RAY TRACE FOCUSING BY ELLIPTICAL LENSLET IN TRANSPARENT GATE RECESSED CHANNEL MOSFET

A dissertation submitted in partial fulfilment of

the requirement for the degree of

MASTER OF TECHNOLOGY

IN

NANOSCIENCE & TECHNOLOGY

by

ANUJ KUMAR SINHA

Roll No. – 2K12/NST/03

Under the Supervision of

DR. RISHU CHAUJAR

DEPARTMENT OF APPLIED PHYSICS

DELHI TECHNOLOGICAL UNIVERSITY

(FORMERLY DELHI COLLEGE OF ENGINEERING)

NEW DELHI-110042

June 2014

CERTIFICATE

This is to certify that the dissertation entitled ***"Ray Trace Focusing by Elliptical Lenslet in Transparent Gate Recessed Channel MOSFET"*** *is being submitted by me* ***Anuj Kumar Sinha*** *bearing roll no.* ***2K12/NST/03*** *to the* ***Delhi Technological University, New Delhi,*** *for the degree of* ***Master of Technology*** *in* ***Nano Science and Technology****, run by Applied Physics Department. The research reports and the results presented in this thesis have not been submitted in parts or in full to any other University or Institute for the award of any degree or diploma.*

Anuj Kumar Sinha

Candidate

Department of Applied Physics

Delhi Technological University

New Delhi, India

Dr. Rishu Chaujar

Supervisor

Department of Engineering Physics

Delhi Technological University

New Delhi, India

Prof. S. C. Sharma

Head of Department

Department of Applied Physics

Delhi Technological University

New Delhi, India

ACKNOWLEDGEMENT

I wish to express my sincere gratitude and veneration to my supervisor, ***Dr.Rishu Chaujar,*** Assistant Professor, Department of Engineering Physics, Delhi Technological University, New Delhi, who has graciously provided me her valuable time whenever I required her assistance. Her counselling, supervision and suggestions were always encouraging and it motivated me to complete the job at hand. She will always be regarded as a great mentor for me.

I am deeply grateful to ***Prof. S. C. Sharma***, Head of Department (Department of Applied Physics), Delhi Technological University for his support and encouragement in carrying out my thesis work.

I would like to express my heartiest thank to my friends and seniors for constant support and motivation. I would like to thank the Department of Applied Physics, for providing us with the facilities of laboratory, and all staff members. Last but not least I thank my parents, for everything I am and will be in future. It's your unspoken prayers and affection that keep me moving forward.

Anuj Kumar Sinha
Roll No.: 2K12/NST/03
Dept. of Applied Physics
Delhi Technological University

ABSTRACT

With advance CMOS technology, there is a leap to another milestone in nanometer regime. As CMOS technology dimensions are being aggressively scaled to reach a limit where device performance must be assessed against fundamental limits, nanoscale device modelling is needed to provide innovative new MOS devices as well as to understand the limits of the scaling process. The conventional MOFET seems to be of little use in continuing scaling of gate length, gate oxides and threshold voltages to controlled leakage current. Aggressive scaling is associated number of high order effects such as short channel effects, hot carrier effects and heating effect which significantly affect the device performance. The Ray trace method in MOSFET emerged to be the ultimate solution. To further improve the sub threshold electrical parameters, a transparent gate may be inserted as the gate material, thereby extending the idea of a transparent indium tin oxide (ITO) gate onto the Recessed Channel MOSFET (RC-MOSFET). The proposed device has an elliptical lenslet above the RC MOSFET to focus the ray trace in to the transparent ITO gate. The effect of illumination with improved photogeneration rate, optical intensity, switching ratio and light absorption is studied. Recessed channel reduce the impact of drain potential over the channel and also improves the gate control because of its negative junctions without any increase in series resistance. Results clearly reflect that transparent gate RC MOSFET has an enhanced absorption within the semiconductor device. The work proves the effectiveness of transparent gate RC-MOSFET for higher efficiency, speed, photogeneration, reduction in power dissipation and better temperature stability. Possible applications can be found in the optically coupled signal transmission in the lower frequency range.The simulation results indicate potential of the proposed MOSFET as optically sensitive structure which can be used for increase in data transmission/reception rates and reduction in power consumption. Luminous-3D RC-MOSFET is fully integrated with ATLAS and the Device 3D which is the part of Silvaco TCAD omni bundle.