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ORIGINAL ARTICLE

Novel conducting terepolymers based on methyl-cyclohexanone moiety in the main chain: Synthesis and properties

Nayef S. Al-Muaikel

College of Pharmacy, Al-Jouf University, P.O. Box 643, Skaka, Al-Jouf 42421, Saudi Arabia

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Abstract Five novel terepolymers based on methyl-cyclohexanone in the polymer main chain have successfully been synthesized via solution polycondensation technique. These terepolymers were prepared from the polycondensation of terephthalaldehyde with methyl-cyclohexanone and different cycloalkanone derivatives. They were characterized by viscosimetry, FT-IR, X-ray, thermal gravimetric analysis, and differential scanning calorimetry, UV–visible spectroscopy, SEM and electrical conductivities. X-ray analysis showed that it has some degree of crystallinity in the region $2\theta = 5$–$60°$. The UV–visible spectra of some selected terepolymers were measured in DMF solution and showed absorption bands in the range 272–394 nm, due to n–π* and π–π* transition. The electrical conductivities in the 10^{-9}–10^{-8} Ω^{-1} cm^{-1} range were observed after doping with iodine.

1. Introduction

Polymers that exhibit high electrical conductivity have now been successfully synthesized and the past two decades have witnessed unabated interest in the synthesis and characterization of such conducting polymers, due to the potential technological applications of these materials (Skotheim, 1986;Bhadani et al., 1992; Alcacer, 1987; Salaneek et al., 1991). In 1977, Heeger, MacDiarmid, and Shirakawa reported that conductivity of polyacetylene increased remarkably by doping with iodine. Up to now, a wide variety of p-conjugated polymers have been synthesized, and their physical and chemical properties have been investigated by many researchers (Heeger, 2001; MacDiarmid, 2001; Shirakawa, 2001; Patil, 1988; Skotheim and Raynolds, 2006; Li et al., 2002, 2005; Konwer et al., 2011; Morita, 2011; Matru and Nayak, 2010; Muath and Bernadette, 2011; Libing et al., 2011). These materials are prepared by polymerization of simple monomers that are able to form a network of highly delocalized electrons. Moreover, conjugated organic polymers have gained increasing interest in recent years as electrically conducting polymers [e.g., poly(p-phenylene), polypyrrole, polythiophene, and others] (Rehahn et al., 1989; Gagnan et al., 1987; Ng et al., 1997; Skoog and West, 1971). In this article we present a route for the synthesis and characterization of some new terepolymers

E-mail address: n_almuaikel@hotmail.com

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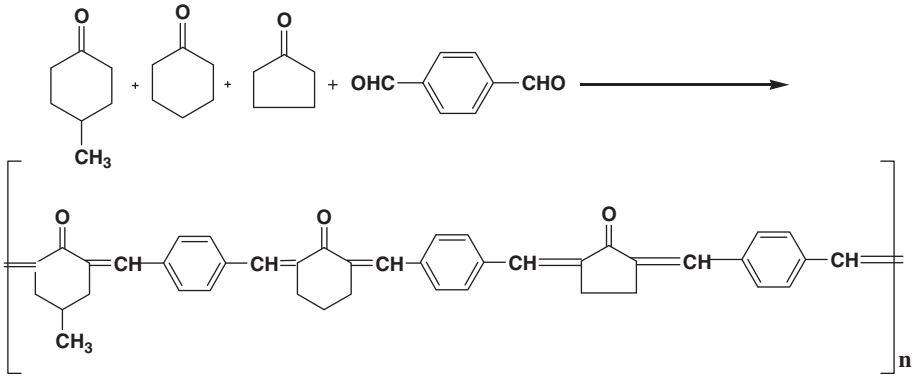
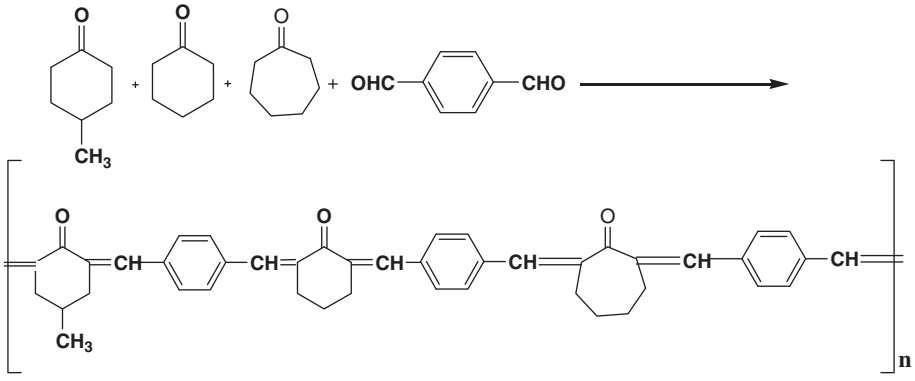
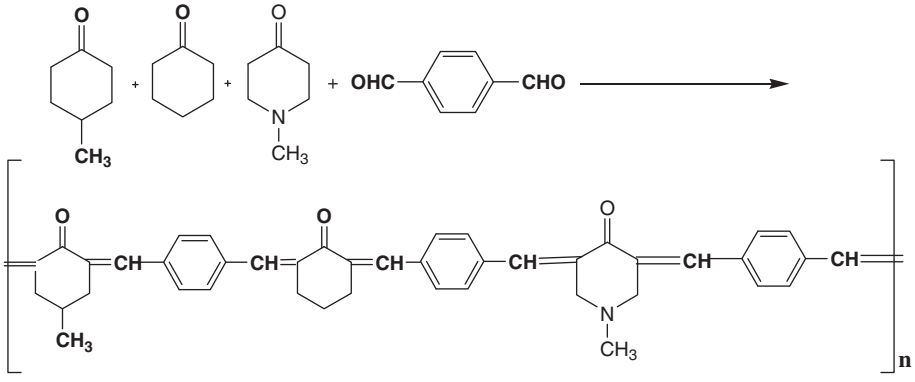


Scheme I Synthesis of terepolymer **I**.



Scheme II Synthesis of terepolymer **II**.



Scheme III Synthesis of terepolymer **III**.

containing the methyl-cyclohexanone moiety in the polymer main chain. A major target of this work was to study the effect of the cycloalkanone moiety upon the properties of polyconjugated polymers, including their thermal stability, solubility, electrical conductivity, morphology and crystallinity.

2. Experimental

2.1. Materials

Methyl-cyclohexanone (Fluka, Germany) was freshly distilled at b.p. 169–171 °C. *N*-methyl piperidone (Merck, Germany) was freshly distilled at b.p. 155 °C. Cyclohexanone, cyclopentanone and cycloheptanone (Merck) were freshly distilled: cyclohexanone (b.p. 155 °C), cyclopentanone (b.p. 130–131 °C), and cycloheptanone (b.p. 179 °C). *N*-methyl piperidone (Aldrich), b.p. 181–182 °C. Terephthalaldehyde (Aldrich, Germany) m.p. 114–116 °C. Potassium hydroxide and all other reagents were of analytical grade and were used as received.

2.1.1. Polymerization procedure

A solution polycondensation technique was used in the synthesis of these conjugated polymer and copolymers which is described as follows:

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