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**Investigation of some physical properties of organic
dye [*p*-N,N dimethylaminobenzylidenemalononitrile
(DBM)] thin films**

A thesis submitted for the degree of
Doctor of Philosophy of teacher preparation in science
(Solid State Physics)

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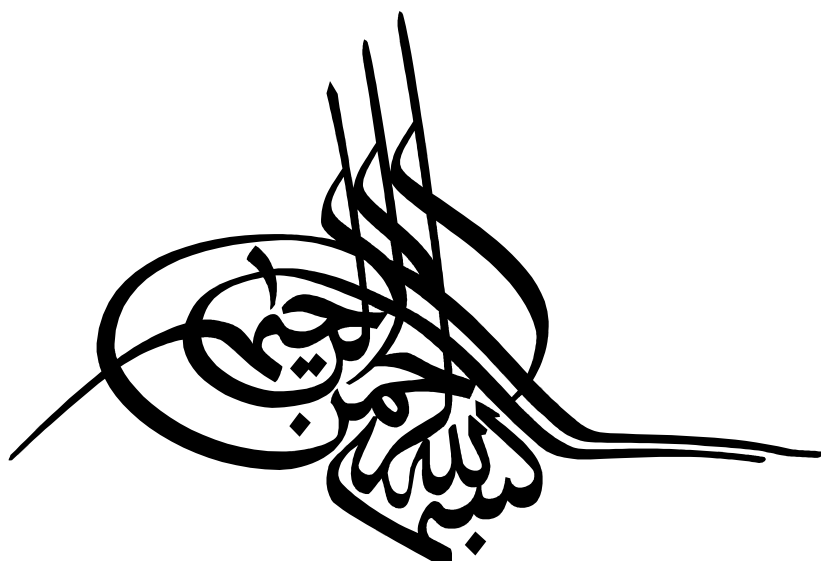
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دراسة بعض الخواص الفيزيائية لأغشية رقيقة
من صبغة عضوية [بارا ن، ن ثنائي ميثيل
امينوبنزيلدين مالونونيتريل]

رسالة مقدمة لنيل درجة دكتوراه الفلسفة لإعداد المعلم في
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موافقة مجلس الكلية

Abstract

The present thesis is devoted to study the structural, optical, and electrical transport properties of the synthesized *p*-N,N-dimethylaminobenzylidenemalononitrile (DBM) organic dye in its bulk and thin film forms. DBM thin films were prepared by thermal evaporation technique. It is also devoted to investigate the J-V, C-V characteristics, as well as the photovoltaic properties of Al/DBM/ITO Schottky diode and Au/DBM/p-Si/Al heterojunction solar cell .

From this study, it was found that DBM compound is thermally stable up to 445 K and has triclinic crystal system. The structure of the as-deposited DBM thin film was found to be in the nano-crystalline (nano-rods) form, and the crystallite size of these nano-rods was increased by annealing this film at 423 K for one hour. However, theoretical and experimental studies of vibrational modes of DBM compound by Hartree-Fock (HF) and density functional theory (DFT) methods using two basis

sets reveal that the higher level of calculations give a reasonable deviation from the experimental data.

The optical properties of DBM were studied by the spectrophotometric measurements of transmittance and reflectance at normal incidence to determine the absorption spectral and dispersion behavior, as well as, the high frequency dielectric constant, the lattice dielectric constant and the optical energy gap.

The electrical transport properties including the dark DC and AC electrical conductivity and space-charge-limited current have been investigated to determine some of the electrical characterization parameters of DBM in its bulk and thin films forms.

The dark I-V and C-V, as well as, the photovoltaic characteristics of the prepared Al/DBM/ITO Schottky diode and Au/DBM/p-Si/Al heterojunction solar cell were measured to determine the solar cell parameters, such as built-in voltage, V_{bi} , the diode quality factor, ξ , operating conduction mechanisms, short-circuit current density, J_{sc} , open-circuit voltage, V_{oc} , fill factor, FF, and power conversion efficiency, η .

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Chapter 1

Introduction

1.1. Overview

The organic semiconducting materials are grouped as polymer, monomer, and organic compounds. Charge carrier transport properties in organic semiconducting compounds have received considerable attention within the last few decades. Organic semiconductors are used extensively in the fabrication of active and passive solid state devices [1,2].

Research on the properties of organic semiconductors has witnessed a revival in recent years due to emerging technological applications of these materials. They possess specific physical properties (significant electroluminescence, bandgap in infrared-visible (IR-Vis) domain), which are very attractive for the technology of electronic devices such as field-effect transistors (FETs) [3,4], organic light-emitting diodes (OLEDs) [5,6], photovoltaic devices [7-9], optoelectronic devices [10], as well as for other technological applications, such as optical pH, a measure of the acidity or