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Editorial

Rare Earths Doped Materials

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The properties of the Rare Earth Elements allow a wide range of applications in optoelectronics, fiber amplifiers, solid-state lasers, telecommunications, biosensing, and photocatalysis, just to mention a few. These applications are all based on the Rare Earth Elements capability to improve the properties of materials doped with them. The Special Issue on "Rare Earths Doped Materials" is focused on the research and investigation of Rare Earth Element-doped materials, on the methods for their characterization, and the development of new properties, i.e., briefly on the way Rare Earth Elements can expand the properties of different materials. All publications in this Special Issue are original contributions. Different materials doped with Rare Earth Elements are presented in the publications, among them nanoparticles of $Zr_{1-x}Eu_xO_{2-0.5x}$ [1], fluoridated hydroxyapatite [2], $Bi_{12}GeO_{20}$ sillenite bulk crystals [3], $GdSb_2O_4Br$, $TbSb_2O_4Br$ [4], and $LuVO_4$ [5].

The influence of the Rare Earth Element Eu on the crystal structure of the host matrix was investigated by increasing the Eu^{3+} concentration in $Zr_{1-x}Eu_xO_{2-0.5x}$ nanoparticles ($x = 0.02 \div 0.15$) according to Bugrov et al. [1]. A transition from the equilibrium monoclinic zirconia phase to metastable tetragonal and cubic polymorphic modifications was observed. The nanoparticles can be used in organic–inorganic composites for medical applications and show changes in the structure with time [1].

The influence of a Rare Earth Element on luminescence properties is demonstrated by Eu^{3+}-doped fluoridated hydroxyapatite. The relationship between the luminescence enhancement of Eu^{3+} ions and the fluorine substitution ratio for hydroxyl groups in hydroxyapatite was discussed by Zhang et al. [2]. The effects of the substitution of hydroxyl groups by fluorine on the phase composition, crystallinity, and crystal size were studied. It was found that fluorine affects the symmetry of the structure and thus changes the surrounding environment of the Eu^{3+} ions [2].

The spectroscopic properties (both absorption and emission) of Eu^{3+}-doped $Bi_{12}GeO_{20}$ sillenite bulk crystals were presented by Kowalczyk et al. [3], measured both at 300 and 10 K. Luminescence was observed at both temperatures due to direct Eu^{3+} ion excitation, as well as under UV excitation due to the energy transfer between Bi^{3+} and Eu^{3+} ions.

Pale yellow crystals of $LnSb_2O_4Br$ (Ln = Eu – Tb) were synthesized via high-temperature solid-state reactions by Goerigk et al. [4]. Photoluminescence studies of Eu^{3+}-doped $GdSb_2O_4Br$ and $TbSb_2O_4Br$ showed efficient sensitization of the Eu^{3+} emission, proving that Sb^{3+} is an efficient sensitizer for Ln^{3+} emission. For $TbSb_2O_4Br$, a remarkably high energy transfer from Tb^{3+} to Eu^{3+} was detected that led to a substantially increased Eu^{3+} emission intensity, showing it can be an efficient red light-emitting material [4].

The crystal- and correlation-field splitting effects in the vibrational spectrum of lutetium orthovanadate $LuVO_4$ were studied and discussed by Rafailov et al. [5]. The Raman investigation of $LuVO_4$ with the full utilization of the symmetry properties of different modes is presented. Modes with exceptionally low Raman intensity were detected, and all 12 Raman active vibrations were assigned [5].

The present Special Issue on "Rare Earths Doped Materials" contains a number of publications that illustrate the improvement of material properties, which can be obtained by using Rare Earth Elements and the work done in this field.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Bugrov, A.N.; Smyslov, R.Y.; Zavialova, A.Y.; Kopitsa, G.P.; Khamova, T.V.; Kirilenko, D.A.; Kolesnikov, I.E.; Pankin, D.V.; Baigildin, V.A.; Licitra, C. Influence of Stabilizing Ion Content on the Structure, Photoluminescence and Biological Properties of Zr1–xEuxO2–0.5x Nanoparticles. *Crystals* **2020**, *10*, 1038. [CrossRef]
2. Zhang, X.; Xing, Q.; Liao, L.; Han, Y. Effect of the Fluorine Substitution for –OH Group on the Luminescence Property of Eu^{3+} Doped Hydroxyapatite. *Crystals* **2020**, *10*, 191.
3. Kowalczyk, M.; Ramazanova, T.F.; Grigoryeva, V.D.; Shlegel, V.N.; Kaczkan, M.; Fetliński, B.; Malinowski, M. Optical Investigation of Eu^{3+} Doped $Bi_{12}GeO_{20}$ (BGO) Crystals. *Crystals* **2020**, *10*, 285. [CrossRef]
4. Goerigk, F.C.; Paterlini, V.; Dorn, K.V.; Mudring, A.-V.; Schleid, T. Synthesis and Crystal Structure of the Short $LnSb_2O_4Br$ Series (Ln = Eu–Tb) and Luminescence Properties of Eu^{3+}-Doped Samples. *Crystals* **2020**, *10*, 1089. [CrossRef]
5. Rafailov, P.; Dimitrov, D.; Chen, Y.-F.; Lee, C.-S.; Juang, J.-Y. Symmetry of the Optical Phonons in $LuVO_4$: A Raman Study. *Crystals* **2020**, *10*, 341. [CrossRef]