Asian Journal of Advanced Research and Reports

12(3): 32-36, 2020; Article no.AJARR.58775
ISSN: 2582-3248

Synthesis and Characterization of Natural Oil Doped PVA Membrane

X. S. Gama[1*]

[1]Kittel Science College, Dharwad, India.

Author's contribution

The sole author designed, analysed, interpreted and prepared the manuscript.

Article Information

DOI: 10.9734/AJARR/2020/v12i330290
Editor(s):
(1) Dr. Azizur Rahman, University of Toronto, Canada.
(2) Dr. Nadia Sabry El-Sayed El-Gohary, Mansoura University, Egypt.
(3) Dr. Bachir Achour, University of Biskra, Algeria.
Reviewers:
(1) Janhvi Manohar, Saveetha University, India.
(2) Sharada T. Rajan, Sri Ramachandra Institute of Higher Education and Research (SRIHER), India.
Complete Peer review History: http://www.sdiarticle4.com/review-history/58775

Original Research Article

Received 14 May 2020
Accepted 22 July 2020
Published 31 July 2020

ABSTRACT

In deciding the workable layout of any network an appropriate technology plays a major role and can improve accuracy and flexibility efficiently, if chosen and implemented in best possible way. The growth in the infrared applications has created a need for knowledge of its optical characteristics in the spectral region for the purpose of designing. Very little work is previously reported in natural oil doped PVA membranes. In this work, a simple attempt is made synthesize and characterize the wintergreen oil and basil oil doped PVA membranes. In investigation, basil oil and wintergreen oil doped PVA membranes were prepared and is made to characterize. The resulting membranes were characterized by Fourier transform infrared spectroscopy (FTIR), wide-angle X-ray diffraction (WXAD), thermo-gravimetric analysis (TGA) and differential scanning Calorimetry (DSC).

Keywords: Membrane preparation; FTIR; TGA; DSC and XRD.

1. INTRODUCTION

The basil oil has a watery viscosity and is pale greenish-yellow in color. Recently, there has been much research into the health benefits conferred by the essential oils found in basil [1,2,3,4]. Wintergreen once commonly referred to plants that remain green (continue photosynthesis) throughout the winter. The term evergreen is now more commonly used for this

**Corresponding author: Email: xaviergama@yahoo.com*

characteristic. In recent years, the devices have been trying the modulation requirements by using natural oil. It will be a material which is suitable for a variety of applications. Its optical and non linear optical properties may attract designers to use it in optical waveguides. Therefore it will also be the material of choice for the manufacture of surface acoustic wave devices.

Design of these devices and prediction of their behavior depend critically on precise knowledge of the spectral region of interest. There is a need for improved knowledge of its wavelengths throughout the transmission range of this material. We have studied the spectra to predict the signal and wavelengths for an optical parameter of interest. We have measured the refractive indices of these oils doped with ratio of 1:20 ml

To make measurements of light absorption at different wavelengths a simple attempt is made to characterize the photorefractive properties of natural oil by preparing the membranes with natural oil doped with PVA membrane.

2. EXPERIMENTS

2.1 Materials

Basil and wintergreen oil were purchased from falcon essential oils, Bangalore, India. All the oils were of reagent grade and used without further purification.

2.2 Membrane Preparation

Proper amount of PVA (Polyvinyl Alcohol) was dissolved in 100 ml of N, N-dimethylacetamide with a constant stirring for about 24 hours at room temperature. The solution was then filtered using a fritted glass disc filter to remove un-dissolved residues particles and the solution was stand overnight to release the air bubble. 5 ml of wintergreen oil is then added to the solution and kept for constant stirring for about 24 hours at room temperature. The resulting clear solution was spread on to a glass plate in a dust free atmosphere at room temperature. After being dried for about 5 days the membrane was subsequently peeled-off and was designated as J1.

2.3 Differential Scanning Calorimetry (DSC)

The thermal property of the membrane is measured using differential scanning calorimeter (Mettler Toledo DSC 822e). The sample is heated up to 250°C at the heating rate of 10°C/min. the intercept point of the slopes was taken as the glass temperature (Tg).

2.4 Fourier Transform Infrared Spectroscopy (FT-IR)

The incorporation natural oil material and its interaction is confirmed by FTIR spectrometer Thermo (Nicolet, Avatar 370) and spectra was recorded in the range of 500-4000cm^{-1} and their characteristics peaks are noted down.

2.5 Wide Angle X-Ray Diffraction (WXRD)

The morphology of membrane was studied at room temperature using X-ray diffractometer (Bruker AXS D8 Advance). The X-ray source was Cu, Wavelength 1.5406A° the dried membrane of uniform thickness was mounted on a sample holder and scanned in the reflection mode at an angle 2θ over the range at a speed of 10°/min.

