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PREPARATIN AND CHARACTERISATION OF PVA BASED POLYMER MEMBRANE

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ABSTRACT

Polymers are advanced materials which are widely used in every material in our daily life. The importance of Polymers have been high lightened by their applications in different dimensions of science, technology and industry. One of them among them are Fuel cells. Fuel cells are electrochemical devices which convert chemical energy into electrical energy. The fuel cell has attracted attention of everyone due to their potential. The Polymer electrolyte fuel cells are electrochemical cells that will easily convert chemical energy of a fuel directly into electrical energy. One among the polymer that is efficient and environmentally benign is chitosan. It is an important and abundantly available in renewable resources on the earth. This is a biopolymer that can be used in both membrane electrolyte and electrode. The application of chitosan as a novel biopolymer in the fuel cell technology can be obtained. The FTIR test is used to access the functional group present in the chitosan. The SEM is also used to analyze the chitosan. The main aim of this analyze is to evaluate the influence of molar mass and deacetylation degree of chitosan. The XRD (x ray diffraction) analyses was applied to characterization of crystallinity of native and cross-linked chitosan. The UV analysis is used to absorb the wavelength of chitosan. This review provides an overview of main available fuel cells following by application of chitosan as novel biopolymer in fuel cell technology.Key words: Polymers, Fuel cells, Electrochemical cells, Chitosan.

INTRODUCTION

The extensive use of fossil fuels has caused severe pollutant emission life SOx, NOx, Cox and particulates which pose severe threat to the health of human beings. Fuel cells are among the most efficient and environmental friendly devices for energy conversion and power generation due to their zero-emission power source. Fuel cells have been recognized as a prime candidate for new energy resources and have extensively studied as an alternative to limited fossil fuels that are generally characterized by electrolyte material. Among electrolyte material, solid polymer-based electrolyte membranes offer advantages such as high efficiency and high energy density. The direct methanol fuel cells have attracted considerable attention for the last several years because of its specific advantages over other type of fuel cells. Chitosan, as a derivative ofchitin, is a naturally abundant and low- caste biopolymer which has attracted attention in various scientific and engineering processes due to its excellent biocompatibility, non-toxicity and chemical and thermal stability. Fuel cells have attracted attention due to their potential as a promising alternative to traditional power source. Recently, the efficient and environmentally being biopolymer “chitosan” have been extensively used as a novel material for

its application in fuel cell. Polyvinyl alcohol (PVA) is a biodegradable synthetic polymer that presented high ionic conductivities. The positive charge arising due to high protonated amino functionalities enables chitosan to polyelectrolytecomplex. The objective of this review is to investigate the current status of fuel cells and advances in utilization of chitosan biopolymer for polymer electrolyte membrane technologies.

MATERIALS AND METHODS

Materials:

Chitosan and PVA used in the investigation were purchased from LOBA chemical and spectrum reagents and chemical pvt. Ltd. And were used as received without any further purification.

Preparation of basic solution of chitosan:

1g of chitosan istaken with 60ml of deionized in a beaker and it set in a stirrer. Then 1g of chitosan is added to the deionized water. The stirrer is set at the speed at 700- 900 rpm. The acetic acid of 5 drops are added and stirred for more than 5 hours to make it in solution form.

Preparation of basic solution of PVA:

1g of Polyvenyl alcohol (PVA) is takenwith 10 ml of deionized in a beaker and set in a stirrer. The stirrer is again set at the speed of 90-120rpm speed. The solution is stirred for more than 4 hours to make it in solvent form.

Ratio:

The basic solution of chitosan 9ml is taken along with the basic solution of PVA 1ml. The solution is taken in a beaker and is set in the stirrer. Then the stirrer is again set at the speed of 100rpm speed. The solution is stirred for about 20 minutes. Now the both basic solutions are completely mixed well. Then the form a solution. The solution of the mixture is now poured in a Petri dish for the evaporation under vacuum. With the mixture of the precursors, a membrane was formed with the solvent evaporation technique (casting).

RESULT

FTIR [Fourier Transform Infra-Red] Spectroscopy:

FTIR spectra for chitosan: PVA nanoparticles, the absorption peak at 3405.95075cm^{-1} indicates the presence of (O-H) stretching of alcohol and also the peak at 2923.7341 cm^{-1} indicates the presence of (C-H) stretching. The band around 1061.55951 cm^{-1} represent S=O stretching of sulfoxide and 815.32147 cm^{-1} represent C=C bonding of Alkene.The band around 562.92749 cm^{-1} is a strong bond.

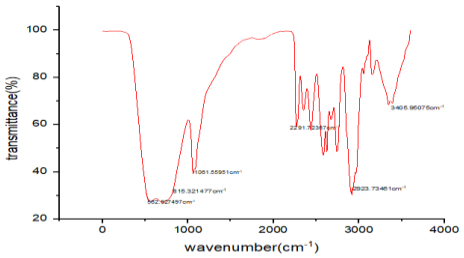

Fig 1 FTIR Analysis of chitosan-PVA in the ratio 8:2 of frequency range 0cm^{-1} -4000cm^{-}

UV (Ultra Violet) Rays:

The absorption spectra were used to study the energy band and type of electron transition. The absorption band energy can be calculated from Einstein's photon energy equation**E=hc/λ_{max}**

λ_{max} - Maximum absorbance wavelength

h - Planks constant (6.6x10^{-34}Js)

- c - Speed of light (3x10 m/s^2)

