Synthesis of poly(copper phthalocyanine-co-ethylene oxide) for obtain an organometallic semiconductor nanomaterial

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1. Summary

In this work a synthesis metodology for poly (CuPC-co-EO) copolymers, and its characterization are given. Obtained materials were characterized by Fourier transformed infrared spectroscopy (FTIR), solubility tests and termogravimetric analysis (TGA). Synthesis conditions, purification method and characterization conditions for copolymers are given.

2. Introduction

The phthalocyanines are promising candidates for several practical applications because of their semiconductivity, photoconductivity [1], and chemical activity [2]. The diverse functionality and thermal stability of the phthalocyanine (Pc) macrocycle originates from its 18-π electron aromatic system. Copper phthalocyanine polymers and its metallic analogous have a good thermal stability and a great range of interesting properties [3]. A particular position between phthalocyanine derivatives are phthalocyanine polymers and its metallic complexes [4].

3. Experimental

3.1 Preparation.

Reagents like copper-phthalocyanine oligomers, poly(ethylene oxide) and sulphuric acid were used in this reaction. Reaction time was 6 hours at ebullition temperature. Purification was by filtration with methanol [5].

3.2 Instrumental analysis.

The analyses were carried out of the following way. In Fourier transformed infrared spectroscopy (FTIR) analysis, KBr pellet technique was used. Raman spectroscopy analysis was carried out in a Yvon Horiba, model LABRAM HR800 device. In thermogravimetric analysis (TGA) studies a differential scanning calorimetry device was used and its experimental conditions were 20ºC/min, temperature range of 30-800 ºC and a nitrogen atmosphere with a flux of 100 mL/min.

4. Results and discussions.

4.1 FTIR spectroscopy

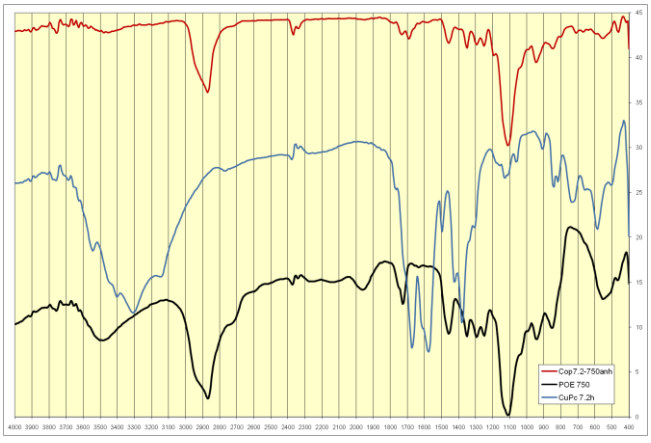

Figure 1. FTIR spectra in range of 400-2000 cm^{-1} of CuPc olygomer (7.2 h), Poly(ethylene oxide) [750] and poly(CuPc-co-ethylene oxide).

FTIR results obtained show, in figure 1, that for CuPc olygomer, major signals correspond to those ones reported in literature early. Signals can be observed that correspond to out of plane CH deformation in benzene ring (640 cm^{-1}), CH of benzene ring (755 cm^{-1}), conjugated system (1056 cm^{-1}), C-N stretch (1303 cm^{-1}), C=N stretch (1689 cm^{-1}), C=O stretch (1774 cm^{-1}), CH stretch in aromatic ring (3062 cm^{-1}), and OH stretch (3193 cm^{-1}), which are characteristic vibrations for CuPc olygomers in accordance with literature [1].

For another hand, poly(ethylene oxide) shows next major signals: O-H (3500 cm^{-1}), C-H stretch (2860 cm^{-1}), C-O (1100 cm^{-1}). When CuPc olygomer and poly(ethylene oxide) forming a copolymer, FTIR signals show that OH stretch have disappeared and C-H stretch are present in this new compound.

4.2 Termogravimetric analysis (TGA).

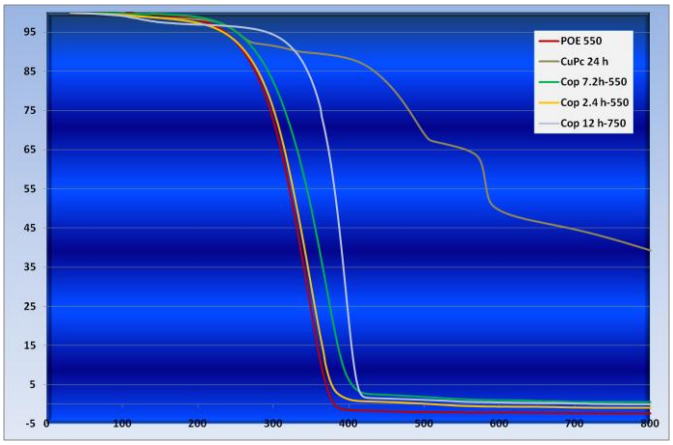

Figure 2. Thermogravimetric analysis for POE 550, CuPc 2.4h, and 7.2h-550, 2.4h-550, 12h-750 copolymers.

