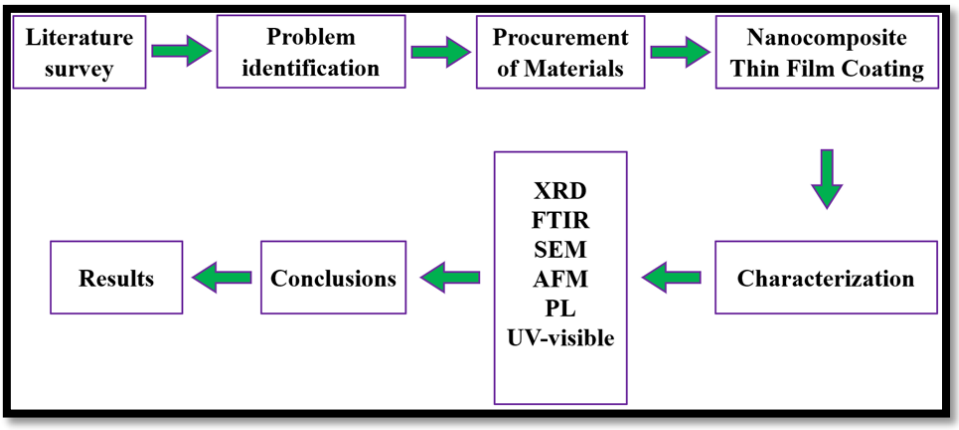

Fig.1 Flowchart of the research's methodology

The proposed plan of research work involves Characterization and Evaluation of CNT/ rGO nanoparticles doped with PVA for optoelectronic and photocatalytic applications. Our work also includes optical characterization of such films to get desired performance. It includes following characterizations techniques: X-ray diffraction (XRD), Scanning Electron Microscopy (SEM), Atomic Force Microscopy (AFM), Fourier Transform Infrared spectroscopy (FTIR), UV-Visible spectroscopy, Fluorescence spectroscopy. This work is intended to be an introductory guide for thin film applicability for optically-absorptive and its characterization modalities, while also identifying SEM and AFM to be amongst the more reliable techniques. The thin films properties of novel polymer composite and Nano particles complexes are characterized by AFM and SEM, etc. The characterization will be carried in IISc or other research institutions. Experimental analysis and validation of thin films using many characterization parameters. The project mainly focuses on the finding new materials for optoelectronic and photonic device applications.

Conclusion:

The Scanning Electron Microscopy (SEM) technique was used for the analysis of the physical morphology of the surface of the products. We can observe the formation of Carbon nanotubes was dispersed in the polymer and also notice the agglomeration of carbon nanotube in the dry film of the PVA-CNT nanocomposite thin film and we can observe that the reduced graphene oxide is thoroughly dispersed throughout the surface of the PVA-rGO nanocomposite thin film. In comparison of PVA-CNT nanocomposite thin film, we find that the average thickness median is almost half of PVA-rGO nanocomposite thin film. Whereas the surface roughness is of PVA-rGO nanocomposite thin film is more than the PVA-CNT nanocomposite thin film which is also confirmed by the SEM images of the PVA-CNT and PVA-rGO nanocomposite thin film.

Due to doping of PVA with CNT & rGO, we observe the O-H stretching vibrations in the PVA-CNT & PVA-rGO nanocomposite thin films and shifting of the chemical functional group peaks from the FTIR Spectra. The

PVA-rGO nanocomposite thin film the emission peak is observed at 502nm which emits the turquoise colour that is of blue-green band region and for PVA-CNT nanocomposite thin film it is 510nm with moderate intensity peak comparatively and also its emission peak corresponds to the blue-green band region. The Photo luminescence intensity is directly proportional to the concentration of molecules.

The XRD intensity peak of rGO is slightly diminished in the PVA-rGO nanocomposite thin film and peak position of CNT is reduced in the PVA-CNT nanocomposite thin films. Hence the doping is done properly and the above films are with significant intensity results in polymer nanocomposite has a potential candidate for photonic and opto electrical applications.

Scope for future work:

1. Low-cost polymer for optoelectronic device and photonic applications.
2. Enhance the photocatalytic and optical properties.
3. To obtain the mechanically stable films of Nanoparticles doped with polymer composite which ensures benign to environment.
4. Better thermal stability
5. The obtained composite could be useful for developing optoelectronic devices and photonic application.