Study OF Electrical Properties Of (PEO-PEG)) and (PEO-PMMA) Blends.

دراسة الخصائص الكهربائية لمزيج من بوليمري بولي اثيلين اوكساييد مع بولي اثيلين كلايكول (PEO-PEG) وبولي اثييلين اوكساييد مع بولي ميتاكريليت المثيل (PEO-PMMA)

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Abstract

The study it includes the recording of the spectrum of electrical properties.The electrical properties include the measuring of the electrical conductivity,then calculate the molar conductivity and the degree of dissociation. for the blend solutions at the room temperature .

These samples have been prepared in different weight concentrations (0.1,0.2,0.3,0.4,0.5,0.6,0.7,0.8 g/mL) % as solutions then the additives (PEG , PMMA) added as (0.25 g) and (0.5 g) respectively , also the samples prepared by liquids mixing method before and after adding (PEG ,PMMA) polymer.

The electrical properties include the measuring of the electrical conductivity and then calculate the molar conductivity and the degree of dissociation. have been measured,. All those properties have been measured for two cases before and after addition at room temperature . The conductivity of pure polymer and its additives used in this work are increasing with the increase of the polymer concentration. After adding of the polymers to polyethylene oxide, the conductivity increases with the increasing of concentration for all additives , Noting the molar conductivity values decrease with increasing the molar concentration, note these values of the molar conductivity decrease after the addition of polymers, that dissociation values of the polymer decrease with increasing of concentrations

Keywords: (PEO),(PEO- PMMA) , (PEO – PMMA) , electrical properties

الخلاصة

أن هذه الدراسة تتضمن تسجيل ظاهرة الخواص الكهربائية. وتشمل الخواص الكهربائية قياس التوصيلة الكهربائية ، ثم حساب التوصيلة المولارية ودرجة التفكك لمزيج من محلول في درجة حرارة الغرفة . أعدت هذه العينات بتراكيز ذات أوزان مختلفة (0,1- 0,2 - 0,3 - 0,4 - 0,5- 0,6 - 0,7 - 0,8غم / مل) ٪ كمحلول ثم إضافة بوليمري (PEG، PMMA) وألاضافة هي (0.25 غرام) و (0.5 غرام) على التوالي، أيضا العينات أعدت بطريقة مزج السوائل قبل وبعد إضافة بوليمري (PEG، PMMA). وتشمل الخواص الكهربائية قياس التوصيلية الكهربائية ومن ثم حساب التوصيلية المولارية ودرجة التفكك. وقد تم قياس كل هذه الخصائص لحالتين قبل وبعد الإضافة في درجة حرارة الغرفة. إن التوصيلية للبوليمر النقي والمواد المضافة لها المستخدمة في هذا العمل تزداد مع زيادة تركيز البوليمر بعد إضافة البوليمرات لاوكسيد البولي ايثيلين، إن التوصيلية تزداد مع زيادة التركيز لجميع المواد المضافة ، و نلاحظ إن قيم التوصيلة المولارية تنخفض مع زيادة التركيز المولاري بعد إضافة البوليمرات ، وأن قيم التفكك من البوليمر تنخفض مع زيادة التراكيز.

1.Introduction

The development of polymer electrolytes has drawn the attention of many researchers in the last three decades as they find applications not only in secondary batteries but also, in other electrochemical devices such as super capacitors, sensors and electro chromic devices, etc. Solid polymer electrolyte may generally be defined as a membrane that possesses transport properties comparable with that of common liquid ionic solutions. [1] Polymer electrolytes are ionically conducting polymers formed by dispersing a salt at the molecular level in a high molecular weight

polymer such as PEO.The high interest in these materials is due to technological applications as solid electrolytes in electrochemical devices such as batteries, display devices and sensors. They are also potential candidates as hosts for drugs to be delivered iontophoretically. The interesting properties of PEO are its relatively high melting point, [2] In recent years, polymer based solid electrolytes are of major technologies important due to their application in various electrochemical devices such as high energy density batteries, fuel cells, sensors, super capacitors, smart windows and display devices. The studies on these existing polymer electrolytes are based mostly on PEO and its copolymers because of their strong solvating ability with a variety of monovalent, divalent and transition metal salts **[3]**

2 Experimental

2-1 Materials and Method

The materials used in the study divided into basic (PEO) and its additives (PEO-PEG) and the (PEO- PMMA) blends were prepared by liquids mixing method ,the appropriate concentrations of blends were (0.1 ,0.2 ,0.3 ,0.4 ,0.5 ,0.6 ,0.7 ,0.8 g/mL) % are dissolved in (250 mL) of Dimethylformamide (DMF) under stirring with heat 30C ° for 120 min. then the electrical properties that include electrical conductivity , molar conductivity and the degree of disintegration are Calculated .Where the conductivity of a solution is highly dependent on its concentration of dissolved and sometimes other chemical species which tend to ionize in the solution.

