ANNOTATIONS UNDER ARTICLE 65 OF THE REGULATIONS FOR THE APPLICATION OF THE LAW ON THE DEVELOPMENT OF THE ACADEMIC STAFF

of the submitted materials for participation in the competition announced in the State Gazette, issue 98 of 19.11.2024, for the academic position of "Associate Professor" in:

Field of Higher Education: 4. Natural Sciences, Mathematics, and Computing
Professional Field: 4.2. Chemical Sciences (Inorganic Chemical Technology)

Candidate: Irena Petrova Kostova, PhD in area of higher education 4. Natural Sciences, Mathematics, and Computing of
professional field: 4.2. Chemical Sciences doctoral programme of *Technology of inorganic materials*

January 2025
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Irena Kostova/

Prepared by:
/Chief Assistant Professor Dr.

ANNOTATION OF SCIENTIFIC WORKS
of Chief Assistant Professor Dr. Irena Kostova

The report on meeting the minimum national requirements for the academic position of Associate Professor presents 25 scientific works:

5 publications meeting the requirements under indicator B4:

1. *A Simple Fiber Optic Temperature Sensor for Fire Detection in Hazardous Environment Based on Differential Time Rise/Decay Phosphorescence Response*, Samia Fouzar, Tinko A Eftimov, Irena Kostova, Todorka L Dimitrova, Abdelbaki Benmounah, Ahmed Lakhssassi, IEEE Transactions on Instrumentation and Measurement, 71, 1-8, **2022**, ISSN 189456

In the present article, we report the development of a simple temperature sensor based on the difference in the temperature dependences of the rise and decay time and the intensity responses of Eu^{2+}, Dy^{3+} -doped strontium aluminates. A 374-nm pulsed LED was used as a UV source in combination with a lead-in and -out optical fiber to excite the sample and capture the phosphorescence. We show that because of the power law rise and decay time responses, the differential signals measured at earlier instants exhibit the highest sensitivities to temperature over the range from about 5 °C to 95 °C. Normalized differential signals are characterized by a wide range of linear responses to temperature changes, sensitivity of up to -1.89 %/°C, and a relative error of less than 0.5%. Application to fire prevention is discussed and argumented.

2. *Rare-Earth-Ion (RE^{3+})-Doped Aluminum and Lanthanum Borates for Mobile-Phone-Interrogated Luminescent Markers,* Katya Hristova; Irena P. Kostova; Tinko A. Eftimov; Daniel Brabant; Samia Fouzar, Photonics **2024**, 11(5), 434

In this paper, we present the synthesis and luminescent spectra of rare-earth (RE)-doped aluminum and lanthanum borates intended to serve as narrow excitation–emission band fluorescent markers. We perform a detailed 3D excitation–emission matrix (EEM) analysis of their spectra, compare the measurements from both standard and mobile phone spectrometers, and outline the basic differences and advantages of each method. While smartphones have a different and non-uniform spectral response compared to standard spectrometers, it is shown that they offer a number of advantages such as contactless interrogation, efficient suppression of the UV excitation light, and simultaneous spectral analysis of spatially arranged arrays of fluorescent markers. The basic emission peaks have been observed and their corresponding electronic transitions identified. The obtained results show that the rare-earth-doped La and Al borates feature excitation–emission bandwidths as low 15 nm/12 nm, which makes them particularly appropriate for use as luminescent markers with UV LED excitation and smartphone interrogation.

3. *A study of strontium aluminates for all optical contactless sensing applications using smartphone interrogation,* Tinko Eftimov; I. Kostova; A. Peltekov; K. Hristova; D. Brabant; S. Fouzar; K. Nikolov, Optics & Laser Technology, Volume 176, September **2024,** 110965

In the present paper we study the spectral and time responses of Eu and Dy doped strontium aluminates and compare the results obtained by means of a standard spectrometer and a smartphone. The advantages of each measurement tool are outlined. It is shown that smartphones equipped with simple transmission diffraction grating can efficiently be used in contactless sensing applications and as measurements tools for the study of the spectral and time dependent responses of phosphors. We also show that smartphones are up to an order of magnitude faster in measuring rise and decay time responses and allow a more detailed analysis of luminescence dynamics compared to spectrometers. A method of duty cycle scanning of the time responses is proposed to study the spectrally and time dependent luminescence structure dynamics which is related to the individual distribution of traps in the phosphors. These smartphone capabilities justify their use as affordable interrogation instruments for time-decay encoded phosphorescent sensors.

