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EFFECT CONCENTRATIONS OF POLYETHYLENE GLYCOL IN STABILITY STRUCTURE OF BLENDING POLYMER CHOLESTERYL ACRYLATE-ITO

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ABSTRACT

Polymer ChoAcry/ITO has added glycol is one of the material polymer liquid crystal modifications. In general, polymer liquid crystal cholesteryl, acrylate, was made for many application usages in optoelectronics materials. This research wants to study effect Polyethylene Glycol (PEG) in polymer choAcry/ITO for the stability structure of blending choAcry/ITO. PEG 0.006 was added to mixed cholesteryl acrylate with ITO. Polymerizations that are doing using UV curing photopolymerizations. Characterizations group functions using Fourier Transformed Infra-Red (FTIR) and Nuclear Magnetic Resonance (NMR). Effect concentrations of PEG in PolyChoAcry-ITO are shown from the FTIR spectrum, shown not differently. A peak in the spectrum showed C=C and C-H aliphatic, C=C aromatic, C-O ester, and para-benzene. Based on data FTIR that PE-b-PEG does not change structures. Therefore, the diffractogram of XRD showed added ITO, and PEG can affect the physical and chemical properties of polymer cholesteryl acrylate. This data showed PEG changed structures of the polymer. Polyethylene glycol is spreading into polymer cholesteryl acrylate. In the literature told that PEG could be a conjunction between that monomer or polymer cholesteryl acrylate-ITO.

***Keywords**: poly-cholesteryl acrylate, ITO, polyethylene glycol*

INTRODUCTION

Polymer cholesteryl acrylate is one of the liquid crystal polymers which have many advantages in the optical material properties improvement for display application. It can be realized by blending the polymer cholesteryl acrylate with other materials properties such as thermal stability and processability [1]. Compared to the different materials, blending polymer cholesteryl acrylate with Indium Tin Oxide (choAcry/ITO) has been demonstrated quite frequently. The UV curing technique explained the blending polymer cholesteryl acrylate with Indium Tin Oxide (choAcry/ITO) offers in previous research [2]. Many advantages fo UV curing compare other methods are the curing process a little using solvent organic, no waste production, cheaper, and product polymer cleaner [3].

Some reports believed that the addition of polyethylene glycol (PEG) into polymer cholesteryl acrylate/ITO (choAcry/ITO) improve some properties [4]. Meanwhile, others reported that PEG could improve the polymer conductivity[5], has high sorption capacity to

the system polymer [6], improving crystallinity properties polymer[7], and as a hydrophilic component [8]. Instead of that, PEG 400 is less toxic and soluble in some solutions are water, acetone, alcohols, and benzene[9].

In this paper, we report the effect of Polyethylene Glycol (PEG) in polymer choAcry/ITO for the stability structure of blending choAcry/ITO nanoparticles. By using ITO nanoparticles, we predict that it can disperse inside chains of polymer cholesteryl acrylate [10]. Polymer cholesteryl acrylate immersible with ITO separated from one another by interface region. Hence, we expect that this composite has properties that filler are nanoparticles, and types of the matrix are organics polymer.

METHODS

1. Materials

Materials this research is cholesteryl acrylate, for that synthesis using some chemicals: Cholesterol, *(S* -(+)-2-methyl-butanoic, hydroquinone, N, N' dicyclohexyl carbo diimidy (DCC), N, N- dimethyl pyridine-4-amine (DMAP), dichloromethane, PTSA (p-toluene-sulfonate), KOH, concentrated HCl, ethanol, methanol, benzene, KI, K_2CO_3, DMF, Acrylic Acid and petroleum ether which is obtained from Merck.

2. Synthesis Composite

For synthesis composite, the chemicals were cholesteryl acrylate, Indium Tin Oxide (ITO), and Polyethylene-block-Polyethylene Glycol (PE-b-PEG). Process of polymeri-zations using UV curing technique [11]. Cholesteryl acrylate/ITO was added 0.006 PEG. Polymerizations that doing for other concentrations of PEG are 0.008 and 0.010.

3. Characterization

Characterizations group functions using Fourier Transformed Infra-Red (FTIR) and Nuclear Magnetic Resonance (NMR). Characterization product thermal analysis of PolyChoAcry-ITO/PEG by Differential Scanning Calorimetry (DSC) and Electrothermal Analysys, crystallinity by X-Ray Diffraction (XRD), and morphology by Scanning Electron Microscopy (SEM). Measuring of conductivity of Poly-ChoAcry-ITO/PEG using LCR Meter type Hioki 3532-50 [12].

