Laser performance overview of rare-earth doped multicomponent garnet crystal $Gd_3(Ga,Al)_5O_{12}$

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Crystaline multicomponent garnet $Gd_3(Ga,Al)_5O_{12}$ (GGAG) was investigated as a solid-state laser host material doped with trivalent rare-earth ions (RE^{3+}). The use of this material as a laser active medium follows successful growth and investigation of Ce^{3+}-doped GGAG as a high yield scintillator with good optical quality [1]. Several factors make the RE^{3+}doped GGAG a promising active medium for diode-pumped, wavelength-tunable lasers. The crystal internal disorder and multi-site structure induces broadening of the dopant spectral lines. Wide absorption bands significantly decrease sensitivity to pump diode wavelength fluctuation. Broadening of emission lines contributes to obtaining broad and continuous wavelength tuning curve. The garnet structure offers advantages such as excellent thermal conductivity, considerable hardness and high damage threshold [2]. Spectroscopic and laser properties were investigated for GGAG doped with active ions such as Er^{3+}, Yb^{3+}, Pr^{3+}, Tm^{3+}, or Ho^{3+} [3-5]. This contribution focuses on spectroscopy and solid-state lasers based on Tm^{3+} and Ho^{3+} doped GGAG, emitting in 2 μm region. Compared to crystalline Tm:YAG, the Tm:GGAG absorption lines useful for diode pumping are broadened from $\Delta\lambda$ = 4 nm to $\Delta\lambda$ = 11 nm in the 0.8 μm region and from $\Delta\lambda$ = 15 nm to $\Delta\lambda$ = 35 nm near 1.7 μm, expressed as full width at half maximum (FWHM). Smooth laser emission wavelength tuning was obtained in range of 1870-2057 nm for Tm:GGAG and 1933-2118 nm for Tm,Ho:GGAG. Furthermore, watt-level continuous-wave operation was achieved under resonant diode pumping.

The work is supported by Operational Programme Johannes Amos Comenius financed by European Structural and Investment Funds and the Czech Ministry of Education, Youth and Sports (CZ.02.01.01/00/23_020/0008525, project LASCIMAT)

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