O.3. Blue InGaN lasers under generation of picosecond pulses

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We report in this paper the numerical results of theoretical investigations of generation of picosecond pulses by blue InGaN with saturable absorber (SA). Using the single mode rate equations, we study the influence of different geometrical and material parameters on the characteristics of output pulses. We discuss also the applications of pulses. Figure 1 shows an analytical model of investigated setup. The system consists of an InGaN active section and a SA added in longitudinal direction. The active layer is composed by three QWs, and the emitting wavelength is 405 nm. Two adimensional injected currents J_1 and J_2 are applied respectively to active section and to SA.

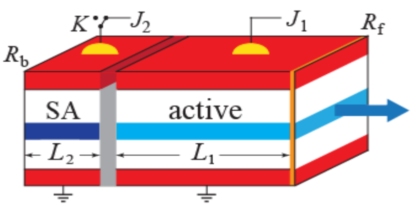

Fig.1.

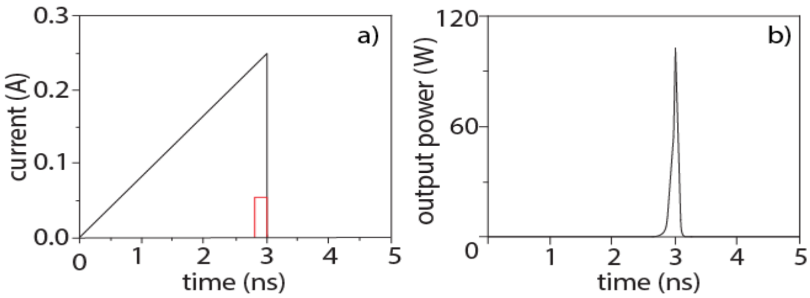

Fig. 2

To simulate the generation of pulses in setup shown in Fig. 1 we use the single mode model [1], which is given by the following rate equations for photon number S and injected carrier number n_1 in active region and n_2 in the SA

$$\frac{dn_1}{d\tau} = -(n_1 - n_{g1})S - \frac{n_1}{\tau_{s1}} + J_1, \qquad \frac{dn_2}{d\tau} = -(n_2 - n_{g2})S - \frac{n_2}{\tau_{s2}} + J_2,$$

$$\frac{dS}{d\tau} = (n_1 - n_{g1} + n_2 - n_{g2})S - B_C(n_1 - n_{g1})S - G_{th}S + M(n_1 + n_2).$$

The mechanism resulting in pulse generation is Q-switching. Thus, the injected current J_1 is increased from 0 to 0.25 A (black line in Fig. 2a). At 3 ns the current is switched „off". The rectangular shape of pulse current J_2 into SA is given by red line in Fig 2a). A typical temporal behaviour of optical output power at the front facet of device is shown in Fig. 2b). We consider lasers emitting at different wavelengths between 350 and 450 nm. The results presented in this paper show the following features: we found that an increase of wavelength lead to decrease in pulse energy and maximum of the pulse. The length of the SA influences drastically features of output pulses, by decreasing its energy and peak, when SA length increases. We also found that for a very small front facet reflectivity the pulses are not generated. An increase of front facet reflectivity lead to a peak in the dependences of energy, and maximum of output pulse.

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