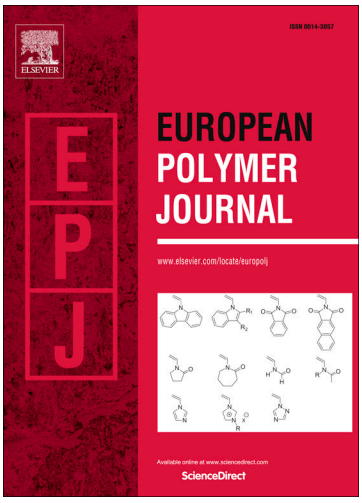

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Solid polymer electrolytes based on phosphorus containing polymers for lithium polymer batteries

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Abstract

This paper is designated to the development of flame retardant solid polymer electrolytes based on phosphorus containing polymers. The new green technique synthesis, respectively polycondensation under microwave irradiation of hexylphosphonic dichloride (HPD) with 4,4'-(1,3-phenylenediisopropylidene) bisphenol (bisphenol M) was described. 86 % yield and 0.95 $dl.g^{-1}$ inherent viscosity were obtained. The polyphosphonate was characterized by FT-IR, ^{1}H and ^{31}P-NMR spectroscopy, gel permeation chromatography, and thermal analysis. The polymer presents thermal stability, begins to lose weight above 280°C. The influence of the reaction temperature and reaction time on yield and inherent viscosity for MW polycondensation was studied and the results were compared with the results of polycondensation reaction under conventional heating in similar conditions. Best results were obtained under microwave irradiation. Solid polymer electrolytes were obtained from the polyphosphonate complexed with different lithium salts using casting technique and the electrochemical properties were determined. The low activation energy of conduction determined for solid polymer electrolyte membrane with bis(oxalato)borate anions overcomes the activation energy request for relaxation process and this membrane presents the best conductivity. Also, the flammability of polyphosphonate and membranes was investigated by measuring limiting oxygen index values.

Keywords: polymer synthesis, molecular engineering, microwave irradiation, polyphosphonate, solid polymer electrolytes.

Introduction

Phosphorus is reactive and it is known for the possibility to form bonds with many other elements. The chemistry of this element is based on the formation of bonds with a number of one or more than 6 atoms. Organophosphorus compounds are often considered very toxic, but they are well known as flame retardants, additives for petroleum products, lubricants, plasticizers, drugs, selective retainers for metal salts, corrosion inhibitors, insecticides, plant grow regulators and polymers [1,2]. Organophosphorus compounds are recognized for their applications in different synthesis as: Wittig, Mitsunobu, Staudinger, etc. Also, phosphorus compounds are used as reagents to obtain valuable complexes or as chiral or achiral ligands for transition metal-catalysis [1-8]. Phosphorus is capable to tolerate the insertion of electrons from any other donor atom because presents empty *d*-orbitals. Therefore, phosphorous is used often in reactions as a transient intermediate [3-8] or for receptor properties [5-12]. Polyphosphoesters have been studied during the last years. They contain groups of biodegradable and biocompatible phosphorus-containing polymers, such as polyphosphates, polyphosphonates, polyphosphites and polyphosphoramides. Polyphosphonates are characterized by the presence in the chain of the C-P bond. These polymers have biomedical applications: biosensors, tissue manufacturing, and drug delivery systems [1,2, 13-16]. Polyphosphoesters have aroused wide