The Feasibility Of XeCl Lasing At The Excitation Of A Xe/CsCl Gas-Vapor Mixture By A Longitudinal Pulse-Periodic Discharge

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At present, the applicability of rare gas and alkali halide vapor mixture excited by a longitudinal pulse-periodic discharge to produce intense ultraviolet luminescence of KrCl* (222 nm), XeBr* (282 nm), and XeCl* (308 nm) exciplex molecules has demonstrated experimentally (see, for example, [1-3]). This radiation is especially suitable for development of spontaneous narrowband radiation sources with a high spectral power density peaked in the UV spectral range. Alkali halides as a halogen donor for exciplex molecule producing has variety of advanced features such as low halogen-carrier toxicity, alternative to traditional mechanism of exciplex molecule formation providing high quantum efficiency, etc.

This advancement leaded to the question of whether it is possible to realize lasing on the exciplex molecule in such discharges. For this purpose an original kinetic model was constructed to simulate the characteristics of the XeCl* exciplex molecule emission excited by the longitudinal pulse-periodic discharge in the mixture of Xe and CsCl vapor. The Xe/CsCl gas-vapor mixture, corresponding to the available experimental data, was chosen due to the highest intensity of the XeCl* exciplex molecules radiation [1]. Application of the created kinetic model in simulation of emission characteristics of XeCl* exciplex molecule spontaneous radiation leads to a good agreement of obtained results with experimental one [4].

In the course of modeling of possibility to realize lasing on the XeCl* exciplex molecule in the Xe/CsCl gas-vapor mixture exited by a longitudinal pulse-periodic discharge the accumulation of XeCl* exciplex molecules at the certain conditions in the simulation turned out sufficient to reach gain of active medium above the threshold value needed to lasing. At the following conditions Xe = $3\cdot10^{17}$ cm^{-3}, CsCl = $1\cdot10^{17}$ cm^{-3}, and f = 4 kHz the calculated specific average power of laser radiation may reach up to 0.2 W/cm^3 with the lasing efficiency with respect to the deposited energy in the active medium of about 3%. It should be mentioned that realizing of lasing at such non-high working pressures (tens of Torr), in contrast with exciplex lasers based on traditional gas mixtures, results in reduction of quenching processes intensity and discharge instabilities development at increasing of pulse repetition frequency, and do not need application of preionization.

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