4. *An Effect of Boric Acid on the Structure and Luminescence of Yttrium Orthoborates Doped with Europium Synthesized by Two Different Routines*, Irena P. Kostova, Tinko A. Eftimov, Katya Hristova, Stefka Nachkova, Slava Tsoneva, and Alexandar Peltekov, *Crystals 14, no. 6: 575,* **2024**

In this paper, we present the characteristics of photoluminescent YBO3 successfully synthesized through a solid-state reaction and a microwave-assisted method. We used ytrium oxide and boric acid in excess as the starting reagents. The synthesis conditions were reflected in the fluorescent characteristics and the structure. Excess boric acid caused structural changes, as observed by the FTIR spectroscopy analysis. Powder X-ray diffraction (XRD) analysis confirmed the crystalline phases and purity of the samples. We observed improved photoluminescence properties in the samples synthesized by the microwave-assisted method. These findings enhance the understanding of the material's properties and indicate potential applications in illumination, displays, and narrow-band fluorescent smartphone-readable markers.

5. *Synthesis and luminescence characteristics of yttrium, aluminum and lanthanum borates doped with europium ions (Eu3+)*, K. Hristova, I. Kostova, T. Eftimov, D. Tonchev, *Bulgarian Chemical Communications, Volume 56, Special Issue D (pp. 121-127), 2024*

Inorganic materials doped with rare earth (RE) ions are an object of intense research due to their optical and electrical properties. These materials have the potential for various applications, such as solid-state lasers, active planar waveguides, optical fiber amplifiers, light-emitting diodes (LEDs), displays, ink fillers, security features, etc. RE trivalent ions can emit light from the ultraviolet (UV) to the near-infrared (NIR) regions due to electronic transitions of the 4f-5d levels. Yttrium borate doped with europium ions was prepared by solid-state synthesis in a muffle furnace at 900oC for 4 hours, while lanthanum and aluminum borates doped with europium ions

were prepared at 1000oC for 6 hours again in a muffle furnace. The resulting materials are fine white powders. Among the rare earth ions, europium is one of the most commonly used activators because the ions of Eu3+ and Eu2+ can be used as emission sites in the host lattices. Eu3+ ions can produce effective sharp emission peaks in different matrix compositions. Photoluminescence analysis of the samples was performed, based on which the luminescence intensity of the Eu3+ ion was determined through a comparative characteristic. YBO3:Eu3+ phosphor is optically active and chemically stable. It is characterized by a strong orange-red emission at ≈ 591 nm, ≈ 612 and ≈ 696 nm due to the 5D0→7F1 and 5D0→7F2 electronic transitions, respectively. Red emission is also observed for LaBO3:Eu3+ at ≈ 592 and ≈ 615 nm, characterizing the 5D0→7F1 and 5D0→7Fj (j=0, 1, 2, 3, 4) transitions. While aluminum borate doped with europium ion shows intense emission at ≈ 612 nm, making this material suitable for lighting devices. The technique of Fourier transform infrared spectroscopy (FTIR) was used to study the structure of the obtained materials.

- **20 научни труда, изпълняващи изискванията по показател Г, от които:**
  - **Една публикувана книга на базата на защитен дисертационен труд за присъждане на образователна и научна степен "доктор" (показател Г6):**

1. I Kostova, *Study of samarium doped zinc borophosphates*, LAP LAMBERT Academic Publishing (**2018**-06-27), Number of pages:56., ISBN-13:978-613-9-86622-9, ISBN-10:6139866227

This book presents the synthesis and analysis of zinc phosphates and also strontium (barium) borophosphates doped with samarium as glasses and glass ceramics. The work contains detailed structural and functional studies of various modifications of these compositions. It was found a correlation between the structures of materials and some of their physical properties. Detailed study of chemical, physical and thermal characteristics of these new materials focus their industrial applications. The book presents the behavior of samarium which is ionized during the materials synthesis that in some cases converts the valence by X-rays irradiation. It is defined the glass forming range depending on the starting composition of these glass and glass ceramics and determined the chemical durability as well. The transformation of the ultraviolet radiation into visible light when these materials exposed to different irradiation are registered and a potential use such as dosimeters application, solar cells, additives to protect valuable documents etc.. The experimental data and the discussion described provide guidance for commercial implementation of these new optically active materials.

