STABILIZATION OF OUTPUT PARAMETERS FOR HIGH POWER SLAB GUIDE LASERS BY THE CHOICE OF AN ELECTRODE MATERIAL AND ITS SURFACE QUALITY

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Results of theoretical and experimental investigation of optical parameters of slab guide resonators used in industrial lasers of the middle IR range with radio-frequency pumping and output power from 200 W up to 4.5 kW are given.

The measurements were carried out with the help of the automated system on the basis of scanning interferometer of the middle IR range. As a source of radiation sealed off and waveguide carbon dioxide lasers with tunable frequency, mode structure and a state of polarization of generation were used. Developed system of positioning allowed to vary geometry of the resonator and electrodes with the precision down to some micrometers. The influence of a material, type of a covering and quality of a surface of electrodes on optical parameters of slab guide resonators have been investigated. Alumina, copper, aluminium and their mixture were used as a material for electrodes. Alumina was used also as a dielectric layer for electrode surface. Electrode surface quality was varied by special instrument which allowed to get both periodical and random profile of the surface roughness. Profile deepness of the electrode surface was varied from 2 till 20 micrometers.

Significant (two, three times and more) variation of optical losses in the resonator under small (down to several micrometers) change of its geometry has been found out experimentally. Replacement of a material or use of dielectric covering of the electrode surfaces has been followed not only by the change of an average level of optical losses due to complex index of refraction, but also rather complex varying of their dependence on geometry of the resonator. It was shown experimentally that absolute value and character of dependence of optical losses on resonator geometry can change drastically with variation of the roughness of electrode surface. For example nearly smooth surfaces (with a the deepness of the roughness of some nanometers) are not optimum for minimal optical losses. The best results can be obtained for a structure of a surface of electrodes representing periodic structure with depth and period, which are greater than a radiation wavelength. If the structure of a surface roughness is more random, the general tendency is an increasing the average level of optical losses and reduction of their variation with the change of the resonator geometry.