Design and realisation of InP Modelocked Lasers Emitting in the 730nm Wavelength Range

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Short pulse lasers are required for small footprint, low cost and on chip alternatives to the Ti: Sapphire laser and specifically for applications in two-photon fluorescent imaging. We explore the design of InP quantum dot mode-locked lasers (MLL) emitting in the visible to near infrared region and demonstrate performance in a simple two-section monolithic footprint.

The laser structures were grown by MOVPE on n-GaAs (100) substrates oriented 10° off toward <111>. Self-assembled InP QDs were covered by slightly tensile strained GaInP quantum wells and separated by AlGaInP barriers, with AlInP cladding layers forming the remainder of the waveguide. Broad-area oxide-stripe non-lasing segmented contact devices were fabricated to measure the material optical gain and modal absorption spectra, via the segmented contact method. These measurements are used to design the mode locked structures, and in particular the absorber to gain length ratios and also the total cavity length.

The mode locked lasers are fabricated as 10 µm wide ridge waveguides and planarised with BCB. Devices with total cavity length between 2mm and 3.5mm, with uncoated cleaved facets, and saturable absorber (SA) sections representing approximately 20% of the total cavity length have been examined and found to either Q-switch, mode lock or both depending on operating regime (laser current, absorber reverse bias and heat sink temperature).

Short abstract:

We explore the design of InP quantum dot mode-locked lasers (MLL) emitting in the visible to near infrared region by measuring the modal absorption under reverse bias and the modal gain. We demonstrate modelocking performance in a simple two-section monolithic footprint. Devices are characterised as a function of laser current, absorber reverse bias and heat sink temperature and pure Q-switching, pure mode-locking or mixed q-switching / mode locking is obtained depending on operating regime.