Study of Energy and Time-Depending Characteristics of Pulse-Periodic Oxygen-Iodine Laser

S. D. Velikanov, V. G. Gorelov, I. V. Gostev, V. V. Kalinovsky, I. A. Komissarov, V. V. Konovalov, I. V. Konovalov, V. N. Mikhalkin, **V. D. Nikolaev**[1], I. V. Sevryugin, A. V. Smirnov, R. E. Sobolev and L. N. Shornikov

"Russian Federal Nuclear Centre – All-Russian Research Institute of Experimental Physics", av. Mira 37, Nizhny Novgorod region, Sarov 607188, Russia

In [1-3] there was investigated the residual chlorine influence on the parameters of pulse generation of chemical oxygen-iodine laser (COIL). It's impossible to achieve 100% of the chlorine utilization without essential deactivation of singlet oxygen in the reactor of the singlet oxygen generator (SOG) that is a constituent part of COIL. Under natural conditions, that's why residual chlorine is always present at the exit of the SOG.

This paper investigates oxygen-iodine laser with an active medium generated by electric discharge in pulse-periodic mode. Our experiments were performed in a 5-m-length resonator. The laser pulses were processed statistically for the following chlorine flowrates: (62 ± 2) mmole/s, (92 ± 2) mmole/s, and (105 ± 2) mmole/s. The repetition rate of the pulses was 12.5 Hz. The experiments were performed at the chlorine concentration in the laser volume varied from $1.0 \cdot 10^{15}$ cm^{-3} to $1.0 \cdot 10^{16}$ cm^{-3}.

The investigations showed:

- when the laser radiation is generated in a steady 5-m-length resonator, the average per-pulse energy does not depend on the concentration of the residual chlorine in the laser volume at the concentration ranged from $1.0 \cdot 10^{15}$ cm^{-3} to $1.0 \cdot 10^{16}$ cm^{-3};
- the per-pulse laser energy increases proportionally to the increasing chlorine flowrate (in the above range) in the singlet oxygen generator;
- in pulse-periodic mode, the average duration of the laser pulses depends on the in-SOG chlorine flowrate and is $\tau = (14.5 \pm 1.5)$ μs at Q = 62 mmole/s, $\tau = (12.5 \pm 1.5)$ μs at Q = 92 mmole/s, $\tau = (12.5 \pm 1.0)$ μs at Q = 105 mmole/s;
- for the laser pulses, the probability to be in the indicated ranges is 80 %;
- when the chlorine flowrate goes up in the singlet oxygen generator, the probabilistic distribution of pulse duration gets distorted and noticeable "wings" appear in this distribution;
- the development of the laser generation gets delayed by the time $\Delta\tau = (12 \pm 2)$ μs by an order exceeding the volumetric discharge lifetime.

[1] Vagin N. P., Zolotarev V. A., Pazyuk V. S. et al., Kvantovaya Elektronika **18**, 840 (1991)

[2] Andreeva T. L., Kuznetsova S. V., Maslov A. I., Sorokin V. N., Kvantovaya Elektronika **32**, 485 (2002)

[3] Velikanov S.D., Gorelov V.G., Gostev I.V. et al., SPIE Proc. **6346**, 63463F (2007)

[1] E-mail: nvd@rol.ru