2.6 Thermogravimetric Analysis (TGA)

Thermal properties of the membrane was investigated by thermo gravimetric analysis (Perkin Elmer Model STA 6000) at a rate of 10°/min under nitrogen atmosphere.

3. EXPERIMENTAL RESULTS AND DISCUSSION

In this section, the obtained absorption data measured at room temperatures.

3.1 Differential Scanning Calorimetry

DSC is the most direct experimental technique to resolve the energetic of conformational transitions of biological macromolecules [5]. In order to investigate the thermal stability of the employed catalysts, DSC analysis was conducted [6]. The melting point of the semi crystalline material is observed at the temperature around 120°C. Fig. 1 shows the progress of semi- crystal change through heat flow to elevated temperature (RT ~120°C). The melting point of the semi crystalline material is observed at the temperature around 220°C. The peak temperature is associated with the temperature at which maximum reaction rate occurs is between 170°C to 200°C. The temperature at which the specific heat or the coefficient of thermal expansion and the dielectric constant changes rapidly is at around 120°C known as the glass transition temperature [7,8].

3.2 Wide Angle X-Ray Diffraction (WXRD)

To study the effect of natural oil doped PVA membrane X-Ray diffraction was employed and the patterns thus obtained are displayed in Fig. 2. A standard theta-2theta scan was performed with position sensitive detector. In the diffraction pattern, the pattern exhibits sharp peaks at around 2θ=20 due to PVA contents. Peak detected at 2θ=28 are due to oil contents.

3.3 Fourier Transform Infrared Region (FTIR)

FTIR spectra of wintergreen oil and basil doped PVA membranes are presented in the Figs. 3 & 4. The characteristic strong and broad band in wintergreen oil appeared at around 3400 cm^{-1} in the membrane corresponds to O-H stretching vibration.

A characteristic strong and broad band is appeared at around 1714 cm^{-1} in membrane was assigned to C-O stretching vibration. The data indicate the location of corresponding absorption bands.