In figure 2, CuPc olygomer, poly(ethylene oxide) [550] and three different copolymers are shown. We can see an increase in decomposition temperature for copolymers, this behavior is in function of CuPc olygomer that has been attached to poly(ethyelene oxide).

4.3 Solubility test

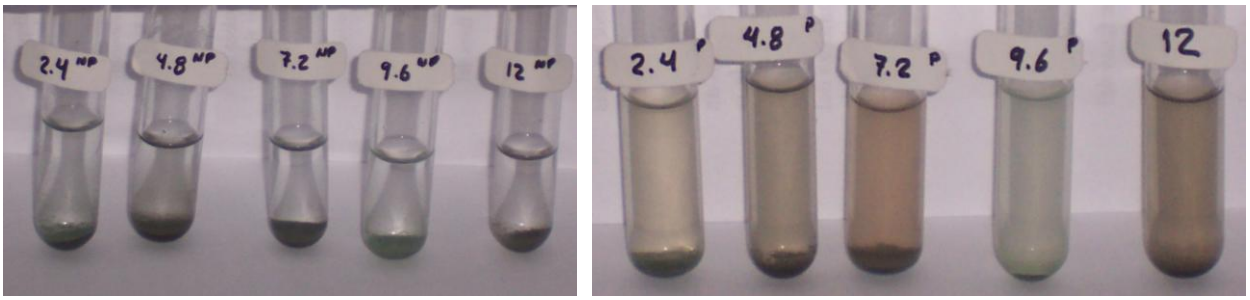

Figure 3. Solubility test for CuPc olygomers in hexane (left) and methanol (right).

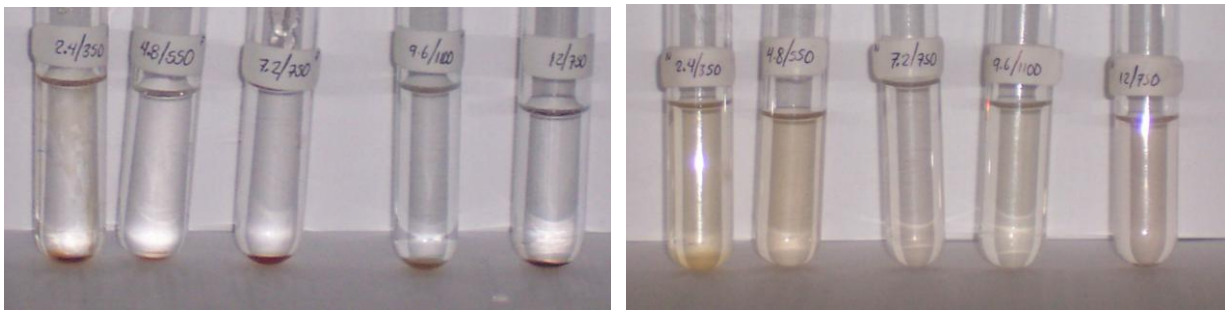

Figure 4. Solubility test for different poly (CuPc-co-ethylene oxide) copolymers in hexane (left) and methanol (right).

We can see, in figure 3, that CuPc olygomers aren´t soluble in hexane (left) and methanol (right). For another hand, in figure 4, poly(CuPc-co-ethylene oxide) copolymers aren´t soluble in hexane (left) but they are soluble in methanol (right).

5. Conclusions

We conclude that reaction between CuPc olygomers and poly(ethylene oxide) occurs due to FTIR signals shows that OH stretching is absent and CH stretching is present in copolymers. For another hand in TGA analysis we can see an increase in decomposition temperature for copolymers in function of poly(ethylene oxide) molecular weight and CuPc olygomers´ reaction

time. Finally in solubility test, we can appreciate that copolymers are soluble in methanol only. Therefore, evidence confirms that from CuPc olygomer and poly(ethylene oxide) a poly(CuPc-co-ethylene oxide) was obtained, last one is a potential semiconductor nanomaterial.

6. References

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