Comparative Study On Properties Of PMMA/PEO/$Liclo_4$ And PMMA/PEO/$Naclo_4$ Polymer Electrolyte Blend Thin Films

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Abstract: Solution-cast method as preparatory method to prepare doped $LiClO_4$ and $NaClO_4$ salts to PMMA-PEO blend films. Modification in different properties of films was examined with different characterization studies such as SEM, FTIR, DSC, and DC conductivity. SEM results revealed that Physical structure and phase behavior of PMMA-PEO film was modified from crystallinity to amorphous in the presence of both salts. Disappearance of melting temperatures with different concentrations of salts doped to PMMA-PEO thin films were observed using DSC thermo grams. Complexation and interaction of salts to PMMA-PEO polymer blend was observed with FTIR spectrum. It was observed that conductivity of all the films increased from room temperature to above.

Keywords: PMMA, PEO, $LiClO_4$, $NaClO_4$

1 INTRODUCTION

Many researchers are working on polymers, Composite or Solid polymers and their blends for several years to carry out their electrical applications by modifying their properties. The main advantages of polymers are low cost, good chemical resistance, and low specific gravity on another side little strength, small modulus, and low operating temperature control its uses in many fields [1]. PEO and its blend salt compounds are investigated for primary studies and applications such as electrochemical devices [2-5]. To achieve the necessary properties from the polymers, blending of two or more polymers is a suitable technique [6, 7]. Blending of the polymers can be an outstanding method to modify and improve the properties of polymers [8]. Accept and donation of proton among the polymers forms complexes and miscibility. PMMA and PEO polymers are example for such couple [9, 10]. The miscibility behavior and interaction of salts with PMMA-PEO blend have been examined with different techniques such as FTIR, Optical absorption, SEM etc.

2 EXPERIMENTAL

The solid polymer electrolyte blend films prepared with well known solution cast method such that required chemical components of PMMA, PEO, $LiClO_4$, $NaClO_4$ were procured from Sigma Aldrich further which were weighed in different wt.% and then together all dissolved in THF (Tetra hydro furan). Magnetic stirrer was used by maintaining at 300K temperature to obtain uniform solution which was shifted into

3.1 SEM

SEM images of PMMA, PEO, PMMA-PEO (80:20) polymer blend and 20wt% of $LiClO_4$ and $NaClO_4$ salts doped thin films as shown in Fig.1. PMMA surface micro structure appeared as smooth which is the primary confirmation for amorphous nature whereas PEO micro structure shown rough surface which was suggested that the semi crystalline in nature. When higher content of 20wt% $NaClO_4$ and $LiClO_4$ salts are present in the PMMA-PEO blend films shows micro pore structure and rough surface indicated that an amorphous phase behavior. SEM results of salt doped thin films also confirm miscibility and complexation among polymers and salts which also leads to blending of PMMA/PEO/salts was compatible.

3 RESULTS

3.2 DSC

DSC curves of Fig. 2(a), 2(b) shows melting temperature of PEO and PMMA as 72^0C and 98^0C respectively. Whereas disappearance of melting temperature was observed in the DSC plots of PMMA-PEO and $LiClO_4$ and $NaClO_4$ (80:20:20) salt doped films as shown in Fig.3, this indicates that the amorphous content is present in both the thin films. Whereas appearance of melting temperature in the PEO polymer film evident that semi crystalline in nature. It has been observed that when PMMA and PEO polymers are blended with each other causes miscibility of these two polymers at the wt.% of 80:20.

3.2 FTIR

In FTIR spectra of PMMA/PEO/salts (80:20:20) (Fig.3) films were found that the peaks are similar in both the plots but few peaks were broadened and few peaks moved towards lower or larger wave number side compared to PMMA-PEO (80:20) system which indicated that complexation of salts with polymers which leads modification of phase from one to another.

