Study of the I-V characteristics of organic light-emitting diodes based on thiophene vynilic derivatives

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Abstract

Organic light-emitting diodes were obtained using a thiophene vynilic derivative polymer electrochemically synthesized. The electrochemistry of the thiophene vynilic derivative, 1,5-bis(2-thienyl)-1,4-pentadien-3 one (CDV), was conducted in a nonaqueous media. The polymer was deposited on tin oxide (SnO2)-coated glass substrates. The films obtained were physicochemically characterized by infrared absorption, a scanning microscope, microprobe X-ray photoelectron analysis, and photoluminescence measurements. It was shown that the coverage efficiency of the films is very high. There is some oxygen contamination, not only at the surface, but also in the bulk of the polymers. The films are photoluminescent with emission between 660 and 720 nm. The current–voltage (I–V) characteristics exhibit a turn-on voltage at about 2–4 V depending on the film thickness (120–250 nm). The electroluminescence–voltage (EL–V) curve has a similar shape but a shift of 1–2 V toward higher voltage. In the conducting state, there is no significant dependence of the temperature upon the current. All these facts cannot be explained easily by a simple thermionic model; a thermally activated tunneling effect appears more adequate. The current in the small potential domains has a behavior more or less erratic with a differential negative resistance and a switching effect. This behavior, arising from localized pathways, has a nature different from the injection processes, allowing electroluminescence. These pathways are related to surface heterogeneities (SnO2/polymer films) and aluminum diffusion. By not being directly related to electroluminescence, these pathways could induce a heating effect and an irreversible short-circuit effect. © 2002 Wiley Periodicals, Inc. J Appl Polym Sci 86: 1128–1137, 2002.