A NEW ANALYTICAL MODEL FOR A GRADED-BASE SINGLE QUANTUM WELL TRANSISTOR LASER

By

Mostafa Radwan Hassan Abdelhamid

A Thesis Submitted to the
Faculty of Engineering at Cairo University
in Partial Fulfilment of the
Requirements for the Degree of
MASTER OF SCIENCE
in
Engineering Physics

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
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Under the Supervision of

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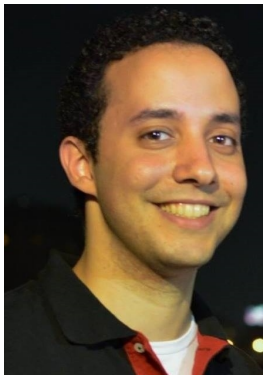

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Title of Thesis:

A New Analytical Model for a Graded-Base Single Quantum Well Transistor Laser

Key Words:
Transistor Laser; Quantum-Well; Optoelectronics; modeling; composition grading

Summary:
The Transistor Laser (TL) device has shown great potential for the use in optical communications in the near future with its superiority in performance to the regularly used Laser Diodes (LDs). In our work, we have derived a closed-form analytical model for a Single Quantum-Well (QW) Transistor Laser (TL) device. The model incorporates the effect of thermionic-emission and tunneling at the abrupt emitter-base junction as a boundary condition for the continuity equation of the minority carriers in the base region. By combining the continuity equation with a virtual state based two-level rate equations, a complete analytical solution is obtained. The model results show good agreement with previously published experimental data. Thus, we have extended the model to investigate the effect of composition grading in the base region on the device performance. Our model shows that a lower threshold current and a higher optical bandwidth can be achieved with proper grading. A parametric study was also conducted on the proposed model to investigate the effect of different design parameters on the overall performance of the transistor laser.

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Mostafa R. Abdelhamid

To my family and all my friends

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