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

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The interest has been attracted since 1998 for InP quantum dot (QD) lasers grown on GaAs substrates. Self-assembled InP QD lasers grown on GaAs substrates emitting wavelength range between 650-780 nm 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 2000 μm long devices at 750 0C growth temperature exhibits a distinctive dependence on the operating temperature, where from 190 K it initially increases with temperature until it reaches a local maximum at 220 K, then it decreases with increasing temperature until a minimum is reached at 260 K. Above 260 K Jth increases superlinearly with temperature. This type of behaviour has previously been observed for p-doped InAs/GaAs quantum dot lasers at lower temperatures. 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

M. S. 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.Phil. and Ph.D. degrees in optoelectronics in 2006 and 2010 respectively. He then returned to Saudi Arabia where he got position at King Abdulaziz University as an Assistant Professor. Then he started to build a group in optoelectronics with a new laboratory while he is still working with other research groups, as a visiting researcher. His 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 is used in photodynamic therapy of cancer and also used in the manufacture of dual wavelength sources. He is a member of IEEE, APS, OSA and IOP societies.

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