2-2 Electrometer

Conductivity meter is a device manufactured by (DDS-307W) company, British, , and that found in College of Science-Babylon University . The device has been calibrated to take measurements with distilled water and compared with tables and the percentage error in the device was (± 0.001). Figure (1) shows that a picture of a device that is used to measure electrical conductivity.

Fig. (1): Electrical conductivity meter.

2-3 Theoretical calculations

2-3-1 A.C. Electrical Conductivity

The electrical conductivity (σ) of an electrolyte is inversely proportional to the measured resistance ($\rho_{el.}$) of the cell constant (K_{cell}) [4]:

$$\sigma = K_{cell} / \rho_{el.} \quad \text{……..(1)}$$

2-3-2 Molar Conductivity

The molar concentration of the same solution and given by the following equation [5]:

$$\Lambda = \frac{\sigma}{C_m} \qquad \text{……..…. (2)}$$

Where (C_m) is the molarity, in mole per volume. (Λ) is the Molar Conductivity and (σ) is the value of its electrical conductivity

2-3-3 Degree of Dissociation (DD.)

The degree of dissociation is given by the following equation [6]:

$$\text{DD} = \Lambda / \Lambda_o \qquad \text{…….…… (3)}$$

Where (Λ_o) is the extrapolation of molar conductivity to the infinity dilution and is obtained from the drawing relationship between the square root of the molar concentration and conductivity and the point of intersection of the curve with the (y) axis represent it. The value of (λ) is less than (Λ_o) according to Estewaled law, where the (DD) equal (one) for strong electrolyte and (zero) for weak [6].

3. Results and Discussion :

3.1 A.C. Electrical Conductivity

The measured conductivity of (PEO) before and after adding (PEG , PMMA) polymers for different concentrations was plotted in figure (2) and figure (3) . This figure shows that the conductivity of pure polymer and its additives used in this work are increasing with the increase of the polymer concentration. Because increasing the number of ions and free electrons on a regular basis and that lead to an increase in the electric polarization of the solution and so increase the electrical conductivity and aqueous solutions tend to be conductive electrolytes to increase ionization at all concentrations . After adding of the polymers (PEG , PMMA) to polymer PEO, the conductivity increases with the increasing of concentration for all additives. The explanation for this is the additives polymers create new paths within the solution allows for the charge carriers passing then increasing conductivity . this is agreement with [7, 8 , 9, 10, 11,12,13 ,14] .