RESULTS AND DISCUSSION

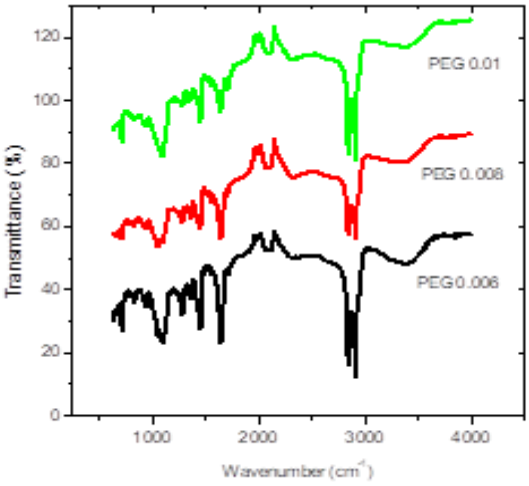

Figure 1. FTIR FTIR spectrums of polymer choAcry-ITO/PEG

Figure 1 showed PolyChoAcry-ITO/PEG formed thin layer. Based on that picture, that polymer very thin and difficult to remove from preparat glass. Analysis structures of polymer choAcry-ITO/PEG by FTIR and NMR. The result of identifications group functions of polymer choAcry-ITO/PEG by FTIR in Figure 1. in general, FTIR spectrums of

polymer choAcry-ITO/PEG for each composition are 0.006 PEG, 0.008 PEG, and 0.010 PEG not different. Some of the wavenumbers in Based on FTIR spectrum Figure 1 showed peak sharpest in 2800-2900 cm^{-1} that showed a strain of bonding C-H aliphatic in molecule structures of polymer choAcry-ITO/PEG. Photopolymerizations of monomer cholesteryl acrylate caused by peaks in FTIR for identifications group of vibrations of C=O ester not showed in 1735-1750 cm^{-1}.

Therefore for a peak at 2100 cm^{-1} not shown because of a break of bonding C=C in the polymerization process. Effect concentrations of PEG in PolyChoAcry-ITO shown from the FTIR spectrum, shown not different. The peak in the spectrum showed C=C and C-H aliphatic, C=C aromatic, C-O ester, and para-benzene. It can be a conclusion based on data FTIR that PE-b-PEG does not change structures, but only as a surfactant for arranging the structure of crystalline of PolyChoAcry-ITO-PEG [13].

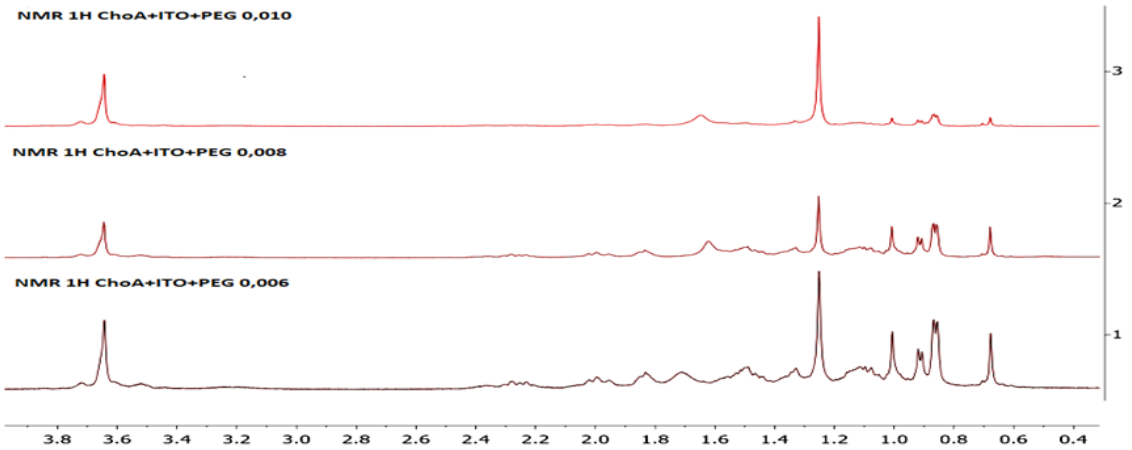

Figure 2. NMR-^{1}H spectrum of poly choAcry-ITO/PEG in variations PEG concentrations