  - **18 научни публикации в издания, които са реферирани и индексирани в световноизвестни бази данни с научна информация (Web of Science и Scopus), извън хабилитационния труд (показател Г7):**

2. D. Tonchev, H. Mani, G. Belev, I. Kostova and S. Kasap*, X-ray sensing materials stability: influence of ambient storage temperature on essential thermal properties of undoped*

vitreous selenium, Journal of Physics: Conference Series 558 (**2014**) 012007 pp. 121–128, ISSN 17426588

Amorphous selenium (a-Se) is currently used in x-ray image detectors as an x-ray photoconductor. Normally a-Se films used in device applications are fabricated by the evaporation of vitreous bulk material loaded into boats in a typical vacuum deposition system. The resistance against crystallization is an important factor in both film and bulk forms of a-Se. Previous work has indicted that the resistance to crystallization is surprisingly more pronounced around 35 °C [1]. In this work we have therefore examined the essential thermal properties of vitreous selenium (99.999%) samples that have been stored at different temperatures. The thermal characterization experiments involved a series of DSC (Differential Scanning Calorimetry) measurements in which have monitored the glass transition and melting endotherms, and the crystallization exotherm in heating-cooling-heating scans. In DSC experiments, a sample would be heated to a temperature above the melting temperature, equilibrated, then cooled at a fixed rate down to 20 °C, then equilibrated and finally scanned again under a heating schedule. The samples were isothermally stored at temperatures corresponding to 18, 35 and 55 °C. The thermal analysis results show that there are distinct differences in the thermal properties. We have examined the stability in terms of the difference in the crystallization onset temperature (T_c) and the onset of glass transition temperature (T_g). We also examined the Hruby coefficient (K_{gl}) of these samples, that is $K_{gl} = (T_c - T_g)/(T_m - T_c)$ where T_c is the crystallization onset temperature and T_m is the melting onset temperature. We have found K_{gl} to depend on the storage temperature. Surprisingly, we observed that the Hruby coefficient is actually larger at 35 °C compared to the values at 18 and 55 °C.

3. Kostova, I., Okada, G., Pashova, T., Tonchev, D., Kasap, S., *Synthesis, thermal and photoluminescent properties of ZnSe-based oxyfluoride glasses doped with samarium*, Journal of Physics: Conference Series, **2014**, 558(1), 012030, ISSN 17426588

Rare earth (RE) doped glasses and glass ceramic materials have recently received considerable attention because of their potential or realized applications as X-ray intensifying screens, phosphors, detectors, waveguides, lasers etc. In this work, we present a new RE doped ZnO-ZnSe-SrF_2-P_2O_5-B_2O_3-Sm_2O_3-SmF_3 (ZSPB) glass system synthesized by melt quenching technique. The resulting glasses were visually fully transparent and stable with glass the transition temperatures around 530°C. The thermal properties of this glass system were characterized by Modulated Differential Scanning Calorimetry (MDSC) measurements before and after annealing at 650°C. We have characterized these glasses by Raman spectroscopy and photoluminescence (PL) measurements over the UV-VIS range using light emitting diodes (LED) and laser diodes (LD) excitation sources. We have also irradiated thermally treated and non-treated glass samples by X-rays and have studied the resulting PL. We discuss the results in terms of previously reported models for Sm-doped Zn-borophosphate oxide, oxyfluoride and oxyselenide glasses.

