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# Preparation and Morphological Studies of $Mn^{2+}$ Ions Filler on Polyethylene and Polypropylene Blend Sheets

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**ABSTRACT:** Commercial grade solid polymer Polyethylene Polypropylene (PEPP) complexes with Manganese Sulphate ( $MnSO_4$ ) were prepared using solution cast technique. The Morphology and structural properties of composite PEPP polymer sheets were examined by microscope and FTIR. Microscopic studies reveals the morphology of the polymer varies  $Mn^{2+}$  Ions and even the sample becomes more brittle. FTIR spectra studies for pure PEPP and complexes revealed the vibrational changes that occurred due to the effect of dopant salt in the polymer.

**KEYWORDS:** FTIR, Polymer blend,  $Mn^{2+}$  Ions, Morphology.

## I. INTRODUCTION

In the field of polymer or polymer blend additives, lot of research work has been carried out earlier towards the development and modification of innovative materials of significant importance. Transition metal ion doped polymers are considered as potential materials for both theoretical and experimental research and found to be essential because of their increasing technological applications. Doping polymer blends with transition metal ions have significant effect on their physical properties. Changes in physical properties of polymer blends are considered to be dependent on chemical nature of dopants and methods of preparation in which those interact with host matrices. An attention has been focused on the structural, thermal and optical properties of doped polymer blend films, since they possess potential properties useful in the advanced industrial applications [1-2].

An important feature of PEPP is the presence of crystalline and amorphous regions and its physical properties which are resulting from crystal amorphous interfacial effects. Many studies have been reported in literature about the electrical conductivity and dielectric properties of polymer blends with regard to storage and dissipation of electric and magnetic energies in materials which explains numerous phenomena in optics, electronics and solid state physics. In order to store electric charges dielectrics are used whereas insulators are used to block flow of electric charges. Dopants are used with polymer blend for several reasons; improved processing, density control, optical effect, thermal conductivity, electrical and paramagnetic properties, etc [3-4].

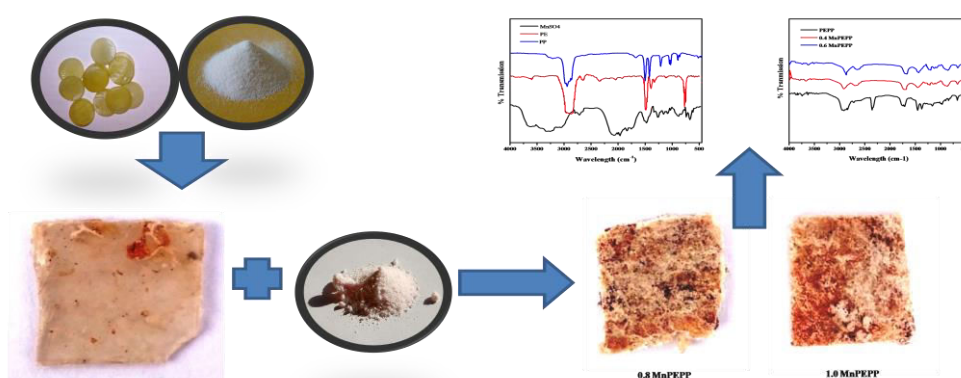
Metal salts have been employed as dopants leading to the conductive polymer. These dopants were found to be able to interact with polymer chains directly and to induce changes in the morphology of the polymer. The typical salts leading to these tendencies are  $NiCl_2$ ,  $EuCl_3$ , and  $ZnCl_2$ , respectively. The properties of the polymer are controlled by doping of the polymer by various chemical agents and blending it with other conventional low-weight plasticizers or polymer matrixes. The concept of doping implies the use of chemical agents that directly interact with the polymer chain. Recently, researchers have proven that some substances which are not primary dopants can substantially improve the conductivity of a polymer.



## II. EXPERIMENTAL

Polyethylene (PE) and Polypropylene (PP) samples as received from POLYPENCO LTD. (UK) are in the form of solid cylinders with a diameter of 2cm of PP and powder form of PE. The as-received PP samples were cut into 1cm length, circular-shaped parallel solid block of 1 gram of weight. Commercial grade  $\text{MnSO}_4$  was used in the present work.  $\text{MnSO}_4$  was received from RANCHEM chemicals.

The 1 gram of PP and 1 gram of PE samples was placed in a crucible onto which a known amount of weight  $\text{MnSO}_4$  was sprinkled. The crucible was placed in an oven maintaining a temperature of 100 °C for approximately an hour or more depending on the distribution of the  $\text{MnSO}_4$  within the polymer matrix. The sample was cooled and then cut into a different shaped parallel solid block and polished and used. The samples were named based on the amount of weight  $\text{MnSO}_4$  added. The sample without  $\text{MnSO}_4$  is considered as PEPP. Whereas, the samples with  $\text{MnSO}_4$  is considered as 0.20MnPEPP, 0.40MnPEPP, 0.60MnPEPP and 0.80MnPEPP and 1.0 MnPEPP. The numbers represent the amount of  $\text{MnSO}_4$  and PE PP added in terms of a gram. i.e, 0.20:1:1 where 0.20 represents  $\text{MnSO}_4$  and 1 represent PE and PP respectively.