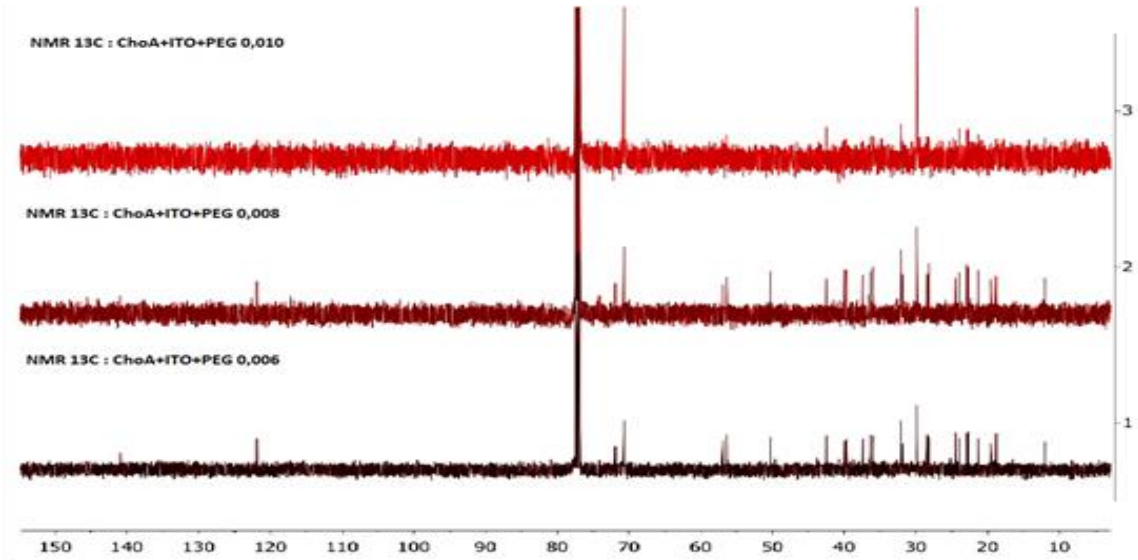

Figure 3. NMR-^{13}C spectrum of poly choAcry-ITO/PEG in variations PEG concentrations

Analysis structure of PolyChoAcry-ITO-PEG was completed by characterizations of ^{1}H-NMR and C^{13}-NMR. Based on spectrum ^{1}H-NMR and C^{13}-NMR showed peaks not different between variations concentrations of PEG : 0.006; 0.008; and 0.010. Therefore that conclusion wich three composites which 3 differents amount of PEG, showed sampel with different composite found same. There are a few peaks shifting in spectrum of ^{1}H-NMR and C^{13}-NMR [14].

