SYNTHESIS AND CHARACTERIZATION OF CuO:Gr NANO COMPOSITE FOR FUEL CELL APPLICATION

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ABSTRACT

Polyvinyl alcohol nanocomposite has an outstanding potential for various application. Moreover, it is possible to fabricate PVAs into desired shapes and sizes, which would enable controlling their properties, such as their surface area, magnetic behavior, optical properties, and catalytic activity. The low cost and light weight of PVA have further contributed to their potential in various environmental and industrial applications. The present review discusses the various methods of preparation available for PVAs, including in Situ synthesis, solution mixing, melt blending, and electro spinning. Solvent casting is one of the easiest and less time consuming methods for the synthesis of polymer nano composite. In this article we present different types of polymer using cupric oxide, graphite and analyzed the characterization through UV, FTIR, SEM, XRD.

KEY WORDS*: Cupric oxide, Graphite, PVA, UV, FTIR,SEM,XRD*

I.INTRODUCTION

Fuel cells are gaining immense research attention due to the remarkable application for the environmental friendly energy materials. Fuel cells directly convert the chemical energy in hydrogen to electricity. The fuel cells are clean and sustainable, highest efficiency of fuel cells in the range of 50 – 70% compared to the combustion engine. CuO/Graphite nanocomposites have emerged as a suitable fuel cell material exhibiting high efficiency. Polymer have very large molecular weight made up of repeating units throughout their chains. PVA is essentially made from polyvinyl acetate through hydrolysis, is easily degradable by biological organisms and in water is a solubilized crystalline structure polymer. This polymer is widely used by blending with other polymer compounds, such as biopolymers and other polymers with hydrophilic properties. However, the present of graphite in the PVA hydrogels reduced the tensile strength, elongation at break and water content of the composite. The nature of the interactions between metal ions and polymer molecules has different techniques. When copper is exposed to water molecules, this free electron is transferred to a neighboring oxygen atom, bonding it into a molecule. To study the effect of CuO / Graphite is used to compare their properties ans applications fuel cells.

II.MATERIALS AND METHODS

A.MATERIALS

Graphite, Cupric oxide was purchased from Madras scientific suppliers Thrichy. The nanoparticles was prepared by using precipitation method with the help of Sakthi college, PG and research centre of Physics. PVA was purchased from Madurai scientific shop. All above solution were prepared by using deionzied water.

B. PREPARATION OF GRAPHITE NANOPARTICLE

The Graphite 9.6g was dissolved in100 ml of distilled water in a beaker. It was stirred at 220 rpm/sec for one hour without heating. And the solution was heated in a hot plate for 40 minutes at 100^0c temperature. After it was heated at muffle furnace.

C. PREPARATION OF CUPRIC NANOPARTICLE

The Cupric oxide 11.9 g was dissolved in 100 ml of distilled water in a beaker. It was stirred at 220 rpm/sec for one hour without heating. And the solution was heated in a hot plate for 30 minutes at 100^0c.After it was heated at muffle furnace.

D. PREPARATION OFPURE PVA

PVA solution was prepared by mixing of 0.9 g of PVA dissolved with 10 ml of deionized water in a beaker. It was stirred at 300 rpm/sec for 5 hours without heating using magnetic stirrer.

E. GRAPHITE-PVA COMPOSITE

The prepared Graphite nanoparticle (0.1g) were added into the PVA solution. It takes an hour to blend the Graphite nanoparticles with PVA. The procedure was repeated to get an another ratios. Finally, the solution casted in a glass petri dish at room temperature until dry.

F. CUPRIC OXIDE-GRAPHITE COMPOSITE

The prepared Cupric oxide (0.05g) and Graphite (0.05g) nanoparticle were added into the PVA solution. It takes an hour to blend the Graphite and Cupric oxide nanoparticles with PVA. The procedure was repeated to get an another ratios. Finally, the solution casting in a glass petri dish at the room temperature until dry.