## MORPHOLOGICAL STUDIES

The morphological studies of the as-prepared samples were performed to understand the physical nature of the compound. Fig 1 and 2 represents the micrograph of the sample processed. From fig 1 it is clear that the physical nature of the compound varies with the added amount of  $\text{MnSO}_4$ . As the concentration of  $\text{MnSO}_4$  increases, the sample becomes more translucent. It is evident from fig 2, that the  $\text{MnSO}_4$  are firmly binded within the polymer matrix. Even we can visualize that as the added amount of  $\text{MnSO}_4$  increases the morphology of the polymer varies and even the sample becomes more brittle[5].

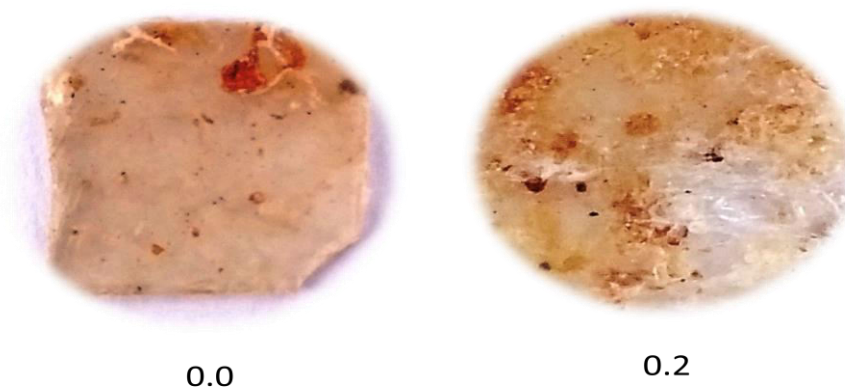


Fig 1. Morphology of the PEPP and MnPEPP samples

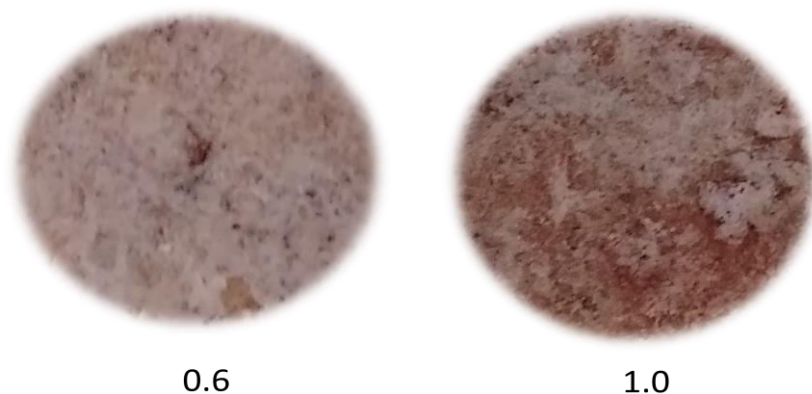


Fig 2. Morphology of the PEPP and MnPEPP samples

### FT-IR SPECTROSCOPY STUDIES

The FT-IR spectra for pure PE, PP, and  $\text{MnSO}_4$  are shown in fig 3. In the FT-IR spectra of PP, The broadband of transmittance spectra at approximately 2,950, 2,920, and 2,840  $\text{cm}^{-1}$  is due to the transmittance peak of the band. The band at 2,950, 2,920, and 2,840  $\text{cm}^{-1}$  corresponds to aromatic C–H stretching vibration. The peak at 1716  $\text{cm}^{-1}$  refers to the stretching of the C=O group. Due to the stretching of the O–H bond, a distinct peak is seen at about 3400  $\text{cm}^{-1}$ . There is a peak at 1255  $\text{cm}^{-1}$  and two peaks around 950–990  $\text{cm}^{-1}$  that can be attributed to the stretching of the C–O bond and out of plane vibration of the O–H. The peaks around 1500–1650  $\text{cm}^{-1}$  refer to the C=C bond and another group around 3100–3200  $\text{cm}^{-1}$  is attributed to the =C–H group. The transmittance band at 841  $\text{cm}^{-1}$  was assigned to aromatic C–H out of plane bending vibration of two adjacent hydrogen atoms.

In fig 4, for PE the band in the regions 3000–2800, 1550–1400, and 750–650  $\text{cm}^{-1}$  were mainly considered. The characteristics absorbance bands for PE which are located at: 2914  $\text{cm}^{-1}$ , 2847  $\text{cm}^{-1}$ , 1470  $\text{cm}^{-1}$  & 718  $\text{cm}^{-1}$ . The 1470  $\text{cm}^{-1}$  & 718  $\text{cm}^{-1}$  peaks are used to identify and quantify the presence of PE. The region 1300–1400  $\text{cm}^{-1}$  is displayed using an enlarged scale, and one can see differences in the absorption pattern of the samples. Three bands assignable to  $\text{CH}_2$  and  $\text{CH}_3$  groups are present: a band I at 1377  $\text{cm}^{-1}$ , band II at 1366  $\text{cm}^{-1}$ , and band III at 1351  $\text{cm}^{-1}$ .

