Monoclinic Tm:$MgWO_4$ crystal: Crystal-field analysis, tunable and vibronic laser demonstration

Pavel Loiko (Foreign) [1],

Yicheng Wang (Foreign) [2],

Josep Maria Serres (Foreign) [3],

Xavier Mateos (Foreign) [4],

Magdalena Aguilo (Foreign) [5],

Francesc Díaz (Foreign) [6],

Lizhen Zhang (Foreign) [7],

Zhoubin Lin (Foreign) [8],

Haifeng Lin (Foreign) [9],

Ge Zhang (Foreign) [10],

Elena Vilejshikova (Foreign) [11],

Elena Dunina (Foreign) [12],

Alexey Kornienko (Foreign) [13],

Liudmila Fomicheva [14],

Valentin Petrov (Foreign) [15],

Uwe Griebner (Foreign) [16],

Weidong Chen (Foreign) [17]

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1 Foreign (Física i Cristal·lografia de Materials i Nanomaterials (FiCMA-FiCNA)-EMaS, Dept. Química Física i Inòrganica, Universitat Rovira i Virgili (URV), Campus Sescelades, E-43007 Tarragona, Spain; ITMO University, 49 Kronverkskiy Pr., 197101 St. Petersburg, Russia)

2, 15, 16, 17 Foreign (Max Born Institute for Nonlinear Optics and Short Pulse Spectroscopy, Max-Born-Str. 2a, D-12489 Berlin, Germany)

3, 4, 5, 6 Foreign (Física i Cristal•lografia de Materials i Nanomaterials (FiCMA-FiCNA)-EMaS, Dept. Química Física i Inòrganica, Universitat Rovira i Virgili (URV), Campus Sescelades, E-43007 Tarragona, Spain)

7, 8, 9, 10, 17 Foreign (Key Laboratory of Optoelectronic Materials Chemistry and Physics, Fujian Institute of Research on the Structure of Matter, Chinese Academy of Sciences, Fuzhou, 350002 Fujian, China)

11 Foreign (Center for Optical Materials and Technologies (COMT), Belarusian National Technical University, 65/17 Nezavisimosti Ave., 220013 Minsk, Belarus)

12, 13 Foreign (Vitebsk State Technological University, 72 Moskovskaya Ave., 210035 Vitebsk, Belarus)

14 Belarusian State University of Informatics and Radioelectronics, 6 Brovka St., 220027 Minsk

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Abstract: Tm^{3+}-doped monoclinic magnesium monotungstate ($MgWO_4$) is a promising material for lasers emitting at above 2 μm. Stark splitting of $^3H_6$ to $^1G_4$ Tm^{3+} multiplets in $MgWO_4$ is determined using low-temperature spectroscopy, calculated within crystal-field theory

modified for the case of an intermediate configuration interaction (ICI) and analyzed in terms of the barycenter plot. Tm^{3+}:$MgWO_4$ features a large Stark splitting of the ground-state ($^3H_6$), 633 cm^{-1}, and high transition cross-sections for polarized light due to its low-symmetry structure. A unique feature of Tm^{3+}:$MgWO_4$ to provide a naturally polarized emission at >2 μm, as well as its suitability for broadly tunable and mode-locked lasers in this spectral range are argued. The first tunable and vibronic Tm^{3+}:$MgWO_4$ lasers are demonstrated, yielding a continuous tuning from 1897 to 2062 nm in the former case. A vibronic laser operated at even longer wavelengths up to 2093 nm due to electron-phonon coupling with low-energy phonons of the crystalline host. Moreover, the optical indicatrix axes of high-refractive-index biaxial $MgWO_4$ are assigned.

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