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In-homogenous broadening in InP/AlGaInP quantum dot laser structures

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Abstract

The interest has been attracted since 1998 for InP quantum dot (QD) lasers grown on GaAs substrates [M. K. Zundel *et al*., Appl. Phys. Lett., **73**, (1998)], [J. Porsche *et al*., IEEE J. Sel. Top. Quantum Electron., **6**, (2000)], [G. Walter *et al*., Appl. Phys. Lett., **79**, (2001)]. Self-assembled InP QD lasers grown on GaAs substrates emitting wavelength range between 650-780nm have potential applications in photodynamic therapies, dual wavelength sources and biophotonic sensing. As a different material from the more-studied InAs on GaAs system, they also offer the possibility of a more generic understanding of QD laser physics. Here we focus on the temperature dependence of the threshold current density (Jth) observing distinctive behaviour that has also been observed in p-doped InAs QD laser devices.

Threshold current density (Jth) as a function of temperature for 2000μm long devices at 750^0C growth temperature exhibits a distinctive dependence on the operating temperature, where from 190K it initially increases with temperature until it reaches a local maximum at 220K, then it decreases with increasing temperature until a minimum is reached at 260K. Above 260K J_{th} increases superlinearly with temperature. This type of behaviour has previously been observed for p-doped InAs/GaAs quantum dot lasers at lower temperatures [I. C. Sandall *et al.,* Appl. Phys. Lett., **88**, (2006)]. The measured unamplified spontaneous emission shows two peaks corresponding to emission from QD and QW states and this is used to explain the behaviour of Jth with temperature in terms of the carrier distributions in the QD and QW states without the need for Auger recombination.

Biography

Dr. Al-Ghamdi completed his B.Sc degree from the Department of Physics at King Abdulaziz University, Saudi Arabia in 2000. Following this he spent a couple of years in working as teacher assistant for King Abdulaziz University. Between 2003 and 2010 he travelled to the UK doing his postgraduate studies at the school of physics and Astronomy, Cardiff University, where he completed his M.Pill and Ph.D degrees in Optoelectronics in 2006 and 2010 respectively. Afterword he return to Saudi Arabia where he got position at King Abdulaziz University, as an assistant professor. Then he started to build a grope in optoelectronics with a new laboratory while he still working with other research gropes, as a visiting researcher. Dr. Al-Ghamdi research interest includes the design and fabrication of semiconductor devices laser diode and studies the optoelectronic properties of these devices by measuring their absorption, spontaneous and stimulated emission spectra. 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, APS, OSA and IOP societies.