In FT-IR spectra of  $\text{MnSO}_4$  peaks at 431, 418, and 408  $\text{cm}^{-1}$ , are corresponding to IR absorbances of Mn. The band in the region between 3700–3100  $\text{cm}^{-1}$  corresponds to  $\text{SO}_4$ .

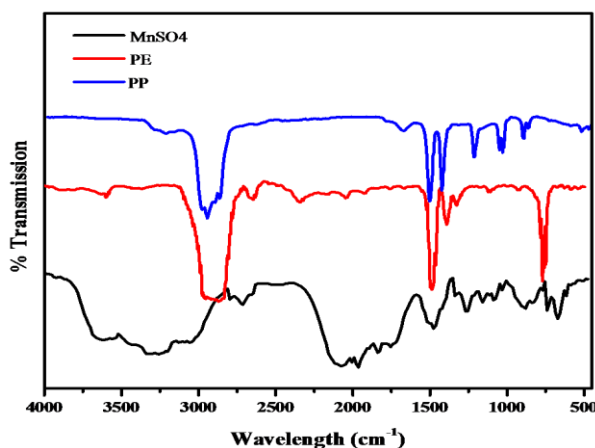


Fig 3. FT-IR spectra of PE, PP, and  $\text{MnSO}_4$ .

In the pure PE-PP block copolymer sample ( Fig. 4), the peaks in the range  $2972\text{--}2860\text{cm}^{-1}$  show that the  $>\text{C-H}$  stretching is present and it is in strong absorption region, i.e. stretching mode of vibration. it is observed in the strong absorption region. The peak at  $\sim 1370\text{cm}^{-1}$  represents  $\text{CH}_3$  symmetric bending mode it is in the middle absorption region. The peak at  $\sim 1462\text{cm}^{-1}$  represents the  $\text{CH}_3$  asymmetric bending mode of vibration and it is medium absorption region, and at  $980\text{--}960\text{cm}^{-1}$  C-H out of plane bending, vibration is present, which is a low absorption region. There is a sharp peak at  $2360\text{cm}^{-1}$  which is a C-C stretching vibration. The peak at  $2360\text{cm}^{-1}$  represents C-C stretching. The peak at  $\sim 1370\text{cm}^{-1}$  represents  $\text{CH}_3$  symmetric bending mode in the middle absorption region. The peak at  $\sim 1462\text{cm}^{-1}$  represents the  $\text{CH}_3$  asymmetric bending mode of vibration and it is medium absorption region, and at  $980\text{--}960\text{cm}^{-1}$  C-H out of plane bending, vibration is unaltered after the doping. In MnPEPP samples, the intermolecular hydrogen-bonded O-H stretching frequency of PEPP appearing in the range of  $3250\text{--}2800\text{cm}^{-1}$  is shifted to  $3300\text{--}2850\text{cm}^{-1}$ ,  $3320\text{--}2870\text{cm}^{-1}$ [5].

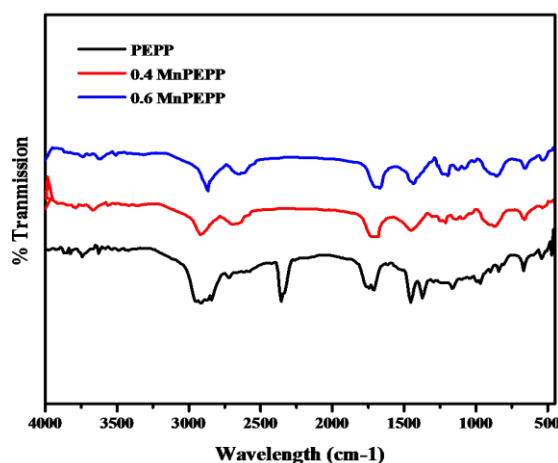


Fig 4. FT-IR Spectra of PEPP and MnPEPP.

### III. CONCLUSION

From the above study, we summarized that the characteristics of (both physical and chemical) of PEPP changes according to the added amount of  $\text{MnSO}_4$ . As the concentration of  $\text{MnSO}_4$  increases, the sample becomes more translucent. It is evident that the  $\text{MnSO}_4$  are firmly binded within the polymer matrix. Even we can visualize that as the added amount of  $\text{MnSO}_4$  increases the morphology of the polymer varies and even the sample becomes more brittle. FT-IR studies revealed the change in the composition of PEPP on introducing  $\text{MnSO}_4$ . The concentration of  $\text{Mn}^{2+}$  ions was explained in terms of an increase in the amorphicity. Thus, these changes show a high sensitivity of these sheets to doping that would suggest the applicability in magnetic and optical devices, fabricating solid state batteries and other electrochemical devices.

### ACKNOWLEDGMENT

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