Effect of Dopant on Electrical Properties of PVA doped NaF Polymer Electrolyte Films

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Abstract. Polymer electrolyte films of Poly (vinyl alcohol) (PVA) doped with Sodium fluoride (NaF) of different weight ratios (6, 8 and 10 wt %) were prepared by solution casting method. We observed that AC conductivity was found to increase with rise in temperature and frequency with slope *S* ranging from 0.7 to 0.9. The Correlated Barrier Hopping (CBH) model is used because the value of *S* is temperature dependent and its value decreases by increasing temperature. The dielectric constant has high values in the low frequency region; this is due to the existence of various types of polarization mechanisms. The X-ray diffraction (XRD) diagram of pure PVA shows a characteristic peak at $2\theta=19.49^0$ indicating its semi-crystalline nature. On the incorporation of NaF salt into the polymer, the intensity of peak decreases gradually, suggesting a decrease in the degree of crystallinity of the complex. The CBH model is used to calculate the polaron binding energy (W_M), the Hoping distance (R), the minimum hoping distance (Rmin) and the activation energy (Ea) results are discussed.

INTRODUCTION

Recent investigation reports that the field of polymer has been considered as one of the most promising and rapidly emerging research area due to its vast applications in day today life. In this concept, polymers are complexed or doped with inorganic salts or alkalies which are being probed for their benefit in high performance energy storage devices like batteries, fuel cells and super capacitors for enhancing their performance. In such devices, the electrolyte which carries electrical charges is vital component and generally liquid or solid electrolytes are used. Thermal stability, sustainability, longitivity and non-leakage are few properties due to which solid electrolytes are preferable over liquid electrolytes, which shows high conductivity for certain amount of the dopant. Polymer electrolytes are high ion conducting polymers and are solid materials which are synthesized by dissolving the salt of alkali metal of type MX (M= Na, Li, Ag, NHI, Cu, etc and X= F, I, CI, etc) in polymers like PVA, PVP, PEO, PPO, PU etc,. [1]. Polymer electrolytes are mainly prepared by solution casting method, sol gel method, electro deposition method etc., which is in the form of bulk as well as thin films. We have chosen PVA based polymer electrolytes because it is easy to prepare and it has excellent film forming property with high tensile strength, chemical stability, non or less-permeability for many solvents and moreover it is non-toxic. These features are accredited to the availability of functional groups such as –OH, C=O, COOH on the surface of the film. Literature reveals that there are many works which were carried out using PVA blended with other polymers or doped with some electrolytes of diverse nature. When Alkali halides (like NaF, LiCl, NaCl, KCl, CsCl, KBr and KI) have been doped in PVA, there has been a marked increase in the crystallinity of the polymeric layer [2]. Thus, by using the doped polymers as polymeric electrolytes, the conductivity properties of the polymer may be improved and this phenomenon is of immense use in developing electrochemical cell [3] and this aspect of research is being actively used throughout the Globe [4].

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