11TH CONFERENCE
FOR YOUNG SCIENTISTS IN CERAMICS

Satellite event:
ESR COST IC1208 Workshop

BOOK OF ABSTRACTS

October 21-24, 2105
Faculty of Technology
Novi Sad, Serbia

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PROGRAMME
and
BOOK OF ABSTRACTS

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Prof. Dr. Vladimir V. Srdić
Prof. Dr. José M. Oton

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find wide variety of industrial applications such as armors, lenses etc. Currently, ceramics is also very interesting material for active media of solid-state lasers. Since the 1990s the technology to generate a coherent beam from ceramic materials is improved and highly efficient lasers are investigated.

Trivalent thulium (Tm) and holmium (Ho) doped materials are suitable for generation of 2 μm emission in "eye-safe" wavelength region and can be used for biomedical, metrology and remote sensing applications. With novel freeze granulation method it is possible to obtain Tm,Ho:YAG ceramics with a high degree of microstructure homogeneity, which has resulted in high mechanical, thermal and optical properties equivalent to the best single crystals.

In this work we present the fluorescence properties in the "eye-safe" spectral range of YAG transparent Tm,Ho:YAG ceramics with various doping level of active ions. The unique set of transparent Tm,Ho:YAG ceramics with Tm concentrations ranging from 2 up to 6 at.% and Ho concentrations ranging from 0.1 up to 1 at.% enabled the investigation of dopants concentration influence on fluorescence properties. Careful spectroscopic characterization was performed, comprising concentration-dependent fluorescence spectra and fluorescence dynamics profiles under direct thulium and holmium ions excitation. All measurements were carried out at room temperature. Moreover, the energy transfer processes between Tm and Ho ions for both types of excitation (785 nm and 538 nm) has been demonstrated and discussed.

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HYDROTHERMAL SYNTHESIS OF OPTICALLY ACTIVE RARE EARTH FLUORIDES

I. Dinic[1], L. Mancic[1], M.E. Rabanal[2], O. Milosevic[1]

[1]*Institute of Technical Sciences of SASA, Belgrade, Serbia*
[2]*Materials Science and Engineering Department and IAAB, Universidad Carlos III Madrid, Spain*

Hydrothermal method has great interest in recent years for synthesis of nano- and micro- crystals of upconverting rare earth (RE) fluorides, with controlled morphology and high purity, under high temperatures and pressures. Some surfactants (ethylenediaminetetraacetic acid (EDTA), polyvinylpyrrolidone (PVP), oleic acid (OA)) along with different type of solvents are added in order to control size, morphology and crystalline phases of particles. In this work Yb^{3+}/Er^{3+} co-doped YF_3 and $NaYF_4$ fine powders were synthesized using the hydro/solvo thermal method in the present of EDTA as a complexing agent. Effect of the processing parameters on the particles crystal structure, morphology and optical properties were estimated on the basis of X-ray diffractometry (XRPD), scanning electron microscopy (SEM) and photoluminescence measurement. It was shown that in terms of increased concentration of RE ions in aqueous solvent media the hexagonal β-$NaYF_4$:Yb^{3+}/Er^{3+} phase with the most efficient green emission were synthesized. On the other side, the occurrence of cubic α-

$NaYF_4:Yb^{3+}/Er^{3+}$ and orthorhombic $YF_3:Yb^{3+}/Er^{3+}$ were observed with a decrease of the RE ions when ethanol is used as a solvent. All of the samples provide intense green emission after been excited with infrared light (λ = 978 nm), which is assigned to the Er^{3+} ($^2H_{11/2}$, $^4S_{3/2}$) → $^4I_{15/2}$ electronic transitions.

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INFLUENCE OF Yb^{2+} ON OPTICAL PROPERTIES OF YAG:Yb GARNET

M. Chaika, O. Vovk, R. Yavetskiy, O. Lopin

Institute for Single Crystals, National Academy of Sciences of Ukraine, Kharkiv, Ukraine

Ceramic yttrium aluminum garnet (YAG) doped with Yb ions is one of promising material for solid state lasers due to the small quantum defect between the pump and the laser photons resulting in low thermal loading, long radiative lifetime of the upper laser level. Ytterbium ions in garnet can exist in two charge states 2^+ and 3^+. The presence of Yb^{2+} ion reduces fluorescence lifetime, and as result laser properties of ceramics. The purpose of this work is investigating charge valence transformation Yb ions in YAG.

To study the oxidation process ceramics of $Yb_{0,3}Y_{2,7}Al_5O_{12}$ was synthesized by reaction sintering. The synthesis was performed in a vacuum furnace at 1750 °C for 10 hours. After vacuum sintering ceramic YAG contain both Yb^{2+} and Yb^{3+} ions. Ceramics studied by means of XRD, scanning electron microscopy (SEM), optical absorption spectroscopy.

Synthesized ceramic consists of grains in range 3–40 nm. X-ray analysis reveals no impurity phase. Ytterbium ion can change valence state by means of oxidizing/reduction process. Under oxidation the oxygen is absorbed by ceramics, diffuses to Yb^{2+}, and oxidizes ones. This process is thermally activated.

Ceramic YAG:Yb was heat treatment at three different temperature 860 °C, 890 °C, 920 °C for different time. Monitoring the concentration of Yb^{2+} was performed with absorption spectra of Yb^{2+} and the ion concentration was calculated using the formula Smakula-Dexter.

The geometrical Yander model was used to describe dependence obtained. It was shown that process of changing valence of Yb ion limited by a diffusion mode. The value of activation energy of the oxidation process Yb^{2+} ions in ceramic YAG: Yb is estimated as 2.7 eV which is two times higher than one for single crystal of the same chemical composition that equals of 1.43 eV. This is most probably the fast that after mechanical treatment surface have different atomic defect, which are the centers of adsorption of molecules. This factor contributes to increasing rate of adsorption of oxygen onto the surface of the sample and consequently accelerated the whole process. Grains in ceramics possess atomic smooth surface, only grains located near the surface of the sample have the broken layer. Structural perfections of grain surface are the reason increasing activation energy process change valence transformation Yb^{2+} ion in YAG.