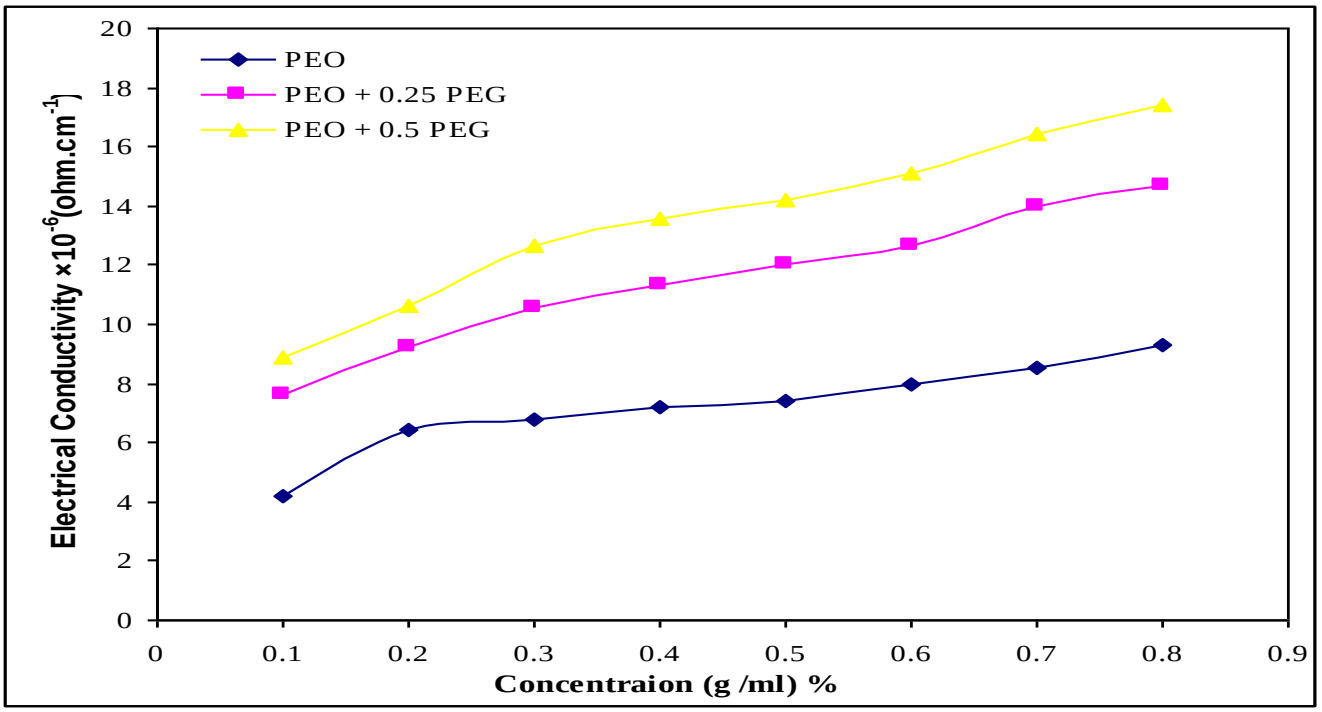

Fig. (2): electrical conductivity vs concentrations of PEO before and after adding (PEG)

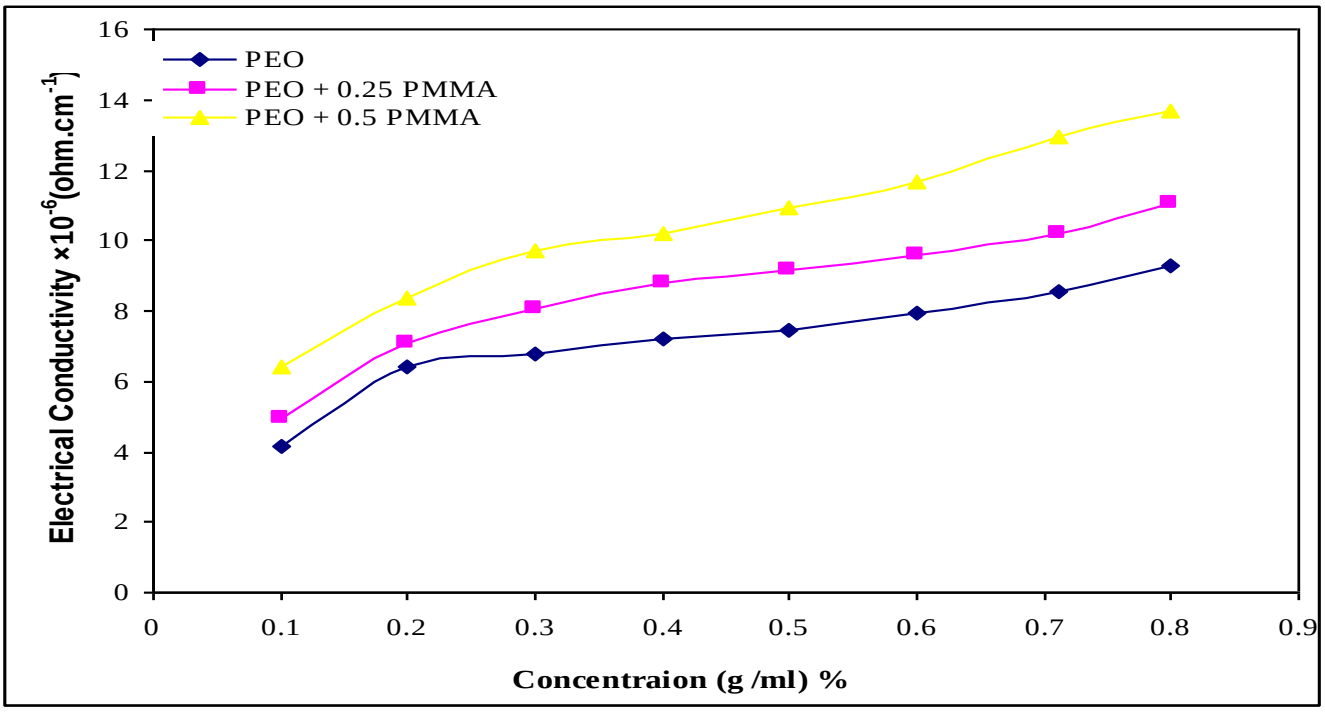

Fig. (3): electrical conductivity vs concentrations of PEO before and after adding (PMMA)