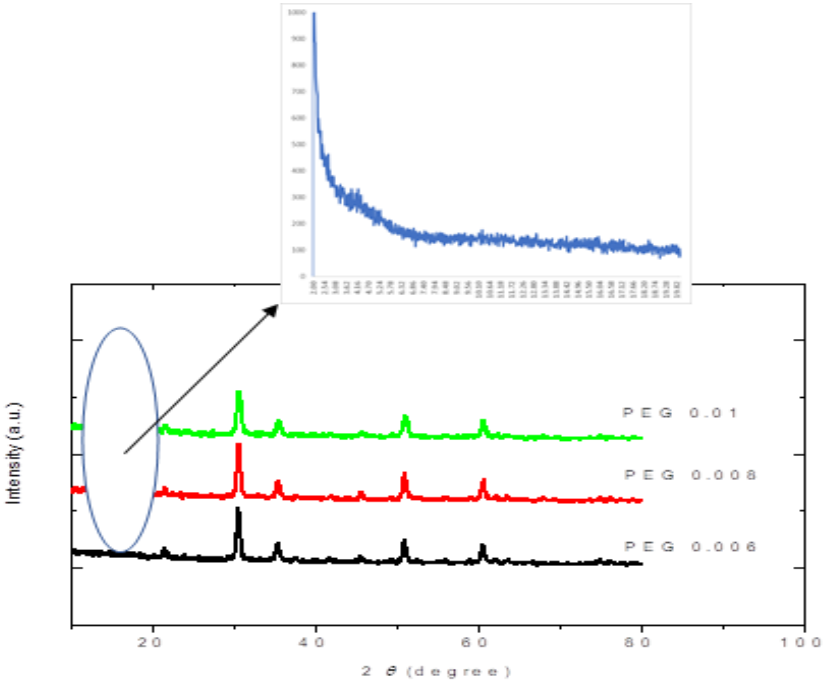

Figure 4. XRD Pattern of poly choAcry-ITO/PEG in variations PEG concentrations

Analysis crystallinity of poly choAcry-ITO/PEG using X-Ray Diffractions (XRD) showed in figure 4. According to the pattern of XRD of poly choAcry-ITO/PEG, some peaks showed in 2θ are. In general some peaks strong at 2θ are 21,2250^{o}, 30,2529^{o}, 35,2715^{o}, 50,7815^{o}, 60,4231^{o}. that peaks showed for ITO nanoparticle and PEG. Therefore from data peaks ITO and PEG strongest in compositions PEG 0.008, this phenomenon showed these conditions adsorptions of ITO and PEG maximal that conditions [15].

Actually many little peaks showed in ranges 2θ between 0 until 20,000. That peaks showed 4.1571; 5.3043; 6.7333; 8.2050; 10.0867; 15.9345; 16.8250; 17.6350; 18.5200; and 19.6153. that's peaks showed for polymer cholesteryl acrylate [16].

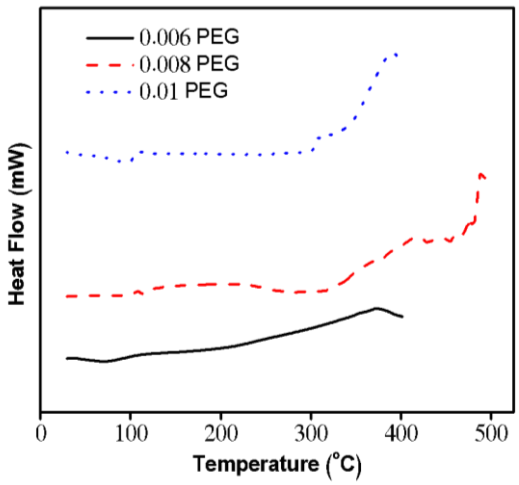

Figure 5. Termogram thermal analysis

Based on the peak of XRD above, showed added ITO and PEG could be affect the phisycal and chemistry properties of polymer cholesteryl acrylate. This data showed PEG changed structures of the polymer. Polyethylene glycol is spreading into polymer cholesteryl acrylate. In the literature told that PEG could be a conjunction between that monomer or polymer cholesteryl acrylate-ITO.

From data XRD we can share information about the crystallinity of poly-choAcry-ITO/PEG. In general, polymer form semicrystalline phase. Added ITO can be an increase in crystallinity. Some molecules of PEG likely affected crystallinity of poly-choAcry -ITO/PEG [17]. Thermal analysis of polymer choAcry-ITO/PEG can be seen in Figure 5.

The resulted from that peaks showed glass transitions (Tg) of poly choAcry-ITO/PEG, that showed begin phase change in temperature 109.06^{o}C until 113.52^{o}C and finally processed in 119.41^{o}C. That process of phase change in exotherm reactions in enthalpy value is -7.13 J/g. the second phase change begins in glass transitions at 248.28^{o}C until 282.22^{o}C and ending in 321.12^{o}C. That process of phase change in exotherm reactions in enthalpy value is -84.69 J/g.

