Effect of Ga concentration on Electrical Properties of InP Quantum Dot Laser Diode Stuctures

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Abstract

The effect of Ga concentration on electrical properties of diodes with InP quantum dot lasers as an active region grown on GaAs substrates are investigated. The device structures in this study contains self- assembled InP quantum dots which covered with $Ga_xIn_{(1-x)}P$ layers have different Ga concentration which varies as 0.54, 0.56 and 0.58 causing a tensile strains in the structures. This work includes an important parameters of electrical properties such as series resistance, ideality factor and reverse saturation current density. These parameters are measured from the current-voltage characteristic for different structures over a wide temperature range starting from 77 K to 400 K.
The series resistance shows a decrease with increasing temperature until 225 K for all studied structures and above that the series resistance is slightly increased with temperature. Also, the series resistance for any structures at high temperatures shows slightly higher values for the structure with higher Ga concentration.
The ideality factor, for the three studied structures, decrease with increasing temperature until 170 K. Above 200 K, the ideality factor is almost constant within 1.9 -2.1 which implies that the effect of Ga concentration on the ideality factor does not appeared at high temperatures. However, this effect on reverse saturation current density does not exist at low temperatures but it does at high temperatures. The ideality factor at low temperatures is low in the structure with high Ga concentration. Furthermore, the reverse saturation current density is also low in structure containing high Ga concentration and only at high temperatures due to the high number of defects.

Keywords— *Quantum dot, Semiconductor Laser, Laser diode, Ga concentration.*

Professional Biography (100-150 words)



Dr. Al-Ghamdi completed his Ph.D degrees at Cardiff University UK in 2010. Afterword he return to Saudi Arabia where he got position at King Abdulaziz University, as an assistant professor. Dr. Al-Ghamdi research interest includes the design and fabrication of semiconductor devices laser diode and studies the optoelectronic and electrical properties of these devices by measuring their absorption, spontaneous, stimulated emission spectra, ideality factor, barrier height and series resistance. The current research topics include red emitters quantum dot laser diode which used in photodynamic therapy of cancer and also used in the manufacture of dual wavelength sources. Dr. Al-Ghamdi is a member of IEEE and OSA societies.

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