CThI18

An Optimized Diode-Pumped $BaY_2F_8:Er^{3+}$(7.5 at.%) Laser at 2.8 µm

S. Wittwer, M. Pollnau, R. Spring, W. Lüthy, H. P. Weber, R. A. McFarlane [1], Ch. Harder[2], H. P. Meier[2], Institute of Applied Physics, University of Bern, Sidlerstrasse 5, CH-3012 Bern, Switzerland, Tel. +41-31-631 89 37, Fax +41-31-631 37 65, [1] Hughes Research Laboratories, 3011 Malibu Canyon Road, Malibu, CA 90265, USA, [2] IBM Research Division, Zürich Research Laboratory, Säumerstrasse 4, CH-8803 Rüschlikon, Switzerland

The potential surgical applications of 2.8-µm radiation due to its strong absorption in water and thus in biological tissue has motivated the investigation of laser operation in erbium-doped host materials. Modern surgical applications demand a compact laser system with high output power. GaInAs diode lasers at 970 nm are an excellent pump source for Er^{3+} lasers and allow the desired compactness.The best pump wavelength for an erbium 3-µm laser is 970 nm leading to a transition into the upper laser level [1]. Fluoride hosts promise high efficiency.This has been confirmed by several experiments, that have been raising the efficiency in $LiYF_4:Er^{3+}$ up to 40 % [2] with Ti:sapphire-pumping and 35 % [3] *with diode-pumping*. The optimization of the slope efficiency for $LiYF_4:Er^{3+}$ lasers is still assumed to proceed towards the theoretically *predicted efficiency maximum* of 56 % [4]. Efficient lasers are also reported in BaY_2F_8: Er^{3+}. For this crystal we expect a similar efficiency as in $LiYF_4$: Er^{3+}, especially for optimized erbium concentrations of 10 to 15 at.% [5].

Only few experiments, however, are reported so far on laser-diode-pumped BaY_2F_8: Er^{3+}. The spectral properties of such a diode-laser pumped system have not yet been described and with the goal to reach a high slope efficiency the laser parameters have to be optimized.

In our report we describe the optimization of a $BaY_2F_8:Er^{3+}$ laser with respect to a high slope efficiency. The measurements are carried out with a nearly hemiconcentric resonator. Resonator length, cavity reflectance and the focus of the pump beam are optimized. The spectrum of the emitted wavelengths at 2.7 to 2.8 µm is measured as a function of absorbed pump power. The threshold is as low as 16 mW. The best slope efficiency of $\eta = 24$ % is reached for a nearly hemiconcentric resonator with reflectance of $R_{in}R_{out}$ = 97.6 % and a pump beam focused with a lens of f_1=20 mm.

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Effect of gamma radiation on performance of Cr, Tm, Ho:YAG and Er:YAG lasers

S.Kaczmarek, Z.Mierczyk, K.Kopczyński - Institute of Optoelectronics, MUT, 2 Kaliski Str., 01-489 Warsaw, Poland
A.O.Matkovsky, D.Yu.Sugak, - SRC "Carat", R&D Institute of Materials, 202, Stryjska Str., 29003, Lviv, Ukraine
A.N.Durygin - Institute of Physics, Ukrainian Academy of Science, 46 Nauka Av., 252650, Kiev, Ukraine
Z.Frukacz - Institute of Electronic Materials Technology, 133 Wólczyńska Str., 01-919 Warsaw, Poland

Summary

It is well-established that color centers (CCs) produced by ionizing radiation or short-wave radiation of the pump lamp, strongly influence the optical characteristics of yttrium-aluminium garnet single crystals [1-4]. However, the possibility of positive effect of ionizing radiation on optical output of YAG lasers should not be rejected. The present work regards the effects of gamma radiation on performance of Er:YAG and CTH:YAG lasers.

After gamma irradiation of Er:YAG crystals, a wide, complex AA band appears within the range of 200-930 nm. The peaks of absorption are placed in the surroundings of 240, 310, 400 and 625 nm. With the increase of gamma irradiation dosage level from 10^2 to10^4 Gy, the AA values grow larger and larger and become saturated for dosage levels of 10^4-10^6 Gy. After gamma irradiation of CTH:YAG crystal, AA bands appears within the range of 250-710nm with some discrete absorption peaks at 255, 320, 385 and 500 nm. it. Stable at room temperature CCs, could be the results of defects of cation sublattice, oxygen vacancies or defects connected with ions of non-controlled impurities. For the rods of CTH:YAG without pre-annealing, the laser output energy increases immediately after irradiation. The changes have the stable character - the output laser energy stay the same after even 80 days from irradiation and after many pulses of pump xenon lamp. The increase of the laser output energy is also observed for Er:YAG crystal after influence of gamma-quanta. At the pumping level of 205 J, the output energy increases from 75 mJ for an nonirradiated crystal to 135 mJ for the sample irradiated. The obtained results point to the direct influence of the CC on the processes of formation of the population inversion of the laser levels of Er:YAG and CTH:YAG crystals.

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