GAIN-SWITCHED OPERATION OF LASER DIODES WITH MODIFIED ACTIVE REGION

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Optical radar, optical tomography, high resolution optical spectroscopy are important areas of applications of high-power picosecond-pulse laser diodes. Gain switching is the simplest operation mode of laser diode, which allows generating picosecond optical pulses, however, the pulse power emitted in gain-switching mode is usually limited to about few watts (in narrow stripe lasers). In [1] it was suggested that implementing hot-carrier effects for carrier accumulation the power emitted by gain-switched laser diodes could be substantially increased. In this report we suggest new laser structure in which carrier heating resulting from high current pumping is most effective thus giving the possibility for gain-switched lasers to produce the output power comparable to that obtained from more complicated and less reliable Q-switched lasers.

We consider a dynamic response of AlGaAs/GaAs laser diode with modified active region under nanosecond current pulse pumping. Contrary to conventional design of DH lasers the active layer of this structure consists of two GaAs wells separated by $Al_xGa_{1-x}As$ barrier layer introduced between the wells. Under high current pulse (we consider current densities about 10^5 A/cm^2) the injected carriers should surpass this barrier in order to fill both wells of the active layer and in this way to build up sufficient modal gain. Simulations performed with advanced time-domain laser model show that with sufficiently large barrier height the carrier density over the barrier is low, the electric field in the barrier is high, and due to this, at the leading front of current pulse, the carriers are strongly heated (up to T~ 500K) in both wells. Because of this the modal gain is deeply suppressed. At the trailing edge of current pulse the carriers are cooled down, the modal gain is recovered, and high power optical spike is generated, typically 20-30 ps long. The described laser structures with modified active region were grown by MBE technique and stripe geometry lasers were fabricated of these structures. The experimental output response measured in gain-switching mode is analyzed and compared with the results of simulations.

1. *Golubev B.E., Chistyakov V.M., Gurevich S.A.* // Proc. of SPIE. 2001. V. 4354. P. 34–44.