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Modeling and Simulation of Carrier Transport for Optoelectronic Devices

A Thesis

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By

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Abstract

This work present ability of applications of the two mathematical models in calculating electrical output (I_d-V_d) and transfer characteristics (I_d-V_g) for improvement performance organic field effect Transistor. This study divided into two parts: The first part focused on calculating output characteristics (I_d-V_d), transfer characteristics (I_d-V_g) and transconductance by using the gradual-channel approximation model. This approach investigats the performance of vertical organic field effect transistor.

The study of Pentacene illustrated both output and transfer characteristics reveal a high drain current at the gate dielectric ZrO_2/PVP of -0.0026A and -0.0015A, respectively.This amount of drain current attributes to the rise in dielectric capacitance.The gate dielectric materials' transconductance characteristics demonstrate that the ZrO_2/PVP gate dielectric has a greater value than the monolayer, showing the influence of dielectric capacitance.

The second approach focused on modeling of Pentacene thin film field effect phototransistors also study the influence of changing the thickness of bilayer dielectric materials Polyvinylpyrrolidone (PVP) / Zirconium Oxide (ZrO_2) on the performance of the phototransistor. By changing the thickness (t) of (PVP/ZrO_2) layer from (100 – 300nm) the electrical characteristics current (I_d) & transconductance (g_m) values were calculated using MATLAB software simulation. The influence showed decreasing of these values by increasing the thickness (t) where the best value of current I_d = -1.25A and transconductance g_m = -1.3A/V was at thickness t = 100 nm. Photoresponsivity (R) also was calculated by different values of light intensities range (20-100) mW/cm^2 which decreasing Photoresponsivity by increasing the incident power.