

Electrical Properties Studies of Solid Polymer Electrolytes Membrane Based on Carboxymethyl Cellulose (CMC)/ Kappa Carrageenan blend

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Abstract. Polymer electrolyte membrane (PEMs) based on carboxymethyl cellulose (CMC) and kappa carrageenan (KC) was successfully prepared by using solution casting technique. The electrical conductivity and thermal conductivity of PEMs system have been measured by the Electrical impedance spectroscopy method in the temperature range of 303K. The PEMs system containing 80: 20 ratio of KC exhibits the highest conductivity of 3.19×10^{-7} S/cm at room temperature. It can be concluded that with CMC/KC blend is accountable for the conductance and assist in the ionic conductivity of the PEMs system. The dielectric behavior study reveals the non-Debye properties of the PEMs system.

INTRODUCTION

Over the past 40 years, the polymer electrolyte membrane (PEMs) has been studied because they can overcome some safety problems in the lithium ion batteries (LIBs) which caused by the liquid electrolyte such as leakage of organic solvents, flammability and poor mechanical properties [1, 2]. Other researchers intensely interesting to physicists, chemists and engineers because of their importance and their possibility of commercial use in technological applications in the development of solid state electrochemical devices. Most PEMs consist of a host polymer to provide high dielectric strength and good mechanical stability and an inorganic salt that supplies ionic carriers to cause electrical conductivity [3, 4].

On the other hand, method of polymers blending is a useful tool to develop new polymeric materials approach to fabricate the CMC/KC based electrolytes with desirable characteristics, in which revealed that have been utilized to enhance the conductivity of the polymer electrolytes as the host material for ionic conduction [5, 6]. Polymer blend based on CMC/KC is easy to prepare since they are both water soluble, and they are miscible with each other. Among all, carboxymethyl cellulose (CMC) is one of the promising conjugated polymer and negatively charged polyelectrolyte. CMC is very stiff and suitable to blend with kappa carrageenan (KC) [7]. Recent investigations have showed the promising properties of KC based hydrogels also in the electrochemical field [8, 9]. The interactions between polysaccharides of CMC may result in the formation of a blend gel with stronger gel strength with KC.

In this present research, polymer electrolyte membrane (PEMs) was modified and processed were prepared by incorporating CMC and KC as a host polymer by using blending techniques. In this paper we report detailed studies on the synthesis and characterization of a new PEMs consisting of CMC/KC blend film, using Electrical impedance spectroscopy (EIS) for electrical characterization. As a result, the polymer electrolyte should act as good electrical insulator but at the same time it should has high ionic conductivity.

METHODS

In this present work, carboxymethyl cellulose (CMC) and kappa carrageenan (KC) polymer electrolyte (PEMs) have been prepared using solution casting method. Different amount of CMC (Acros Organic Co.) and KC (Shanxi-orient Co.) were dissolved in distilled water until a homogeneous solution was formed. The mixture solution was then casted into several petri dishes and left dry in the oven at 55 °C about 5 hours for the