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Design and Construction of Optical Detector-Based on Polymer/ Carbon Nanotubes

A thesis Submitted to

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Abstract

In this study, Polyaniline/Carbon nanotube films were prepared for polymer nanocomposite photodetector applications. The optical characteristics of polyaniline and polyaniline doping concentrations of carbon nanotube thin films deposited on a glass substrate by the spin-coating technique are presented. photodetectors were prepared, once by using Polyaniline / Multi-wall carbon nanotube and the other by polyaniline / single-wall carbon nanotube thin films at different concentrations of (٠,٠٤ g and ٠,٠٦ g)

We observed the structural characteristics of the composite films that matched Carbon nanotubes and polymers. Scanning electron microscopy was used to examine the surface morphology of the deposited films. The current-voltage (I-V) characteristics of the manufactured devices demonstrated a notable increase in current with the percentage content of the Carbon nanotube weight. The optical characteristics of the prepared films were determined by ultraviolet-visible (UV-vis) light spectroscopy analysis.

Polyaniline/Multi-wall carbon nanotube photodetectors have a specific detectivity of ٥,٥ μA $mW^{-١}$ and a photoresponsivity of ١٠ × $١٠^{١٥}$ Jones was achieved using ٣٠٠-٧٠٠ nm laser energy. In the meantime, the expected response and recovery times of the addressed laser energy were determined to be ٠,٣٢ s and ٠,٣٥ s, respectively. The second Photodetector has a specific detectivity and photoresponsivity of ١٢ × $١٠^{١٥}$ Jones and ٩,٥ μA $mW^{-١}$ were achieved, with a recovery/response time of approximately ٠,٣٥ s and ٠,٣٣ s, respectively.

The best performance characteristics of the polyaniline / single-wall carbon nanotube photodetector were a spectral responsivity of ١٢,١٤١٤ μA/mW, a detectivity of ١,٤٣× $١٠^{١٦}$ Jones, and an external quantum efficiency of ٤٤,٣٦ %

at ٣٢٠ nm. It also showed a fast rise time of ٣٣٠ ms and a fall time of ٣٥٠ ms for high-performance UV detection applications.

The photodetector characteristics were enhanced by the irradiation of the samples, with the best results using laser diode radiation at different powers. It shows that the spectral responsivity was enhanced to reach about ١٥,٥٩ μA/mW, and the optical detectivity and external quantum efficiency reached ١,٣× ١٠^{١٦} Jones and ٥٥,٧٪ at ٣٢٠ nm, respectively.