3-2 Molar Conductivity

The values of molar conductivity were calculated theoretically by using equation (2) and the results are shown in figure (4) and figure (5). Noting from figure the molar conductivity values decrease with increasing the square root of molar concentration, and the reason for this is due to the solutions that does not happen any interaction among molecules and the electrostatic repulsion between particles that generated leads to a decrease in bonding molecular between polymer molecules and the solvent, which lead to increase the dimensions of the polymer and consequently to slow down the movement of ions . The conductance molar values increased after the addition and the reason for this is due to the increased powers Vanderfz to attract and arise from the attraction of particles with each other due to the formation electrodes temporarily on the particles due to the addition polymers (PEG , PMMA) and the polymer molecules being large it has the ability to polarization inductively which in turn leads to increased connectivity molar and this result obtained by researchers agree [7, 8] .

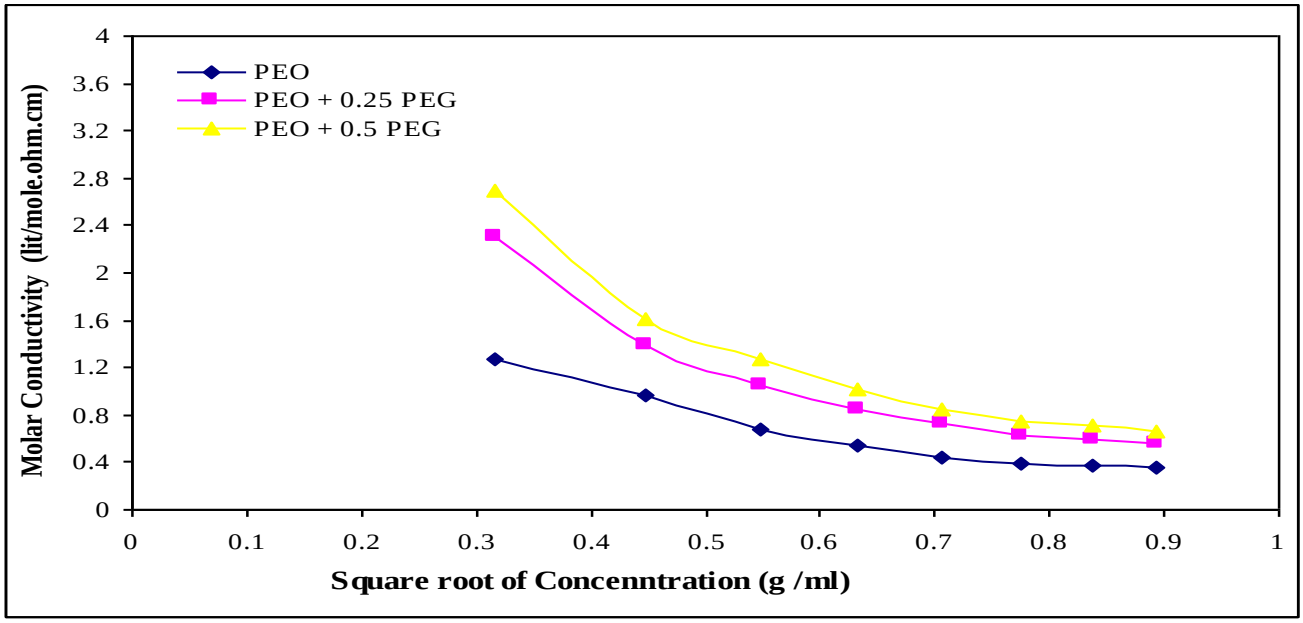

Fig. (4): molar conductivity vs concentrations of PEO before and after adding (PEG)