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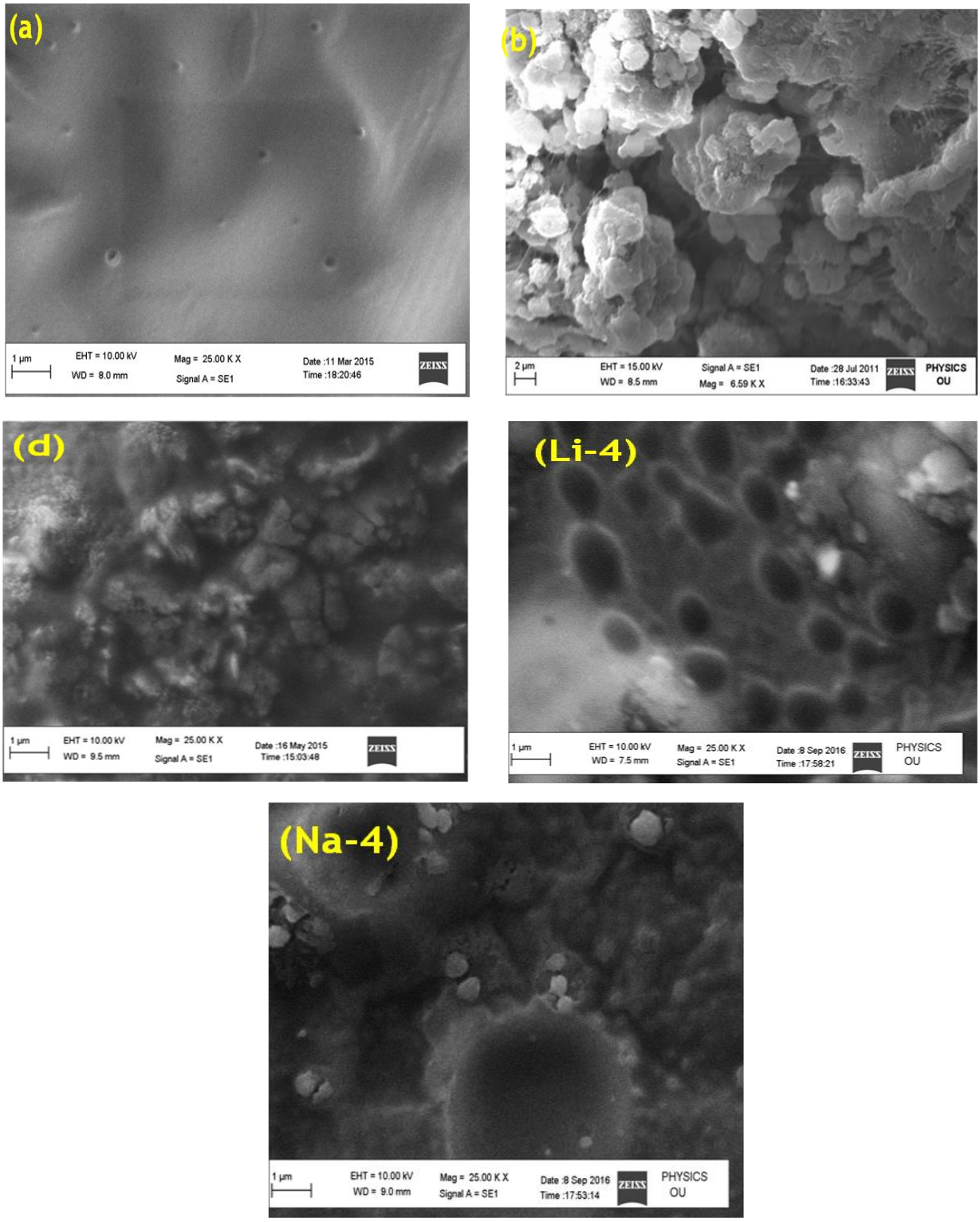

Figure 1: *SEM microimages of (a) PMMA, (b) PEO polymers, (c) PMMA-PEO (80:20) polymer blend and (Li-4, Na-4) 20wt% of salts doped thin*

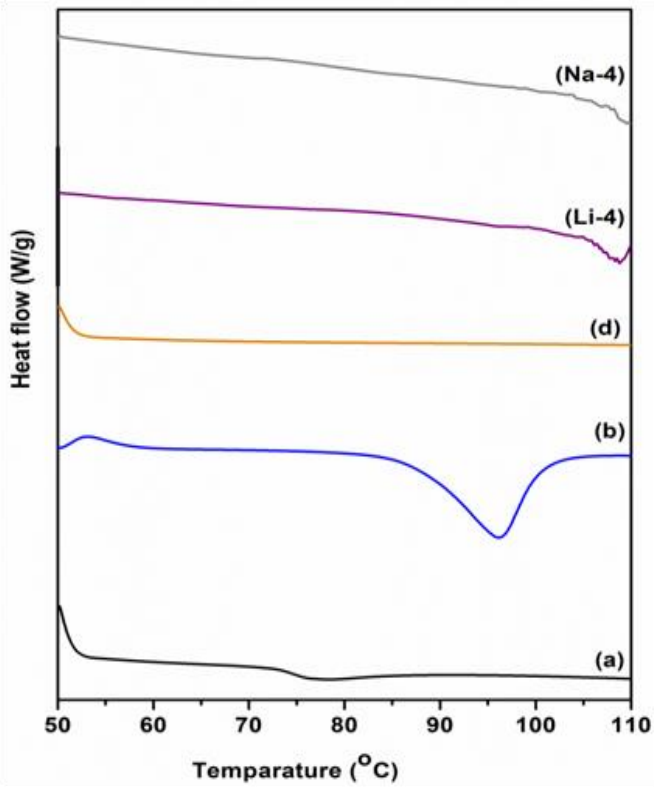

Figure 2: *DSC curves of (a) PMMA, (b) PEO, (d) PMMA-PEO(80:20),*

(Li-4) PMMA-PEO-$LiClO_4$ (80:20:20) and (Na-4) PMMA-PEO-$NaClO_4$ (80:20:20) Blend Thin Films