4. Kostova, I., Nachkova, S., Tonchev, D., Kasap, S., Synthesis, uv-vis spectroscopy and conductivity of silver nanowires, NATO Science for Peace and Security Series A: Chemistry and Biology (**2015**), 39, pp. 175–182, ISSN 18746489

In this work, we report on the synthesis of silver nanowires (AgNW) by a modified polyole process. Conductive thin films were prepared from synthesized nanowires; then their basic properties were characterized. The influence of the raw materials, solvents, washing and centrifugal separation of these synthesized AgNWs was studied. UV-VIS absorption/transmission spectra of clear solutions were measured, and the size of AgNWs was estimated from these measurements. We also studied the influence of light on synthesized AgNWs in solution, and performed optical microscopy studies to identify possible aggregation processes. Thin films of AgNWs were fabricated on different transparent flexible substrates by a spray-coating process and other coating techniques. The optical transparency and the sheet resistance of these films were also measured. The influence of some additives on the properties of these thin films was checked. Due to the high flexibility and electrical conductivity of AgNW thin films, these nanoproducts are excellent candidates for touch screen displays, solar cells conductive layers and other electronic devices.

5. Pashova, T., Eftimov, T., Kostova, I., Tonchev, D., Investigation of the influence of strontium carbonate on fluorescence spectra of oxy-fluoride glasses doped with samarium oxide and samarium fluoride, Proceedings of SPIE - The International Society for Optical Engineering, **2015**, 9447, 94470B, ISSN: 0277786X, ISBN: 978-162841563-6

Oxy-fluoride glasses containing strontium carbonate doped with samarium have been prepared. The glasses are sorted with respect to the quantity of strontium carbonate. The fluorescence spectra recorded for different pumping wavelengths are presented. We have investigated the influence of the excitation on the efficiency of the fluorescence, depending on the quantity of strontium carbonate in the samples for a variety of excitation wavelengths. The results of optical pumping in the range 370 - 490 nm show a typical fluorescence spectrum of Sm^{3+}. When pumped with wavelengths above 500 nm a new peak that has not been reported appeared in the fluorescence spectrum. From the data analysis the range of appearance of the fluorescence peak was determined and the most efficient source for its excitation was found.

6. T. Pashova, I. Kostova, T. Eftimov and D. Tonchev, **2015**, *Analysis of fluorescence spectra of oxyfluoride compositions doped with Samarium oxide (Sm_2O_3) and samarium fluoride (SmF_3),* Bulgarian Chemical Communications 47(2), pp. 9–14, ISSN: 0324-1130, 2015.

ZnO-ZnF_2-P_2O_5-B_2O_3 compositions, doped with a varying quantity of samarium oxide (Sm_2O_3) and samarium fluoride (SmF_3) have been synthesized. The thermal properties of the obtained compositions have been measured using DSC analysis. Fluorescence spectra measured at different excitation wavelengths are shown. The fluorescence excitation efficiency for varying quantity of Samarium in the samples and the pumping wavelength has been studied. With optical pumping in the 370–490 nm range fluorescence spectra indicating the presence of

Sm3+ have been obtained. The widening of the pumping range to higher wavelengths a new fluorescence peak was observed. The range in which the peak is observed was established from the performed analysis and the excitation wavelength of maximum efficiency was determined.

7. G. I. Patronov, I. P. Kostova, D. T. Tonchev, **2017**, *Synthesis and characterization of samarium doped zinc borophosphate glasses,* Bulgarian Chemical Communications, Volume 49, Special Issue A (pp. 40–45), ISSN: 0324-1130

This paper is focusing on the synthesis and characterization of the optical, mechanical and thermal properties of samarium doped ZnO-rich borophosphate glasses. Two series of samples have been synthesized–non doped with composition:(68+ x) ZnO–18B2O3–(14–x) P2O5 and doped–(67.5+ x) ZnO–18B2O3–(14–x) P2O5–0.5 Sm2O3, where x= 0, 2, 4, 6 mol%. The obtained materials have been investigated by powder X-ray diffraction, differential scanning calorimetry, infrared spectroscopy and photoluminescence analysis. Furthermore, the density has been measured and the chemical durability in acid, neutral and alkaline medium has been determined. The obtained samples are amorphous, homogeneous and transparent glasses except for the samples with the highest content of ZnO. Samarium doped samples exhibit strong visible immediate photoluminescence signal under UV light. The synthesized samarium doped ZnO-rich borophosphate glasses may find applications for preparation of energy converters, solar cells, X-ray dosimeters and for protection of valuable documents.