III. RESULT AND DISCUSSION

A. UV (ULTRA VIOLET) RAYS

The absorption spectra were used to study the energy band gap and type of electron transition. It represents the UV visible absorption spectrum of synthesized Gr. The absorption peaks were obtained for these sample in the range of 376 nm which is prescribed for Graphite, 386 nm which is prescribed for Cupric oxide and Graphite sample. The conduction band gap can be calculated from Einstein’s photon energy equation.

$$E=hc/\lambda \ max$$

Where,

Max – maximum absorbance wavelength

h - Planck’s constant ($6.626*10^{-34}$ Js)

c - velocity of light ($3*10^{-8}$ m/s^2)

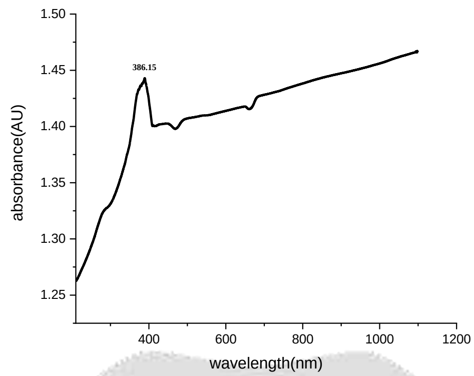

Fig 1. UV – visible spectra for Gr /PVA nanocomposite films with single ratio

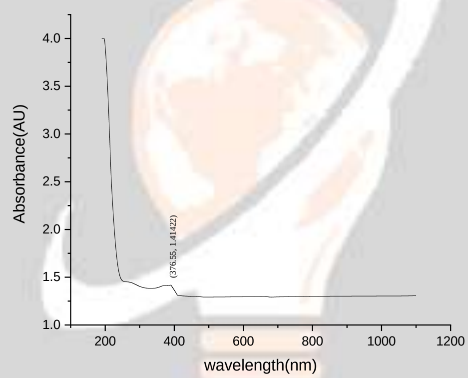

Fig 2. UV-visible spectra for Cuo-Gr / PVA nanocomposite films with single ratio

B. FOURIER TRANSFORM INFRARED SPECTROSCOPY(FTIR)

The FTIR spectroscopy is used to study the change in chemical composition, impurity content and interaction between different species. FTIR spectrum is used to calculate various functional groups which are present in Graphite and cupric oxide which were synthesized by solution casting method. Its ranging from 3774 cm^{-1} – 660 cm^{-1} as shown below fig (a). Its ranging from 3352 cm^{-1}- 788 cm^{-1} as shown below fig (b).

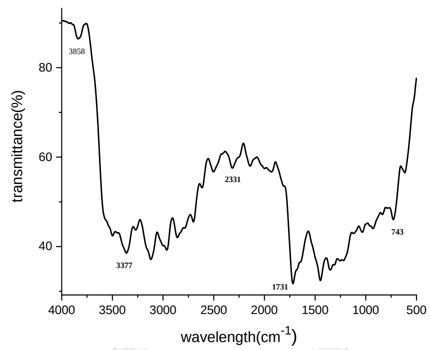

Fig 3. FTIR spectra of Gr/PVA nanocomposite films with single ratio

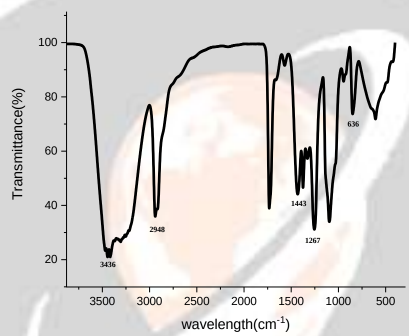

Fig 4. FTIR spectra of Cuo-Gr / PVA nanocomposite films with single ratio

C.X- RAY DIFFRACTION (XRD):

Using X – Ray diffraction phase analysis was studies. The average crystalline size of the Graphite, cupric oxide and Graphite nanocomposite was calculated based on Debye's scherer's equation.

