Fayoum University
Faculty of Science
Department of Physics

Modeling and Simulation of Terahertz radiation detectors based on Field Effect Transistors

By

Yasmeen Adel Kelanee Mohamed

A thesis submitted in partial fulfillment

Of

The requirements for the degree of

Doctor of Philosophy

In

Experimental Solid State Physics

(Electronics)

Department of physics

Faculty of Science, Fayoum

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Bachelor of Science (2009)
Master of Science (2014)

Dr/ Mohamed Youssef Farag

Assistant Prof. of Solid State Physics, Faculty of Science,

Fayoum University

Signature ……...

Prof. Dr / Salah Elden Amin Elnahwy

Prof. of Engineering Physics and Mathematics,

Faculty of Engineering, Cairo University

Signature ……...

Dr/ Nihal Yassin Mohamed Ibrahim

Associate Prof. of Engineering Physics and Mathematics,

Faculty of Engineering, Cairo University

Signature ……....

Approval Sheet

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This thesis Ph.D. degree has been

Approved by :

Dr/ Mohamed Youssef Farag
Assistant Prof. of Solid State Physics, Faculty of Science
Fayoum University

Signature ……...

Prof. Dr / Salah Elden Amin Elnahwy
Prof. of Engineering Physics and Mathematics,
Faculty of Engineering, Cairo University

Signature ……...

Dr/ Nihal Yassin Mohamed Ibrahim
Associate Prof. of Engineering Physics and Mathematics,
Faculty of Engineering, Cairo University

Signature …….

Date of Examination: / / 2023

Abstract

Despite the advantages of using terahertz radiation detection technology in semiconductor field-effect transistors, it still has not shown a strong enough response compared to other competing technologies. It is therefore important to improve our understanding of the FET operation as a THz detector. Metal-semiconductor field-effect transistors (MOSFETs) are emerging as promising candidates for THz detection due to their high level of integration with other electronic circuits and relatively fast response time for operation at room temperature with low noise.

All these features have made the metal-semiconductor field-effect transistor one of the most effective THz detectors. In this work, we present a review of the effect of physical models used in the literature to model the operation of the FET of the THz detectors. Due to the significance of MOSFET applications in many fields, a simulated model of the terahertz detector was made by MOSFET to develop a model of terahertz detectors using this type of transistors.

In addition, Silicon MOSFET with several channel lengths is simulated by Synopsis Sentaurus device simulator and then investigated to operate as THz detectors in the photovoltaic and photoconductive modes. The results of our model were discussed and compared with the experimental data of other known FET detector models. Also, they interpreted using a proposed theory to provide an optimum design of the THz detector with high response.