DESIGN AND CHARACTERIZATION OF RESONATOR MIRRORS FOR MICROLASERS ON THE BASE OF $YAlO_3$ SINGLE CRYSTALS ACTIVATED WITH Nd^{3+} AND Tm^{3+} IONS

O.S. Ilyina[1], V.G. Hajduchok[1], A.I. Izhnin[1], D.Yu.Sugak[1*], R.M. Kuzmak[1], I.I. Syvorotka[1], Ya.J. Diachok[2], M.M. Vakiv[1]

[1] Institute of Materials, SRC "Carat", Lviv, Ukraine
[2] Institute of Physical Optics MEU, Lviv, Ukraine
* sugak@carat.lviv.ua

Nowadays one of the most actual problems for laser systems is their dimension decrease. This task can be resolved by means of creating of microlasers with diode pumping, where multilayer dielectric thin-film mirrors are applied on working surfaces of the active element instead of using of external resonator mirrors. One of the most used laser active medium is $Y_3Al_5O_{12}$ but more of the task can be resolved with the usage of $YAlO_3$ crystals that have certain advantages comparing with garnet: higher growth rate, lower melting temperature, polarization of radiation. Of high interest are lasing wavelengths 1,079 and 1,342 μm that can be obtained on $YAlO_3$:Nd and 1,94 μm on $YAlO_3$:Tm.

Present work is devoted to theoretical calculations of input (transparent to pumping radiation and opaque to laser radiation) and output (opaque to pumping radiation and partially transparent to laser radiation) mirror characteristics for $YAlO_3$:Nd and $YAlO_3$:Tm microlasers and to studying of the mirrors obtained by electron-beam evaporation method in accordance with the calculations.

The mirrors were created from SiO_2 (material with lesser refractive index (n_i) than the refractive index of $YAlO_3$) and from HfO_2 (material with higher n_i). The cdalculations were made with the help of the program *Berechnung und Optimierung von dielektrischen Spiegeln-Version 0.22*. The results of the calculations are given in the table below.

Substrate material	Mirror type	λ_{pump}, μm	λ_{gen}, μm	R_{pump}, %	R_{gen}, %	Quantity of layers	Total thickness, nm
$YAlO_3$:Nd	input	0,808	1,079	0,51	95,40	15	4355,5
$YAlO_3$:Nd	output	0,808	1,079	96,99	90,90	16	4893,3
$YAlO_3$:Nd	input	0,808	1,342	0,022	91,27	13	3308,5
$YAlO_3$:Nd	output	0,808	1,342	95,36	90,69	16	4781,2
$YAlO_3$: Tm	input	0,795	1,940	0,64	94,54	15	4215,7
$YAlO_3$: Tm	output	0,795	1,940	94,63	72,84	14	3384,7

To check our theoretical calculations, we have evaporated the input mirror on the $YAlO_3$:Nd crystal surface (λ_{pump} = 0.808 μm, λ_{gen} = 1.079 μm) and measured its reflection spectrum to compare with the theoretically obtained. Laser damage of obtained mirrors was studied as well. It was demonstrated that used calculations method can be applied for the development of resonator mirrors for microlasers.