PICOSECOND PULSE GENERATION IN InGaN BLUE LASERS WITH SATURABLE ABSORBER

V. Dobrovolschi*, S.Rusu, V.Tronciu
Department of Physics, Technical University of Moldova, Chişinău, Republic of Moldova.
*E-mail: veronica.dobrovolschi@fiz.utm.md

In this paper we report the results of theoretical investigations of generation of ps-pulses by blue InGaN with saturable absorber. We study numerically, using the single mode rate equations, the influence of wavelength of laser, and the length of saturable absorber on the features of output pulses. We investigate also, the impact of different material and laser parameters on properties of pulses. The mechanism belong to pulse generation is also presented. Finally, we discuss the applications of ps-pulses in distant measurements, free-space communications, material processing and spectroscopy.

Figure 1 shows an analytical model of investigated setup. It consists of an InGaN active layer and a saturable absorber (SA). The active layer is composed by six QWs, and the emitting wavelength is 405 nm. Lasers with different cavity length and wavelengths have been investigated theoretically.

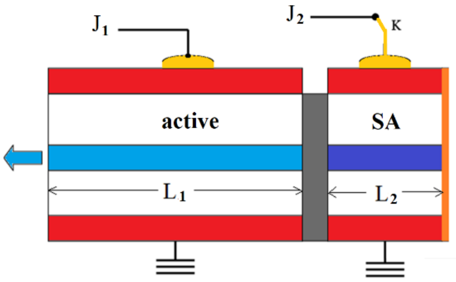

Figure 1. Setup of InGaN laser

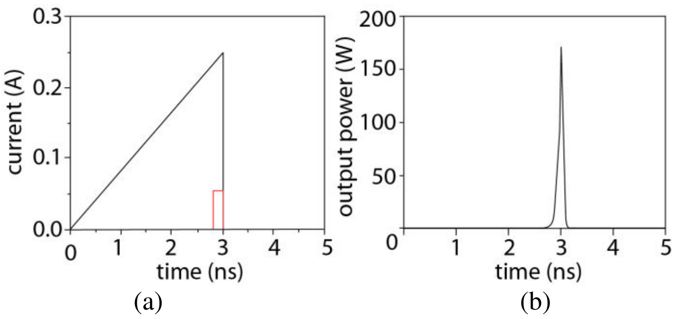

Figure 2. Principle of pulse generation. a) injected current into active (black line) and SA (red line) sections. b) Generated output pulse.

To simulate the generation of pulses in an InGaN lasers 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 saturable absorber.

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

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

We integrate numerically this set of equations by studying the features of pulses in dependence of laser wavelength and length of SA. Figure 3 shows the dependence of pulse energy and maximum of output pulse on the laser wavelength. One can see that a large wavelength implies a low maximum of pulses, as well as a decrease of their energy. Figures 3 c) and d) shows the dependence of the same pulse features on length of SA. Large SA length lead to low energy and peak of pulse due to the increase of losses in SA. We believe that our work provides a good basis for future experimental study of pico-seconds pulses generated by blue InGaN laser with saturable absorber.

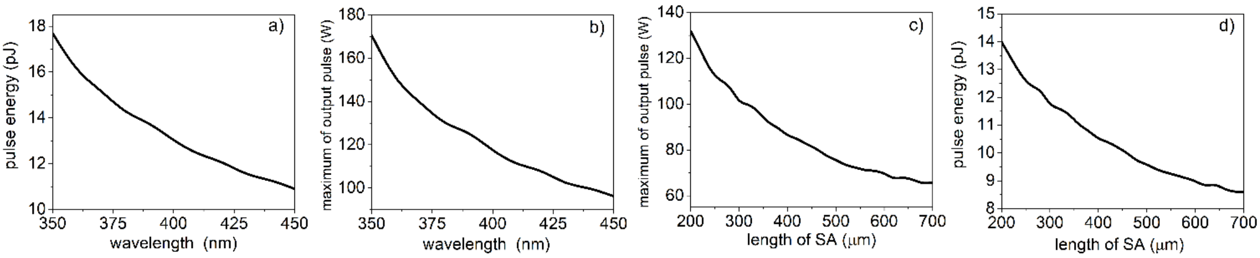

Figure 3. Dependences of pulse features (energy and peak) on the laser parameters.

[1] V.Z. Tronciu et al Optics Communications 235 (2004) 409–414