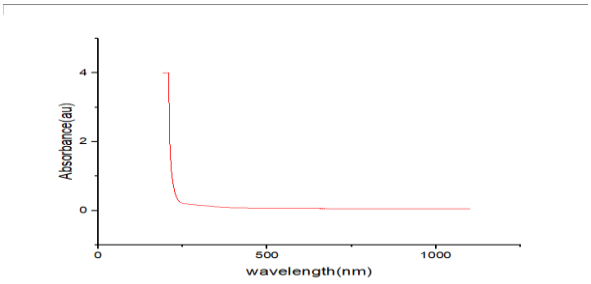

Fig 2 UV-Visible spectroscopy analysis of chitosan-PVA of ratio 8:2

5.3. SEM (SCANNING ELECTRON MICROSCOPY)

SEM Image of a composite material contains visible morphological structures like clusters of its constituent particles. which are immiscible with the material base. These structures generally are attributed in terms of their shape and size of a morphological structures more accurately SEM image analysis of material like Nanocomposite revels its several morphological as well as mechanical properties.The Chitosan($C_{56}H_{103}N_{9039}$): PVA$(C_2H_4O)_x$ image of ratio 8:2 is given above. A Chitosan($C_{56}H_{103}N_{9039}$): PVA$(C_2H_4O)_x$ combination of the nanocomposite is in the hexagonal shape and rod shaped.

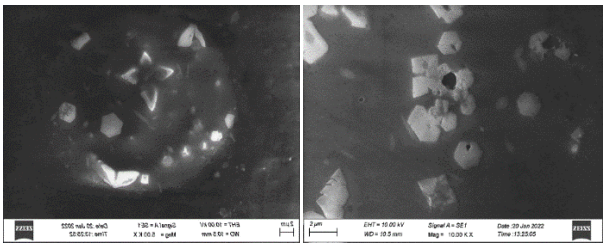

Fig 3 SEM IMAGE

XRD(X-Ray Diffraction):

Using X-ray diffraction phase analysis was studied. The average crystalline size of the nanoparticle were calculated based on Debye's Scheres's equation,

$$\mathbf{D}=\frac{k\lambda}{\beta\cos\theta}$$

Where,

D – Mean crystalline size
K – Shape factors taken as 0.9
λ -Wavelength of the incident beam
θ- Bragg's angle

The chitosan- PVA sample shows a major peak 9.6922. The below table shows that the interplanar distance and FWHM of corresponding 2θ values of chitosan-PVA nanocomposite. The average or estimated crystalline size is about 4.57543 nm.

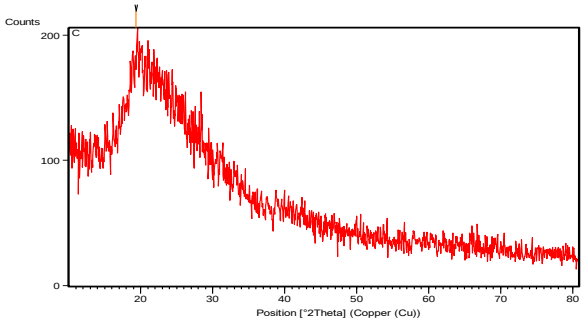

Fig 4 XRD analysis of chitosan-PVA

TGA (Thermal Gravimetric Analysis)

Two stages of weight losses were observed in the TGA. The first stage at around 90^0C, the weight loss of about 10% was observed in all the three samples. The weight loss in chitin and chitosan is due to the release of hydrogen bonded water. The second stage weight loss of about 60% around 250^0C- 320^0C temperature is attributed to the dehydration of saccharide rings and the depolymerization and decomposition of the chitosan .

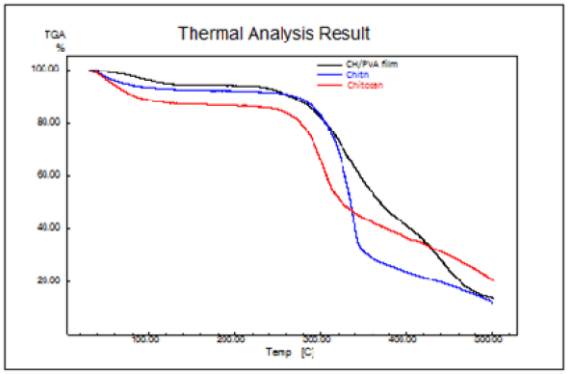

Fig 5 TGA curve of chitosan andPVA

The enhancement of the tensile strength in the CH/PVA blend as compared to chitosan and PVA is due to the strong hydrogen bonding between -OH and - NH_2 in chitosan and -OH groups in PVA.

It is fundamental to investigate the swelling behavior of the hydrophilic films for wound dressings, as it determines the capacity of the films to absorb exudates from the wound, avoiding maceration. From table I, it is seen that, increase in the percentage of chitosan in CH/PVA blend significantly increases both the water absorption and the time to reach the equilibrium. The increase of swelling degree is due to the presence of amino groups in chitosan. In an ionic environment chitosan molecules become uncoiled and assume more elongation or exist in a rod like shape. In presence of ions, the electro-neutrality condition increases and creates an additional osmotic pressure that expands the CH/PVA polymeric film.

CONCLUSION

The Polymer membrane based on Chitosan and PVA has been prepared by Solution Casting Method.The Polymer membrane was subjected to various characterization techniques like FTIR, UV, XRD, SEM, DTA and impedance analysis**.** Thus, we concluded that the polymer nanocomposite membranes (chitosan/PVA) are used as an electrolyte in the fuel cell application.The ionic conductivity has been enhanced by the addition of PVA solution in the Chitosan of 8ml.The ionic conductivity of the polymer membrane is increases with increase in temperature

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