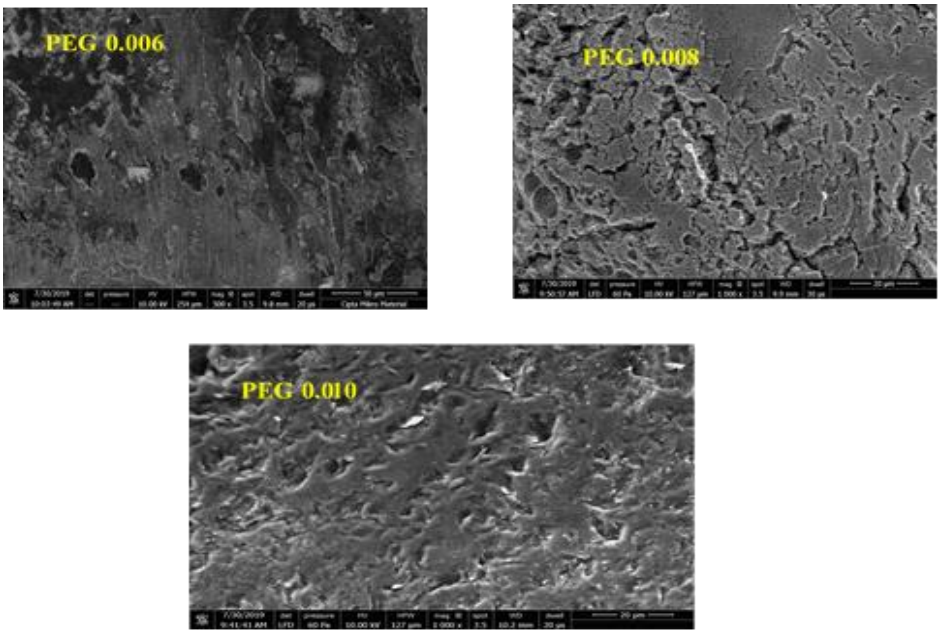

Figure 6. SEM image of poly choAcry-ITO/PEG

Figure 6 showed images of surface polymer choAcry-ITO/PEG in general, not differences between PEG 0.006; 0.008; and 0.010. images showed there are chains and pores. The surface of polymer choAcry-ITO/PEG was made PEG 0.006, and PEG 0.008 showed uneven, therefore concentrations of PEG effect for surface morphology. Special for polymer was made by PEG 0.010 more homogenous than the others on the surface. Compositions of polyethylene glycol (PEG) affects thin films of polymer choAcry-ITO/PEG [18].

Result images SEM can be showed crystallinity of polymer choAcry-ITO/PEG. In general, polymer crystalline showed chain

regular. Therefore polymer amorph showed irregular chains. It is maybe much more PEG in system polymer choAcry-ITO/PEG. Polyethylene glycol effects polymer-polymer choAcry-ITO/PEG showed from images of SEM. Added PEG in a system that polymer making regularly bonding between chains in a system that polymer [19]. This fact can be seen in images; therefore, PEG 0.010 more regularly than PEG 0.008and PEG 0.006, maybe PEG can bee arranged chains in system polymer. This phenomenon can affect the relationship with conductivity value [20].

According to results measuring conductivity, conductivity value each for PEG 0.006; PEG 0.008; and PEG 0.010 were 41.30 x 10-6 S; 40.24 x 10-6 S; and 40.58 x 10-6 S in Figure 7. more regular chains so more crystallinity properties that polymer. Therefore when PEG 0.006 images SEM showed not regular. PEG 0.008 until PEG 0.010 more crystallinity [21].

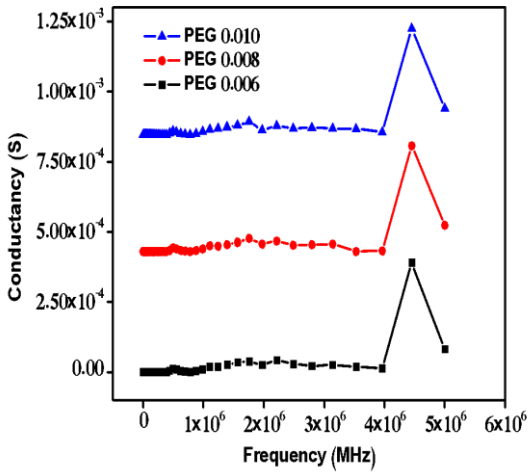

Figure 7. Conductivity value of poly choAcry-ITO/PEG

CONCLUSION

Characterizations of polymer choAcry-ITO/PEG for each composition are 0.006 PEG, 0.008 PEG, and 0.010 PEG by FTIR showed spectrums not different. The peak sharpest in 2800-2900 cm^{-1} that showed the strain of bonding C-H aliphatic in molecule structures of polymer choAcry-ITO/PEG. Therefore spectrum ^{1}H-NMR and C^{13}-NMR showed peaks not different between variations concentrations of PEG: 0.006; 0.008; and 0.010. From data XRD we can provide information about the crystallinity of poly-choAcry-ITO/PEG form semicrystalline phase. Thermal analysis of polymer choAcry-ITO/PEG peaks showed glass transitions (Tg) of poly choAcry-ITO/PEG that showed begin phase change in temperature 109.06^{o}C until 113.52^{o}C and finally processed in 119.41^{o}C. In general, polymer crystalline showed chain regularly, therefore polymer amorph showed irregular chains. Polyethylene glycol effects polymer-polymer choAcry-ITO/PEG showed from images of SEM. Added PEG in a system that polymer is making regularly bonding between chains in a system that polymer. This fact can be seen in images, therefore PEG 0.010 more regularly than PEG 0.008 and PEG 0.006. It maybe PEG can be arranged chains in system polymer. This phenomenon can explain the relationship with conductivity value.

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