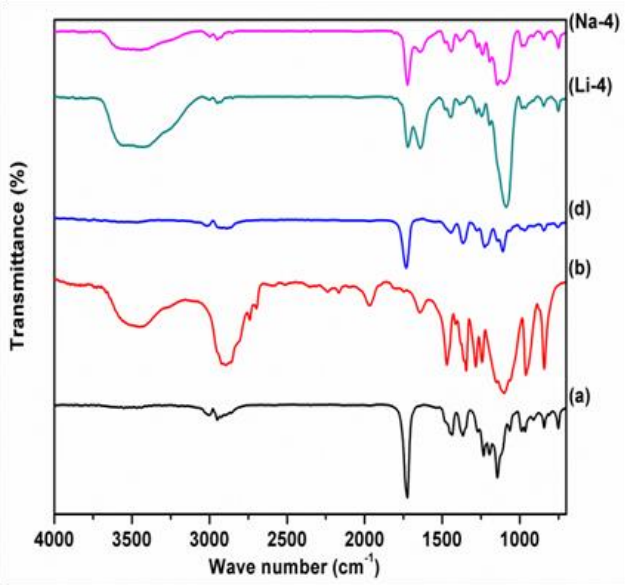

Figure 3: *FTIR Spectra of (a) PMMA, (b) PEO, (d) PMMA-PEO(80:20),*

(Li-4) PMMA-PEO-$LiClO_4$ (80:20:20) and (Na-4) PMMA-PEO-$NaClO_4$ (80:20:20) Blend Thin Films

3.4 DC Conductivity

The conductivity of PMMA and PEO polymers depends on amount of salts added to them. The results of blending of PEO and PMMA with 20wt.% doped salts $NaClO_4$ and $LiClO_4$ showed almost similar conductivity properties and behavior with the temperature as shown Fig. 4. It was observed that at 20 wt.% of salts to polymers shown higher conductivity up to higher temperature. Li^+ and Na^+ ions presence in the polymer chains plays an major role to enhance the conductivity along with temperature. Due to more strength and conductivity, both the films of PMMA-PEO-$LiClO_4$ and PMMA-PEO-$NaClO_4$ may be useful in the electro active applications.

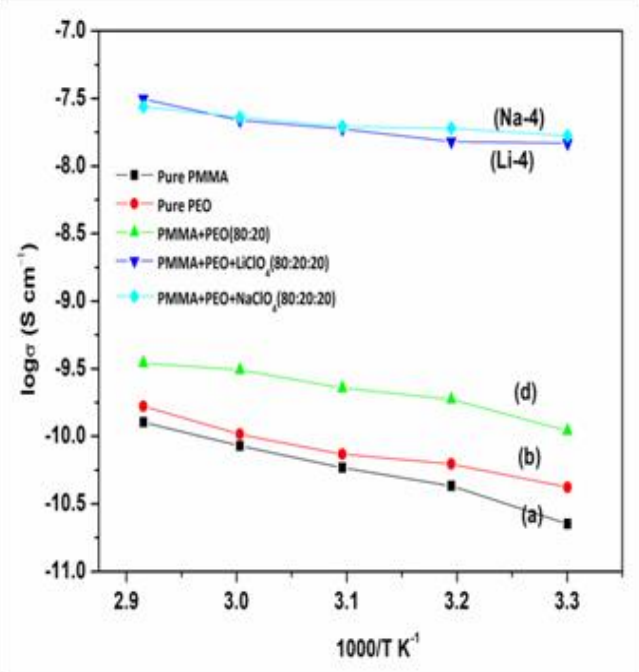

Figure 4 *DC Plots of (a) PMMA, (b) PEO, (d) PMMA-PEO(80:20),*
(Li-4) PMMA-PEO-$LiClO_4$ (80:20:20) and (Na-4) PMMA-PEO-$NaClO_4$ (80:20:20) Blend Thin Films

4 CONCLUSION

Phase behavior i.e either smooth are rough of the polymers and their blend thin films were investigated through SEM images. Disappearance of melting temperature was observed at higher content i.e. 20wt.% of $LiClO_4$ and $NaClO_4$ salts on PMMA-PEO polymer blends. An FTIR spectrum of PMMA-PEO-$LiClO_4$ and PMMA-PEO-$NaClO_4$ thin films showed the complexation of salt and interaction of two polymers. Enhancement in conductivity is observed with temperature at higher wt.% of $LiClO_4$ and $NaClO_4$ salts to the PMMA/PEO blend.

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