The effect of mercury lamp irradiation on the threshold current density of electron beam pumped ZnSe-based lasers

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Abstract—It has been demonstrated that after 3 - 5 minutes irradiation of the MBE grown ZnSe-based electron beam pumped laser heterostructures with the light intensity of mercury lamp of 40-60 W/cm², the luminescence intensity increased by ~20-50 %, whereas the threshold current density reduced by 20-40 %. Evidently, the results could be explained by the annealing (or optical transformation) the initial point defects in the active area of the laser heterostructure induced by low-temperature growth.

Keywords—electron-beam pumped lasers, QW-structures, mercury lamp

ZnSe-based semiconductor QW-structures grown by molecular beam epitaxy on GaAs substrates are used as active elements of electron-beam pumped (EBP) lasers. Such lasers emitting in the wavelength range from yellow to blue, may be used for the optical radar and communication, for data transmission on the plastic fiber, medicine, etc. Recently, the electron energy of ZnSe-based green electron beam pumped (EBP) lasers of less than 5 keV has been demonstrated [1], and the output pulsed power as high as 600 W has been achieved for the laser array at U_e = 27 keV [2]. However, further reduction of the threshold current density (j_th) of ZnSe-based EBP lasers is of a great importance. The j_th is governed by both EBP laser structure design and the level of defects in the structure acting as a non-radiative recombination centers. The paper reports on studies of the effect of mercury lamp irradiation on the luminescence intensity and j_th of EBP ZnSe-based lasers.

The structures studied contain lower and upper cladding ZnMgSSe layers, graded index waveguide based on alternately-strained Zn(Mg)SSe/ZnSe superlattice [3], and active region consisted of one or two CdSe quantum dot layers placed in the center of ZnSe quantum wells. The structures were irradiated by the light of mercury lamp in the fluorescence microscope. The parameters of the electron-beam pumping used in laser experiments were the following: electron beam energy up to 11 keV, pulse duration time of ~ 0.3 μs and repetition rate of 1.5 Hz. All measurements were done at room temperature.

References