8. T. Eftimov, D. Tonchev, I. Kostova, G. Patronov, T. Pashova, **2018**, *Application of Sm oxide doped oxyfluoride glasses for the development of extrinsic fibre optic X-ray sensors,* Springer Science+Business Media B.V., part of Springer Nature, P. Petkov et al. (eds.), Advanced Nanotechnologies for Detection and Defence against CBRN Agents, NATO Science for Peace and Security Series B: Physics and Biophysics, PartF2, pp. 375–387, ISSN: 1874-6500

spectral response to X-ray radiation are presented. We report on the observation of a spectrally dependent, radiation induced attenuation of the radio and photo luminescence spectra which follow a power law with different fitting parameters. The spectral maxima in the visible attenuate differently during irradiation which permits the development of extrinsic sensors in which scintillation responses and fluorescence from laser excitation are observed separately using time multiplexing. Due to substantially different time scaling parameters lower doses can be measured using fluorescence while larger doses can be measured using the spectrally differentiated scintillation responses.

9. Irena Kostova, Dan Tonchev, **2018**, *Synthesis of UV Sensitive Rare Earth Doped Materials,* Springer Science+Business Media B.V., part of Springer Nature, P. Petkov et al. (eds.), Advanced Nanotechnologies for Detection and Defence against CBRN Agents, NATO

Science for Peace and Security Series B: Physics and Biophysics, pp. 69–78, ISSN: 1874-6500

In this work we report on the synthesis of photoluminescent inorganic crystalline materials by a hydrothermal process. The synthesis of rare earth doped and co-doped strontium/barium aluminates was performed in a muffle furnace in air atmosphere. The prepared powders were excited with an ultraviolet (UV) source and their emission spectra measured. The PL results show slight fluorescence and strong visible green phosphorescence under UV light. We also measured the thermal properties by differential scanning calorimetry (DSC). The structures of synthesized RE doped materials were studied by XRD analysis. The basic properties of these materials show potential for different applications. We focused on protection of security documents. For this reason, we performed additional experiments. We blended fine grinded phosphorescent powders into different polymer composites and made successfully thin films from them. The composites were prepared by polyethylene, polymethyl methacrylate and polystyrene mixed with synthesized inorganic additives.

10. Zhana Petkova, Irena Kostova, Ginka Antova, **2018**, *Green Synthesis of Silver Nanoparticles and their Application in Thin Polymer Films,* Springer Science+Business Media B.V., part of Springer Nature, P. Petkov et al. (eds.), Advanced Nanotechnologies for Detection and Defence against CBRN Agents, NATO Science for Peace and Security Series B: Physics and Biophysics, PartF2, pp. 293–298, ISSN: 1874-6500

The focus of the present study is on synthesis procedures, morphology and application of silver nanoparticles (AgNPs). A green synthesis approach was performed with aqueous extracts from lawn grass and parsley (*Petroselinum crispum* Mill.), both of them microwave assisted. The formation of the silver nanoparticles was observed using UV-Vis spectroscopy (Boeco S26 spectrophotometer); they were characterized by transmission electron microscopy (TEM). The absorption spectra show peaks in the range 380–400 nm for all products. The TEM images depicted that the synthesis method yield nanoparticles with spherical shape and different size. This gives rise for a wide range of application of AgNPs which may be used as additives in papers and polymers due to their antimicrobial properties which depend on particle size and shape.

11. Kostova I., Patronov, G., Tonchev, D., *Luminescent properties of rare earth doped ZnO-B_2O_3-P_2O_5 glasses,* Journal of Chemical Technology & Metallurgy. **2018**, Vol. 53 Issue 6, p1087-1094. 8p., ISSN: 1314-7471

