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SYNTHESIS AND CHARACTERIZATION OF TiO₂ DOPED POLYVINYL ALCOHOL

POLYMER COMPOSITES

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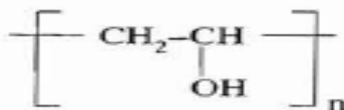
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ABSTRACT

The study is to characterize the properties of structural and physical properties of TiO₂ doped PVA composites. The composites were prepared by Solution Casting Method. The experimental results show that the formation of TiO₂ doped PVA matrix formation and their natural thermal conductivity.

1. INTRODUCTION

Polyvinyl alcohol [PVA] was first prepared by Hermann and Haehnel in 1924 by hydrolyzing polyvinyl acetate in ethanol with potassium hydroxide. PVA is an odorless, tasteless, translucent white or cream colored granular powder. The structure of PVA is as given below



PVA has excellent film forming, emulsifying and adhesive properties. It is also resistant to oils, grease and solvents. PVA is a water – soluble synthetic polymer. Due to the characteristics of easy preparation, good biodegradability, excellent chemical resistance and good mechanical properties. PVA has been used on many biomaterial applications like artificial pancreas, hemo dialysis and implantable biomaterials.

PVA is produced commercially from Poly Vinyl acetate. The Physical characteristics and its specific functional uses depend on the degree of polymerization and the degree of hydrolysis.

In the present paper, the preparation and characterization of TiO₂ doped Poly Vinyl Alcohol composites have been discussed.

2. EXPERIMENTAL

Synthesis of PVA/TiO₂ Composite: The pure Poly Vinyl Alcohol films and TiO₂ doped PVA films has been prepared by employing Solution Casting Method.

The double distilled water of 25 ml has poured into a beaker which contain 10 mg of PVA granules, and dissolved PVA completely. The above resulting solution was magnetically stirred continuously about 3 hrs, until the solution mixture became a homogeneous viscous gel at room temperature. The gel is poured into petri dish and keep it for 7 days to solidify under room temperature condition and finally a thin membrane of less than 1 mm thickness of Pure PVA film has formed.

In order to prepare the composite of TiO₂ doped PVA film, the 2 weight percentage TiO₂ is added to the solution of PVA i.e., solution of 10ml PVA dissolved in 25 ml of double distilled water. Then the solution is magnetically stirred continuously about 3hrs, until the solution mixture become a homogeneous viscous gel at room temperature. The prepared gel is poured into petri-dish and keep it for 7 days for solidify at room temperature and finally a thin membrane of less than 1 mm thickness of 2 weight percentage TiO₂ doped PVA film has formed.

The above process is repeated to prepare the composite of TiO₂ doped PVA film with 0.75 weight percentage of TiO₂. The composition of the PVA and TiO₂ is shown in Table – 1.

The thickness of the composite polymer film was controlled at between 0.3 mm to 1 mm.

In this paper, we are studying the IR spectra of the respective composites and their thermal conductivity by Lee's Method.

3. RESULTS AND DISCUSSION

Fig.1 shows FTIR spectrum of pure PVA, Fig. 2 and Fig.3 shows FTIR spectrum of TiO₂ doped PVA composite film for 2% and 7.5 % of TiO₂ respectively. Fig.4, Fig.5 and Fig.6 shows the thermal conductivity of Pure PVA, TiO₂ doped [2%] PVA and TiO₂ doped [7.5%] PVA composites.

The O-H stretching band in the IR spectrum is by far the most characteristic IR band of alcohols and phenols. The free O-H vibration occurs as peak at 3470 cm⁻¹ in pure PVA, but this peak is broaden in the complexes which is due to the

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hydrogen bond formation. The broad hydroxyl band in the polymer complexes is displaced towards the lower wave number, and gives a clear indication about the specific interaction in the polymer matrices.

The vibrational peaks at 1260 and 863 cm^{-1} are assigned to C-C stretching and C-H rocking of PVA. The characteristic band appearing at 1474 cm^{-1} is assigned to C-H bend of CH_2 of PVA, which is shifted to 1473 (2% of TiO_2) and 1465 (7.5% of TiO_2) in the composite.

On the characteristic vibrational peak appearing at 1100 cm^{-1} is assigned to CO stretching of secondary alcohols of PVA. Other bands at 820 cm^{-1} and 520 cm^{-1} belongs to the asymmetric stretching of Ti-O-Ti group. The last band at 412 cm^{-1} is due to the bending mode of Ti-O-Ti.

From IR results it is observed that some of the peaks were shifted and some of them were disappeared with respect to the pure PVA compounds. This results manifested the conclusion about the specific interactions in the composite polymer matrices and hence complexation. Thus the complex formation in the composite polymer matrices has been confirmed from the analysis.

Fig.4, Fig.5 and Fig.6 be the three cooling curves relating with thermal conductivity of Pure PVA, 2 weight percentage TiO_2 doped PVA and 7.5 weight percentage TiO_2 doped PVA respectively reveals that with the increase of TiO_2 weight percentage the Cooling rate is also increase slightly. This shows the conductivity increases slightly as the polymer matrix of PVA enriched with TiO_2 .

