Contribution ID: **147** Contribution code: **S06-CMPSP-212** Type: **Poster presentation (virtual)**

Structural and Optical properties of PEO/PVP-I blended polymer electrolyte membranes

Wednesday 31 August 2022 11:02 (2 minutes)

In the process of replacement of solid electrolytes, polymer electrolyte membranes have been gaining substantial attention in view of safety, non-toxic and economically viable. It is well acquaint that, till today lithium ion batteries are exhibiting reliable characteristic output properties. However, the continuous decrease of lithium resources lead to the development of better rechargeable electrochemical energy storage systems complementing Li-ion batteries [1]. Magnesium is one of the lightest multivalent metals identified for battery applications and magnesium is the most abundant element in earth's crust, seawater, and geographically prevalent than lithium. Polyethylene oxide (PEO) is non-toxic in nature, economically viable, and find in various industrial applications. Nevertheless, pure elastomeric PEO polymer-based electrolytes demonstrate lower ionic conductivities at room temperature due to the existence of a dominant semi-crystalline portion in the matrix of PEO [2, 3]. It is worth mentioning that, metal ion conduction is predominant in the amorphous portions. Most of the scientific literature is available on PEO polymer-based blend or composite electrolytes complexed with different lithium salts for lithium-ion battery (LIB) applications only [39, 40]. However, high cost, a decrease of abundance, environmental impact, and safety limitations are impeding the widespread implementation of LIBs in large-scale batteries for future generation technologies. It shows the impetus scope to search for better alternative energy storage systems capable of complementing the LIB technology. Different polymer host materials and fabrications procedures for lithium polymer electrolytes are widely investigated. Few researchers followed similar procedures and reported insignificant results on magnesium - ion-conducting polymer electrolytes [4]. The distinct differences between the magnesium and lithium systems, such as stronger interaction of the magnesium cation (Mg2+) with counter ions or polymer hosts, higher under/overpotentials for Mg electrodeposition/dissolution, and nature of the anode-electrolyte interface, mean that new materials and evaluation techniques are required for impactful advances in magnesium polymer electrolytes. Free-standing and flexible blended electrolyte membranes of nanocomposite 'Poly (ethylene oxide) (PEO)/Polyvinylpyrrolidone, iodine complex (PVP-I) 'complexed with magneisum sulphate (MgSO4) at various concentrations (10, 20, 25 and 30 wt.%) were prepared using conventional solution casting technique. The microstructural and optical properties of the pure and MgSO4 salt complexed PEO/PVP-I membranes were characterized by means of Fourier transform infrared spectroscopy, Raman spectroscopy, differential scanning calorimetry and optical properties. The significant changes in nature of characteristic vibrational modes of PEO revealed the decrease of crystalline portion in the matrix of PEO/PVP-I blend electrolyte.

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Session Classification: Poster session (virtual)

Track Classification: Scientific Sections: S06 Condensed Matter Physics and Statistical Physics