ZnO-B_2O_3-P_2O_5 (ZBP) glasses are a comparatively new material with a wide application potential for some optic devices. This is so because they are an excellent host matrix for different rare earths, especially for samarium ions, which in turn leads to intense luminescence in the visible region. Based on some previous studies of the structure, chemical durability, thermal stability, physical and optical properties it is found that this matrix is not only a good candidate as a host material for different RE ions but it is also applicable in sensing

and valuable documents protection. The present communication reports results referring to synthesis of new rare earth (Eu, Gd, Tb, Nd) doped and co-doped with Gd/Nd, Gd/Sm, Nd/Eu, Nd/Sm, Tb/Sm ZBP glasses and study of their absorption and fluorescent properties. The synthesis is performed by the conventional melt quenching method at 950oC in a muffle furnace. It is found that all synthesized glasses are homogeneous (with no gases inclusion), while some of them are fully transparent. The luminescent analysis reveals strong fluorescence in the visible and near infra-red region for different doping ions. Rare earth co-doping widens the potential applications of these glasses. ZBPs are also found a good host matrix for laser-active ions.

12. Georgi Patronov, Irena Kostova, Dancho Tonchev, *Rare earth metals in zinc oxide rich borophosphate glasses,* 29th International Conference on Metallurgy and Materials, METAL **2019**, Conference Proceedings, ISBN 978-808729497-0, 1646 – 1651

The focus of present research is on the behaviour of rare earth metals as dopants in zinc oxide rich borophosphate glasses. Attention is turned on the influence of Sm, Eu, Gd and Nd on the structure and optical properties of these new materials. Analysed glasses 71.81 ZnO – 18 B_2O_3 - 9.69 P_2O_5 - 0.5 RE_2O_3 (mol%) were prepared by conventional melting quenching method. The ratio of the main components - ZnO, B_2O_3, P_2O_5; the content of the dopant rare earth element (Sm, Eu, Gd, Nd) and the conditions of synthesis and analysis are set on the basis of literature data and our previous studies. The structure of the synthesized samples was investigated by powder X-ray diffraction, differential scanning calorimetry and infrared spectroscopy, and their optical properties - by photoluminescence analysis. The synthesized rare earth doped glasses are mainly amorphous with the presence of one or more crystalline phases in some of them - $SmPO_4$, $GdPO_4$ and $NdPO_4$. They have the typical structure of borophosphate glasses - the presence of PO4 tetrahedra and BO4 tetrahedra. The high glass transition temperature of the synthesized materials (above 500 °C) is an indication of the stability of the glasses obtained. The RE-doped ZnO-rich borophosphate glasses have a potential for practical application in optical devices for engineering, electronics and medicine.

13. Kostova I, Chicilo F., Eftimov T, Patronov G, Tonchev D, Kasap S., *Near infrared photoluminescence of nd-doped zbp glasses,* NATO Science for Peace and Security Series B: Physics and Biophysics, 341 - 349, ISSN 18746500, 10.1007/978-94-024-2018-0_27

In this work we report on a study of a series of zinc-borophosphate (ZBP) glasses doped with neodymium oxide (Nd_2O_3). The synthesis of the samples was performed by a high temperature melt quenching procedure in an air atmosphere. We present a complex photoluminescence study on a series of (72.31-*x*) ZnO-18B_2O_3-9.69P_2O_5-*x*Nd_2O_3 glasses doped with trivalent neodymium oxide (with concentration *x*) in a range 0.15–1.00 mol%) to explore possible applications. The excitation and luminescence properties were measured, and the photoluminescence was studied within the spectral range from 200 nm to 950 nm under different excitation wavelengths.

Emission spectra in the 850–1500 nm range were obtained under an excitation wavelength of 808 nm. We have also measured the thermal properties by differential scanning calorimetry (DSC). A strong emission peak is observed at 1060 nm with a width of 30 nm and an exponential decay with a characteristic time of 95 µs. The results of a series of Nd-doped zinc-borophosphate glasses show potential as a medium for solid state infrared laser applications.

