

Synthesis and characterization of polyphenylene vinylenes having *m*-terphenyl group: comparison of their optical properties

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Received: 16 February 2016 / Accepted: 17 August 2016 / Published online: 1 September 2016
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Abstract A series of alternate block copolymers of polyphenylene vinylenes that have 1,3-dioctyloxy phenylene in the center of kinked *m*-terphenyl group as one of the building blocks with either one of the aromatic groups, viz., 1,4-dioctyloxy benzene, 4,6-dioctyloxy benzene and 4,4'-dioctyloxy biphenyl, was synthesized through Heck polymerization. These alternate block copolymers, viz., poly(2,5-bis(octyloxy)phenylene vinylene *alt* 4',6'-bis(octyloxy)-1,1':3',1''-terphenylene) (P1), poly(2,4-bis(octyloxy)phenylene vinylene *alt* 4',6'-bis(octyloxy)-1,1':3',1''-terphenylene) (P2) and poly(4,4'-bis(octyloxy)-3,3'-biphenylene vinylene *alt* 4',6'-bis(octyloxy)-1,1':3',1''-terphenylene) (P3), were characterized for their thermal and optical properties. The synthesized polymers had good solubility in organic solvents and were stable up to 350 °C. The molecular weights of the synthesized polymers were in the range 4370–10,900 Da with polydispersity range 1.52–1.65, which were measured by the gel permeation chromatography technique. The optical properties of these polymers showed absorptions in solution at around 400, 329, and 345 nm for P1, P2, and P3 polymers, respectively. The photoluminescence emission maxima of the polymers were at around 461 nm with a shoulder 439 and 424 nm for P1, P2, and P3, respectively. Photoluminescence emission of films of these polymers showed minimum red-shift (20 nm) when compared with spectra of their solutions.

The optical and photoluminescence emission properties of these polymers were found to vary on the backbone structure.

Keywords *m*-terphenylene vinylene · Alternate copolymer · Heck coupling · Photoluminescence · 1,3-Dibromo-4,6-dioctyloxy benzene

Introduction

Over the past two decades, much research has focused on the synthesis of conjugated polymers due to their diverse potential applications as transistors [1], photovoltaic devices [2], nonlinear optical devices [3], rechargeable batteries [3], light-emitting diodes (LEDs), [4] and sensors [5]. Among them, polymer light-emitting diodes (PLEDs) that incorporate polymers as emissive layers are an interesting and thrusting area for research owing to the potential advantages of polymers, i.e., substantial mechanical and optical properties, low cost of manufacture, and amenability to large area displays [6–8]. A large number of polymers, e.g., polyphenylenes (PP), polynaphthalenes (PN), polyfluorenes (PF), polythiophenes (PT), and polyphenylene vinylenes (PPV), have been extensively studied.

Among the different types of polymers, polyphenylenes and polyphenylene vinylenes play a predominant role as an emissive layer. Good thermal and oxidative stability of polyphenylene and their derivatives make them frontier candidates for PLED materials. However, their low solubility, high turn on voltage and the difficulty of tuning the color emission, namely, violet blue to green and red emission limit their application.

Polyphenylene vinylenes have emission tunability by chemical modification with introduction of electron-withdrawing groups [9, 10] or electron-donating groups [11, 12] or

Electronic supplementary material The online version of this article (doi:10.1007/s13726-016-0470-4) contains supplementary material, which is available to authorized users.

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