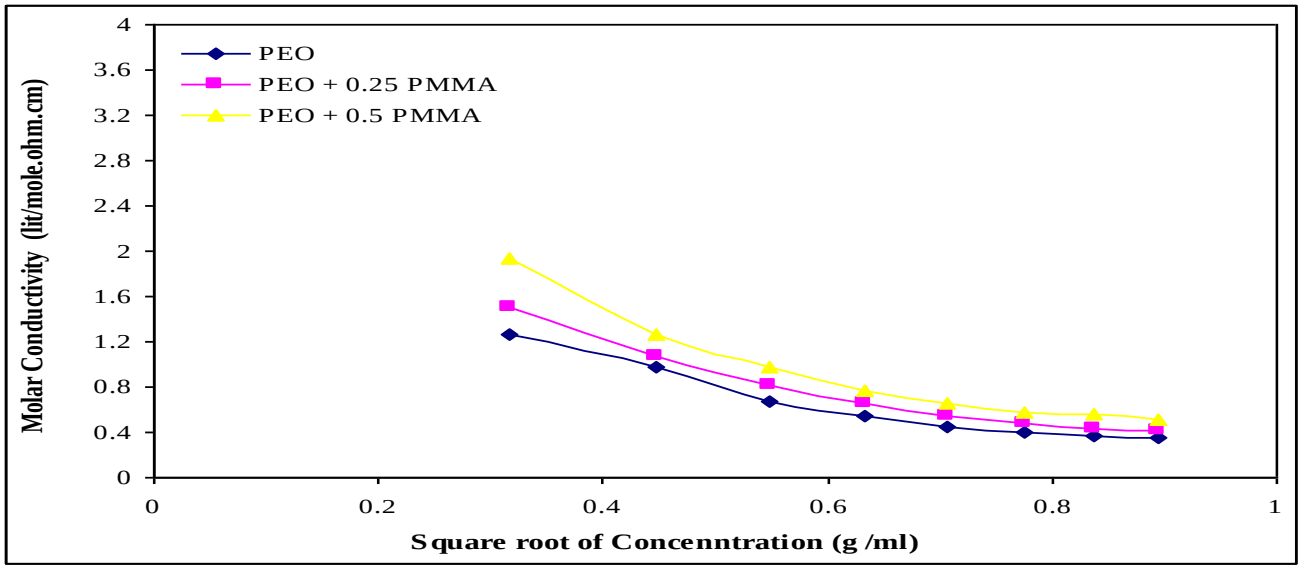

Fig. (5): molar conductivity vs concentrations of PEO before and after adding (PMMA)

3-3 Degree of Dissociation

The values of the degree of dissociation of the (PEO) polymer solutions before and after the addition of (PEG , PMMA) polymers are shown in figure (6) and figure (7), that dissociation values of the polymer decrease with increasing of concentrations and the reason for that is due to the law of Ostwald (stating that the degree of dissociation of the electrolyte increases with the degree of dilution of the solutions) , figure (6) and figure (7)shows that the molar conductivity values for both cases before and after the addition of polymers. This result is agree in behavior with those obtained by researcher [7 , 8].

