Spectroscopic properties of Bi_3TeBO_9 ceramics doped with rare earth ions

Taras Zhezhera[1*], Pawel Gluchowski[2], Marek Nowicki[1,3], Maciej Chrunik[4], Andrzej Majchrowski[4] and Dobroslawa Kasprowicz[1].
*taras.zhezhera@put.poznan.pl
[1]Faculty of Materials Engineering and Technical Physics, Poznan University of Technology, Poznan, Poland
[2]Institute of Low Temperature and Structure Research of Polish Academy of Sciences, Wroclaw, Poland
[3]Center for Advanced Technology, Adam Mickiewicz University, Poznan, Poland
[4]Institute of Applied Physics, Military University of Technology, Warszawa, Poland

Investigated $Bi_3TeBO_9:Yb^{3+}/Er^{3+}$ μ-crystalline powders and ceramics are bifunctional materials, exhibiting nonlinear optical properties of Bi_3TeBO_9 matrix [1] and effective luminescent properties of active Yb^{3+} and Er^{3+} ions. In this work, we present the results of investigation of up-conversion luminescence of $Bi_3TeBO_9:Yb^{3+}/Er^{3+}$ μ-crystalline powder and ceramics studied by optical spectroscopy methods. $Bi_3TeBO_9:Yb^{3+}/Er^{3+}$ μ-crystalline powder were prepared using modified Pechini method. The hexagonal structure of $P6_3$ space group of Bi_3TeBO_9 μ-crystalline powder was confirmed using XRD measurements [2]. Low temperature high pressure sintering method was used for the fabrication of the $Bi_3TeBO_9:Yb^{3+}/Er^{3+}$ μ-crystalline ceramics using as starting $Bi_3TeBO_9:Yb^{3+}/Er^{3+}$ μ-crystalline powder under various pressure: 2, 4, 6 and 8 GPa. The vibrational properties of investigated samples were studied using μ-Raman spectroscopy. The results indicate a potential use of $Bi_3TeBO_9:Yb^{3+}/Er^{3+}$ ceramics as spectral converters in new generation photovoltaic devices.

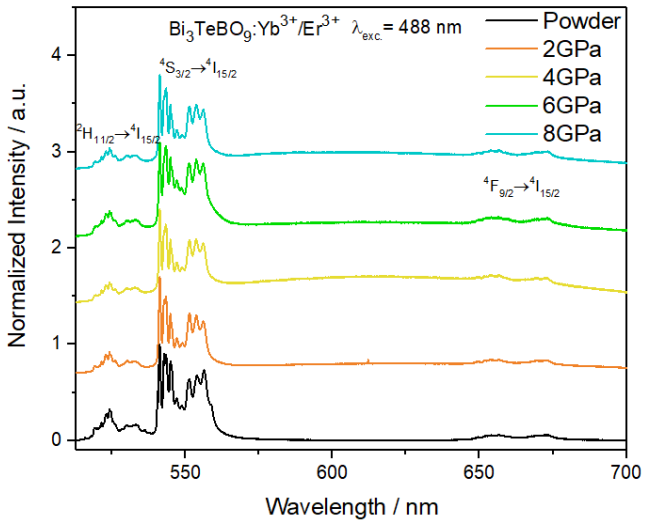

Fig.1 Emission spectra of $Bi_3TeBO_9:Yb^{3+}/Er^{3+}$ samples upon 488 nm excitation, recorded at 300 K.

[1] Xia M, Jiang X, Lin Z and Li R, "All-Three-in-One": A New Bismuth–Tellurium–Borate Bi_3TeBO_9 Exhibiting Strong Second Harmonic Generation Response, J. Am. Chem. Soc. 2016;138(43): 14190-14193.
[2] Kasprowicz D, Zhezhera T, Lapinski A, Chrunik M, Majchrowski A, Kityk A V and Shchur Ya, Lattice dynamics of novel Bi_3TeBO_9 microcrystals: μ-Raman/IR spectroscopic investigation and ab initio analysis J. Alloys Comp. 2019;782:488-495.

Acknowledgement: This work was supported by the Research Project of the Polish Ministry of Sciences and Higher Education: 0511/SBAD/2251.