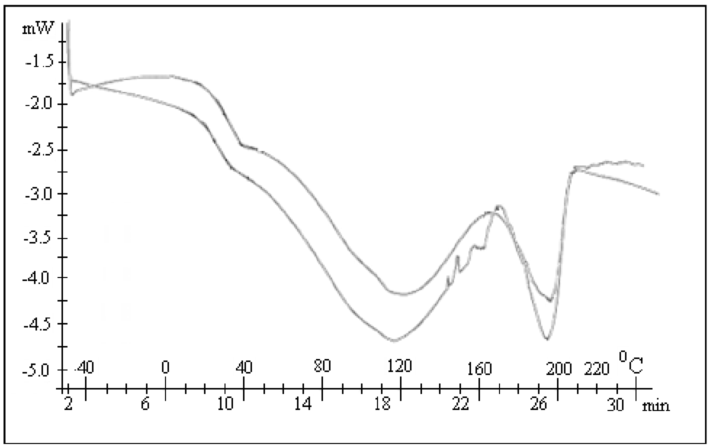

Fig. 1. DSC thermo-gram of natural oil doped membrane

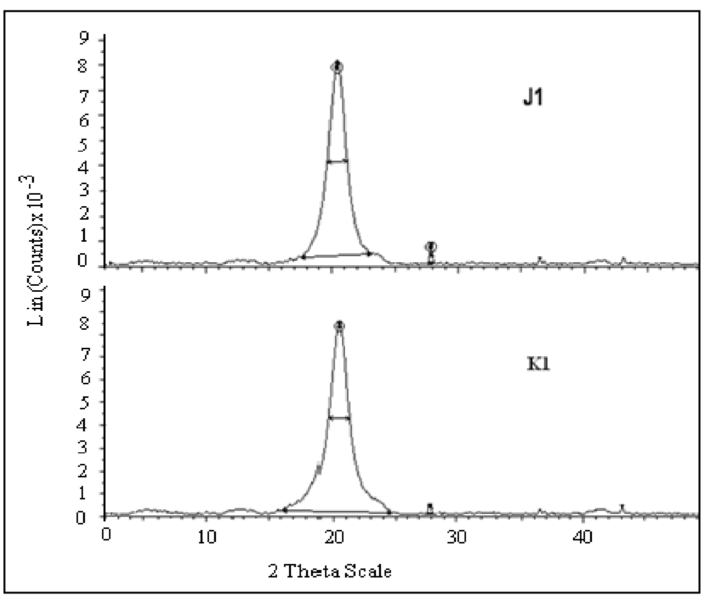

Fig. 2. WXRD of $CuCl_2$ doped $LiNb0_3$ membrane

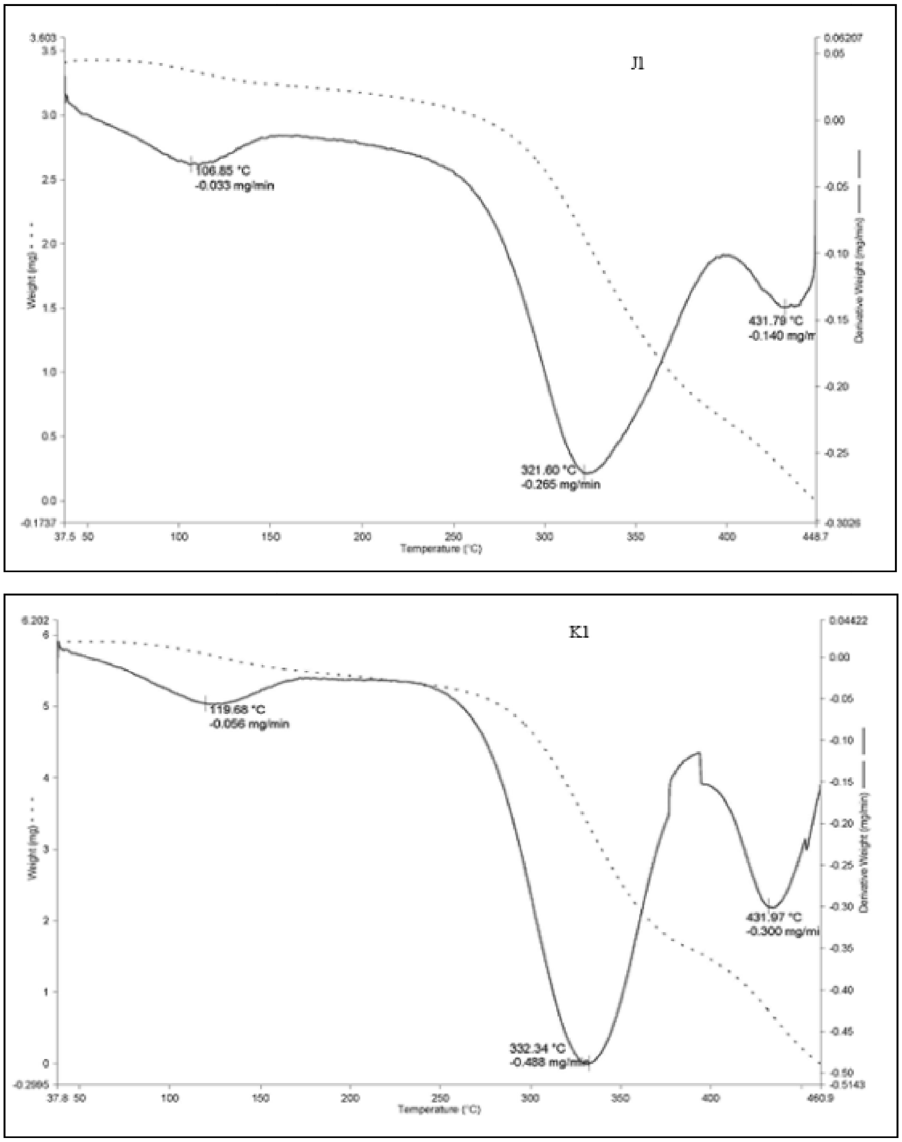

Fig- 3 & 4. FTIR spectrum of PVA membranes doped with Wintergreen oil & Basil oil

3.4 Thermo Gravimetric Analysis

The thermal stability and degradation behavior of the mixture of wintergreen and basil oil doped PVA membranes were investigated under Ni atmosphere at 10°C / min. Three mass losses up to 500°C, first at about around 110°C due to the loss of water molecules and second mass loss occurs at about 300°C of PVA and the third at about 430°C due to decomposition of oils. The lowest temperature (T_i) at which the onset of mass change can be detected is 200°C and final temperature (T_f) is the final temperature at which the decomposition completed is about 500°C.

4. CONCLUSION

This investigation studied the properties of hydrophilic PVA membranes by introducing natural oils like basil and wintergreen oil. Characterization of polymerized PVA membrane doped was reported by FTIR spectral data, DSC, XRD and with TGA. Data give an accurate prediction of experimental results for processes. The data will be useful to designers of devices that will use these materials for frequency-conversion devices. The information can be used to select material for certain end -use application, predict product performances and improve product quality.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sdiarticle4.com/review-history/58775