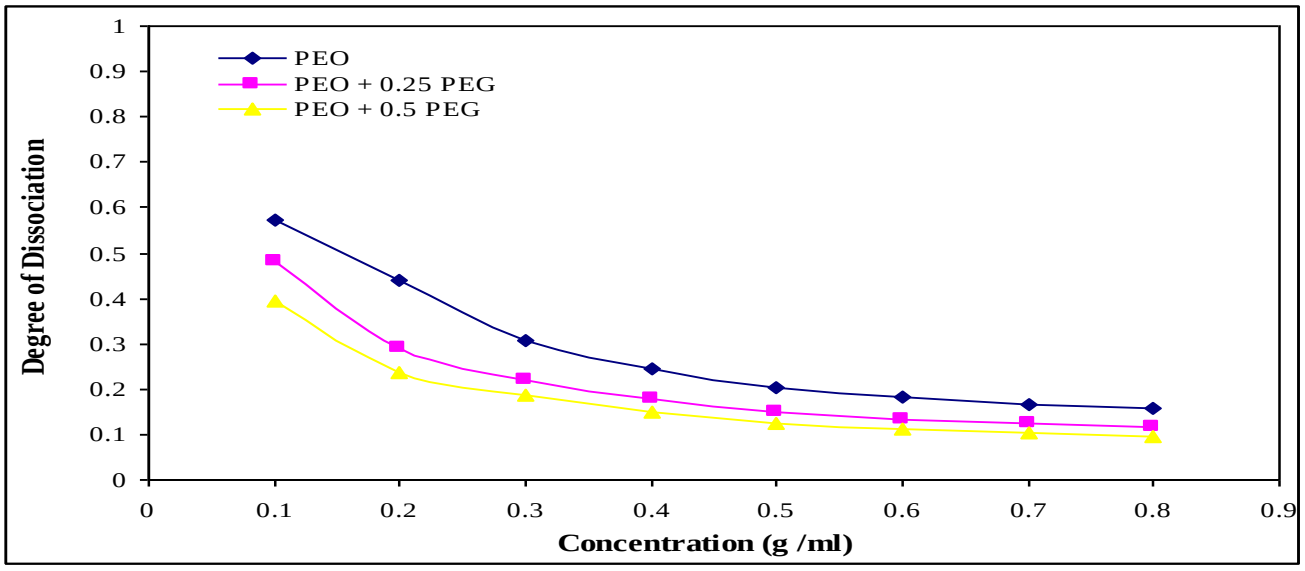

Fig. (6): degree of dissociation vs concentrations of PEO before and after adding (PEG)

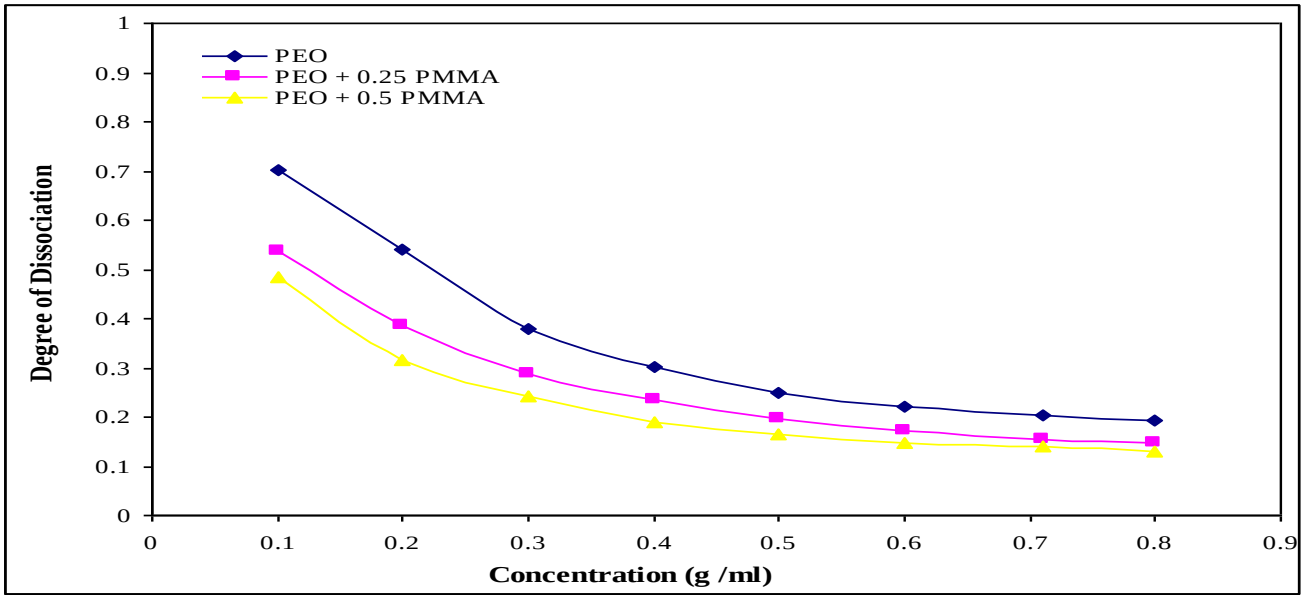

Fig. (7): degree of dissociation vs concentrations of PEO before and after adding (PMMA)

4. Conclusion

The summarized results from this work are the following:

1. It is found through the study that these polymers appear a continuous change in their physical properties (electrical) as a result of adding (PEG) to (PEO) as the (PEO- PMMA) led to the improvement of these properties.
2. The addition of (PEG , PMMA) to (PEO) led to the improvement electrical properties as The conductivity of pure polymer and its additives used in this work are increasing with the increase of the polymer concentration. After adding of the polymers to PEO, the conductivity increases with the increasing of concentration for all additives , Noting the molar conductivity values decrease with increasing the square root of molar concentration, we note these values of the molar conductivity decrease after the addition of polymers, that dissociation values of the polymer decrease with increasing of concentrations

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