ANALYTICAL CALCULATION OF OUTPUT STOKES PULSE ENERGY AT INTRACAVITY RAMAN CONVERSION IN Q-SWITCHED LASERS

Yu. V. Loiko, A. A. Demidovich, A. P. Voitovich

Institute of Molecular and Atomic Physics, NASB, Minsk

In this communication we address the problem of Stokes pulse energy finding and its optimization in Q-switched lasers with intracavity laser frequency conversion by stimulated Raman scattering (SRS). The analytical expressions for the energy extracted from the Q-switched lasers by the Stokes pulse at different time intervals of pulse development as well as for the total output Stokes pulse energy have been derived. It has been demonstrated that the obtained analytical expressions in conjunction with the analytical expressions which describe the shapes of the pulses at fundamental (FL) and Stokes frequencies can be applied for finding the Stokes pulse energy and they are suitable for optimization of the Stokes pulse energy of Q-switched lasers with intracavity SRS. It has been found that the overall optimization of Stokes pulse energy is closely related with the problem of intracavity FL pulse peak power optimization in the Q-switched lasers without the intracavity Raman conversion but with the same laser parameters. We check the validity of the obtained analytical expressions by comparing with the numerical results. Good agreement with the numerical data has been found.

We also considered the problem of the output Stokes pulse energy optimization. It has been shown that there is the cavity output coupling factor at Stokes frequency which optimizes (maximizes) the output Stokes pulse energy when the other laser parameters are fixed. It has been found that the output Stokes pulse energy increses with intreasing the output mirror refelectivity at FL frequency. The obtained analytical expressions have been applied for the optimization of the output Stokes pulse energy for the Cr^{4+}:YAG Q-switched Nd:LSB microchip lasers with the $Ba(NO_3)_2$ Raman medium. The analytical results agree with the known experimental data.

Hence the following strategy for the Stokes pulse energy optimization in the Q-switched lasers with intracavity Raman conversion can be proposed for the given gain medium and saturable absorber. To achieve the maximum output Stokes pulse energy, the Stokes pulse peak and the FL pulse peak should be aligned in such a way that meet it maximum closeness at maximum cavity losses at Stokes frequency.