Fig. 1 IR spectrum of Pure PVA

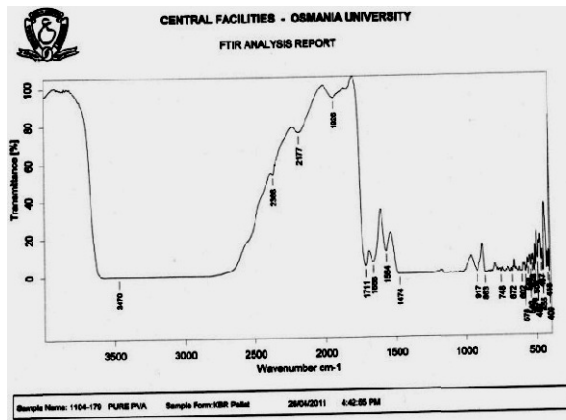


Fig.2 – IR spectrum of TiO_2 doped [2%] PVA

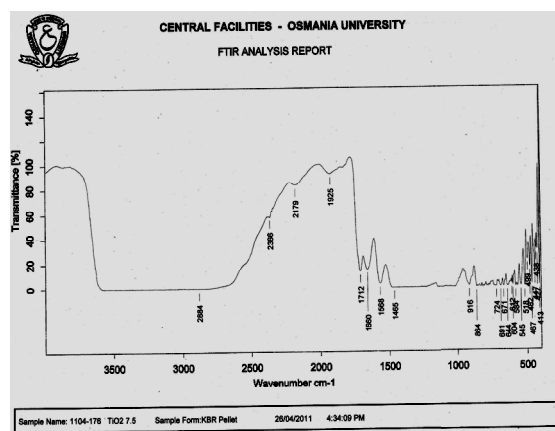
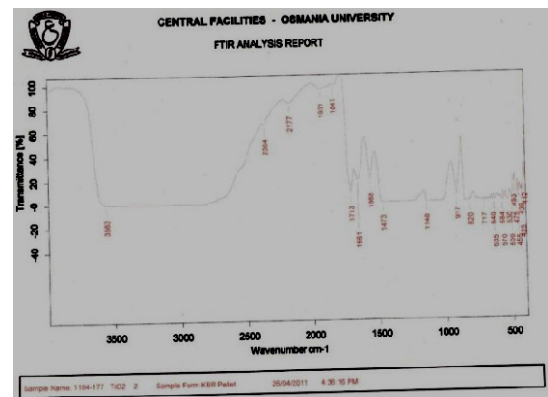


Fig.3 – IR Spectrum of TiO_2 doped [7.5%] PVA

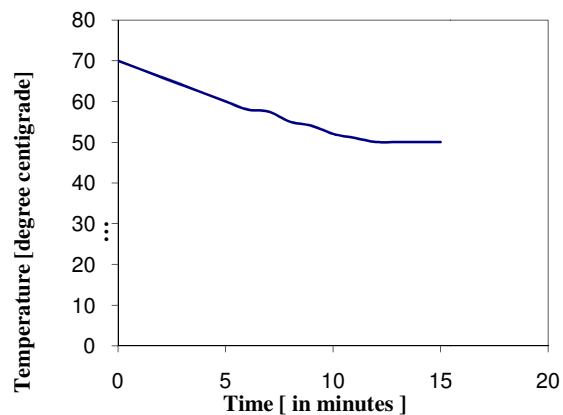


Fig. 4-Thermal Conductivity of Pure PVA

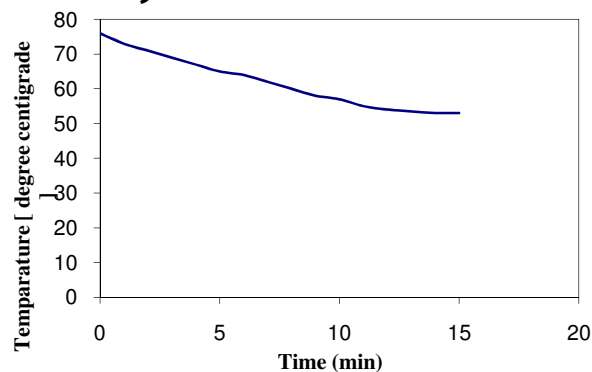


Fig.5 - Thermal Conductivity of PVA / TiO₂ (2%) doped composite

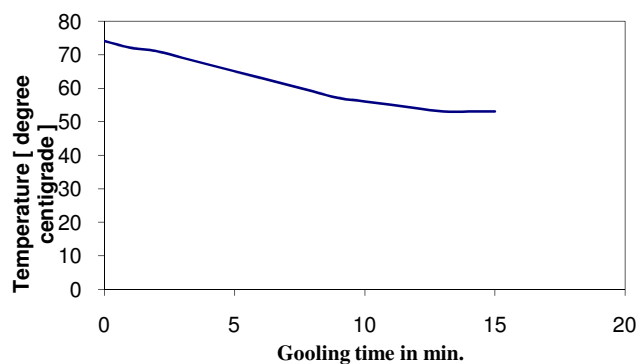


Fig-6 Thermal conductivity of PVA / TiO₂ (7.5%) composites

Table-1: Composition of PVA and Ti O₂

Sample	Poly Vinyl alcohol	Titanium Oxide (Wt%)
Pure PVA	10 mg	0
TiO ₂ doped PVA - 1	9.8 mg	0.2
TiO ₂ doped PVA - 2	9.25 mg	0.75

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