$$D = K\lambda / B \cos \theta$$

Where,

D- mean crystalline size

K- shape factors taken

λ- wavelength of the incident beam

B- full width half maximum

θ- Bragg's angle

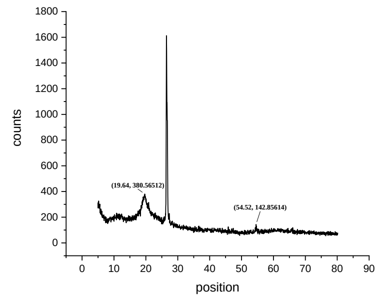

Fig 5. XRD spectra of Gr / PVA nanocomposite films with single ratio

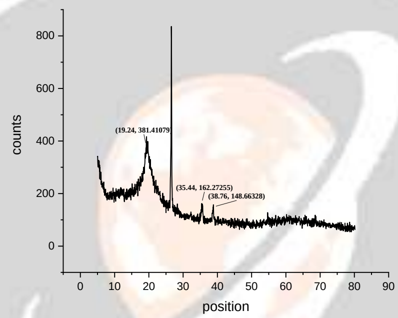

Fig 6. XRD spectra for cuo-Gr/PVA nanocomposite films with single ratio

D. SCANNING ELECTRON MICROSCOPY:

SEM is a process that scans a sample with an electron beam to produce a magnified image for analysis. It include the three dimensional topographical imaging and the versatile information obtained from different detectors. It provides the information about the size, shapes, location of individual nanocom.

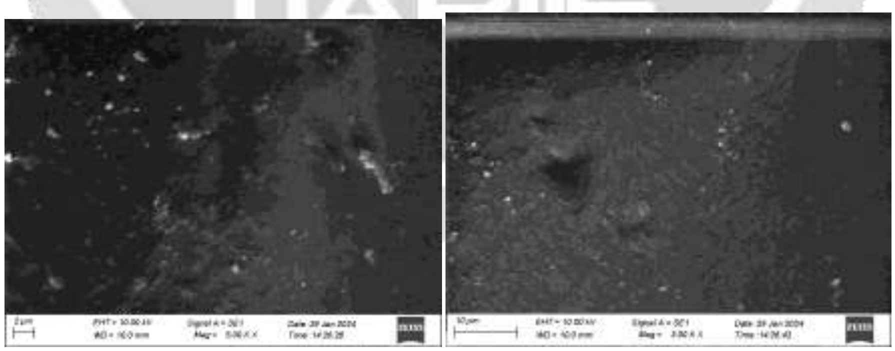

Fig 7. SEM for Gr / PVA nanocomposite films with single ratio

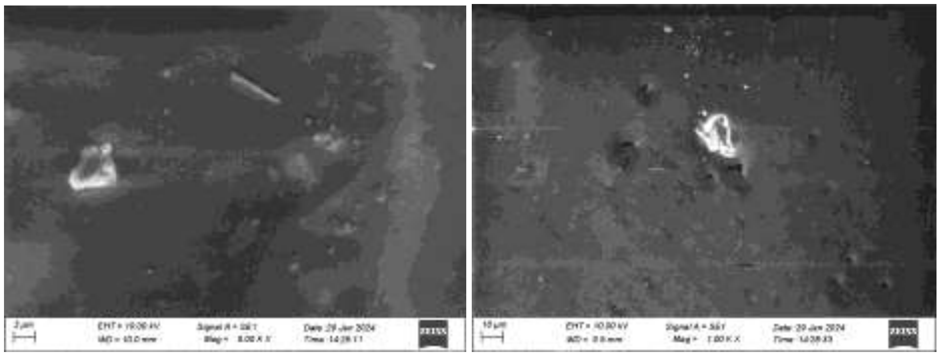

Fig 8. SEM for Cuo-Gr/PVA nanocomposite films with single ratio

IV. CONCLUSION :

The Nanocomposite polymer were prepared by PVA based nanocomposite by using solution casting method. The characteristics of PVA – Graphite – cupric oxide nanocomposite were studied using FTIR, UV, SEM, XRD. By the UV—Visible, the absorption spectrum reveals the concentration Graphite and Cupric oxide shifts in the absorbance peak and results in 386.15 nm for Graphite and 376.55 nm for Cupric oxide with Graphite. The FTIR characterization shows the interaction of functional group of PVA – Graphite – Cupric oxide through O-H bonding . XRD analysis is taken to identify the crystalline structure of PVA – Graphite – Cupric oxide. The XRD analysis gives the clear data for the presence of PVA – Graphite – Cupric oxide compounds. XRD results indicates that the nanoparticles have been combined with each other. The purity of the prepared CuO / Graphite were confirmed by XRD spectrometry.

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