FRGS TOP-DOWN

NOVEL ADVANCED ORGANIC MATERIALS:

POLYIMIDES (PI) & POLY(*p*-PHENYLENEVINYLENE) (PPV)

PROJECT 1: SYNTHESES OF NEW POLYMERIC MATERIALS

INSTITUT PENGURUSAN PENYELIDIKAN

UNIVERSITI TEKNOLOGI MARA

40450 SHAH ALAM, SELANGOR

MALAYSIA

By:

Ahmad Sazali Hamzah
Zurina Shaameri
Mohd Fazli Muhammat
Nor Saliyana Jumali

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RESEARCH TITLE: **NOVEL ADVANCED ORGANIC MATERIALS: POLYIMIDES (PI) AND POLY(*p*-PHENYLENEVINYLENE) (PPV)**

ABSTRACT

This research involved the synthesis of polyimides (PI) and poly(p-phenylenevinylene) (PPV) derivatives. Polyimide was synthesized through condensation reaction which involved the reaction between variety diamines and dianhydrides with different substitution. The synthetic approaches involved the formation of poly(amic acid) (PAA) precursors followed by the conversion of PAA acids to desired polyimides *via* thermal imidization process. Six new polyimides were successfully synthesized. All synthesized polyimides were characterized by FTIR spectroscopy, viscosity, solubility and thermal analysis.

Poly(*p*-phenylenevinylene) (PPV) derivatives was successfully synthesized *via* modified Gilch's route. The PPV derivatives were prepared by chemically modifying the PPV unit at 1 and 4 positions of the aromatic ring with different alkyl chain lengths. Ten new PPVs and MEH-PPV which is a commercially available polymer were successfully synthesized using this method. Seven of which were further subjected to conductivity measurement against MEH-PPV as the standard, to observe the effect of the modification of the ring system. The results showed that one of PPV derivative has higher conductivity in comparison to MEH-PPV, 1.02 X 10^{-7} Scm^{-1}. The highest conductivity value was recorded for polymer 36 (MPR-PPV) which is 1.11 X 10^{-6} Scm^{-1}. In conclusion, 10 new PPV derivatives were successfully synthesized in three main steps and some of these polymeric materials showed good conductivity in their free standing condition. These PPV derivatives can thus provide an option and good candidates for several applications including polymer light emitting diodes (PLEDs), photovoltaic cells, photodiodes, solar cells and optically pump-lasers.

INTRODUCTION

Polyimides (PI)

Polyimides are well known as high performances polymers (HPPs). It is thermally stable polymers. The structure of polyimides was usually consisting of stiff aromatic backbones. This polymeric material was a demanding material for vehicles, microelectronic devices and aerospace sector. Polyimides was widely used as adhesives, films and coatings, electrical insulators and antibacterial plastic (DBA and PMDA). However, polyimides were hardly difficult to fabricate and process due to high softening temperature and also poor stability.

Poly(*p*-phenylenevinylene) (PPV)

Poly(*p*-phenylenevinylene) (PPV) is a well known as heat resistant and conducting polymer. Many of the current research and attentions focus on PPVs and their derivatives. MEH-PPV is an example of PPV derivatives, which received much attention due to its electrical and photo conjugated properties. This polymeric materials offer several advantages such as ease of synthesis, lower turn on voltage, short switching time, high efficiency and good environmental stability. Despite all the advantages PPVs possesed, the available polymer materials still could not cover a wide range of full color display. Therefore there is a need to develop a material with blue color for full-color display material, which has band gap energy of more than 2.90 Ev. In order for us to develop such material deep understanding on the fundamental theory of the polymer is required. PPV was chosen to be the subject of study due to the fact that the band gap energy of this conjugated polymer can be tuned by simply changing or altering the substituent on 2 and 5 positions of the phenylene ring to form PPV derivatives besides retaining its processing capabilities.