UNIVERSITI TEKNOLOGI MARA

STRUCTURAL, THERMAL AND ELECTRICAL PROPERTIES OF PMMA/ENR 50/$LIBF_4$ ELECTROLYTES CONTAINING CARBOXYLIC ACIDS MODIFIED SIO_2 FILLERS

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Thesis submitted in fulfillment
of the requirements for the degree of
Master of Science

Faculty of Applied Sciences

November 2017

ABSTRACT

Study on PMMA/ENR 50 blends as electrolyte is still being carried out because this blend has produced flexible and free standing film of PMMA. Since the blend is not homogeneous, several modifications have been done to improve the phase separations of the blend such as adding plasticizers and fillers. It was found that the addition of filler such as SiO_2 not only has improved the homogeneity of the blend yet enhance the ionic conductivity of the polymer blend systems. Unfortunately, the filler tends to agglomerate due to the formation of silanol groups (Si-OH) that is prone to react with the surrounding moisture. Therefore, in this study carboxylic acids of various carbon chain lengths; i.e. butanoic acid (C_4), octanoic acid (C_8), dodecanoic acid (C_{12}) and hexadecanoic acid (C_{16}) has been used to reduce the number of silanol groups by replacing the -H atom from the silanol group with the R_nCOO^- of the acid via esterification technique. The presence of R_nCOO^- on modified SiO_2 (MoC_x-SiO_2) filler were confirmed by elemental analysis (CHNS) and Fourier Transform Infrared Spectroscopy (FTIR). It was found that MoC_{12}-SiO_2 filler exhibited the highest percentage of -H replacement in which 61% of H from Si-OH group has been reduced. From Emission Scanning Electron Microscopy (FESEM) analysis, MoC_{12}-SiO_2 filler showed a compact structure indicating the C_{12} has filled up the porous structure of SiO_2 particles. This MoC_{12}-SiO_2 filler also gave the smoothest surface with less agglomerate when added into PMMA/ENR 50 blend ($PEMoC_{12}S$) systems with the two single glass transition temperature (T_gs) of the separated phase almost merging. The less MoC_x-SiO_2 filler agglomerates also increased the flexibility of polymer chains where the polymer chains were able to freely rotate. However, the film obtained was slightly brittle due to the formation of polymer networking via hydrogen bonding between the main functional group of C=O, OCH_3 and COC of the polymers and the acid modified filler. This interaction has been confirmed from its FTIR analyses in which the intensity of OH band was slightly increased in $PELMoC_xS$ systems. However, this interaction was not excessive as the two T_gs obtained in $PELMoC_xS$ systems was lower than PELS systems. Due to this, these $PELMoC_xS$ systems also exhibited higher thermal degradation temperature, T_d than the PELS system. The highest ionic conductivity of 5.56×10^{-7} S/cm at room temperature was achieved in $PELMoC_{12}S$ film due to the formation of a smoother surface for chain rotation and ion transport. Both polymer systems obeyed Arrhenius rule and the lowest activation energy, E_a also achieved in $PELMoC_{12}S$ system.

ACKNOWLEDGEMENT

Alhamdulillah, all praise be to Almighty ALLAH, the all-knowing and the all opener who opens the solution to all problems and remover of all difficulties. Thank you ALLAH for giving me the strength, peace of mind and good health to complete this research.

This thesis becomes a reality with the generous support and help from many parties. I heartily acknowledge my supervisor, Associate Professor Dr. Famiza Abdul Latif for her guidance, supervision, supportive and inspiring suggestion throughout the years. It is such a great honor for me to be a part of her research team. Not forgetting, my co-supervisor Dr Sharifah Fauziah Syed Deraman who support and believed in me.

I would like to express my deepest thanks and sincere appreciation to Dr. Sharil Fadli Mohamad Zamri, for his encouragement, valuable views, kindness, comprehensive advice and helping hand at every stage of research works until this work came to existence. I also would like to thank the other lecturers and laboratory staffs who encouraged me during this journey: Dr Zaini, Dr Karimah, Dr Mardiana, Madam Kamariah, Madam Ruhani, Madam Fazni, En Khairul, En Zul, En Adnan and En Nizam.

I am greatly indebted to my parents and family members for their unconditional love, never ending support and concern about me till the end of this research. Kakak loves all of you so much! A special thanks goes to my supportive friends: Nadia, Mariah, Nurul, Shima, Ilani, Zurean, Hanis, Finas, Barakah, Nabilah, Syafiqa and master rangers. This long and winding road much better and fun with your existing. Thank you for each moment that we shared together and cheer up each other during this wonderful journey. Highest appreciation to all people that I have met and contributed to the development of my research. Their contributions are gratefully acknowledged.

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