14. Kostova I, Eftimov T., Nachkova S., Patronov G., Arapova A., Cellulose based luminophore material, Cellulose Chemistry and Technology, ISSN 05769787, 10.35812/CelluloseChemTechnol.**2020**.54.64, Volume 54, Issue 7-8, Pages 653 – 662

In the present work, the synthesis of strontium aluminates has been performed aiming at obtaining different emission colours induced by excitation with various sources from the near UV and visible spectrum domain and identifying the most appropriate of them. Also, the study included the incorporation of the resulting phosphors into polymers in the form of thin films, as well as the preparation of polymer/cellulose/luminophore composites. According to the above, the main purpose of the present work has been to obtain hybrid composite materials. The study involved the investigation of their structure and properties. According to the reported results, the developed micro-sized luminescent strontium aluminates have strong potential to be used as fillers in paper, polymers or hybrid materials. The use of the phosphorescent particle filler in polymer/cellulose materials can increase the security features of the materials to the second level.

15. I. Kostova, Chemical resistance of zinc-borophosphate glasses, Journal of Chemical Technology and Metallurgy – Sofia: Univ. of Chem. Technology and Metallurgy, **2020**, ISSN 1314-7471; ISSN 1314-7978, Vol. 55 Issue 2, p354-358

Zinc-borophosphate (ZBP) glasses of the system 71.81ZnO-(18-x) P_2O_5-xB_2O_3: 0.5Sm show wide application potential for different optical devices. It is important for optical applications glass materials to be homogenous, thermal and chemical resistant. Based on some previous studies of the structure, thermal stability and optical properties of these glasses, it is found that this matrix is a good candidate as a host material for different rare earth (RE) ions. The present work is a study of ZBP glasses chemical resistant by calculating the decomposition rate of the series of samples at different pH medium and duration.

16. Eftimov, T., Kostova, I., Arapova, A., Patronov, G., Rise and decay time responses of Sr aluminate phosphorescent materials, Journal of Luminescence, **2021**, 235, 117985, ISSN 0022-2313

In this paper we have studied the rise and decay time responses of Eu and Dy doped strontium aluminates prepared by different methods. The spectrum was characterized by 3D excitation emission matrices (EEM). The normalized rise and decay responses of the total power and at two wavelengths on either side of the spectral maximum exhibit individual behavior. We show that the individual switch on and switch off time responses can be approximated by power law and

logarithmic dependencies. The relation between spectral and time responses and the sample contents and technology of fabrication is commented.

17. Fouzar, S., Eftimov, T., Kostova, I., Benmounah, A., Lakhssassi, A., Effects of temperature on the time responses of strontium aluminates, Optical Materials, 2021, 122, 111619, ISSN 0925-3467

In this paper we study the effect of temperature on the rise and decay time responses of Eu and Eu, Dy doped strontium aluminates. Normalized switch on and switch off time responses are used to estimate the share of phosphorescence in the observed luminescence. The parameters of the power law time responses related to the relative share of phosphorescence in luminescence and to the rise/decay rates are found to be strongly temperature dependent. The results show that unlike luminescence intensity, the overall efficiency of phosphorescence increases strongly with temperature and reaches a maximum around 65 °C. The maximum correlates with the activation energy of the samples and depends on their doping and fabrication technology.

18. Samia Fouzar, Irena Kostova, Tinko Eftimov, Abdelbaki Benmounah, Mohammed Ouchabane, Ahmed Lakhssassi, *Excitation and spectral dependence of the rise and decay time responses of Eu^{2+} and Dy^{3+} doped strontium aluminates,* Journal of Materials Science: Materials in Electronics, **2022**, ISSN 09574522

In this paper, we study the phosphorescence rise and decay time responses of Eu^{2+}- and Dy^{3+}-doped strontium aluminates prepared by different methods after scanning them with a narrow spectral width (15 nm FWHM) light from a monochromator. The experiments performed show that the time responses essentially depend on the excitation duration as well as on the excitation and the emission wavelengths. It has been found that at the excitation wavelength of maximum efficiency λ'_{max}, a 'fast track' rise and decay of the phosphorescence exists. We suggest that by studying the normalized switch on and switch off time responses, we can determine the relative share of slow phosphorescence afterglow with respect to fast and slow phosphorescence decay as well as the rate of luminescence rise and decay processes. The relation to the synthesis technology and to the contents of the samples is discussed.

19. Tinko Eftimov, Irena Kostova, Samia Fouzar, Daniel Brabant, Kristian Nikolov, Veselin Vladev, *Smartphone-Readable Optical-Fiber Quasi-Distributed Phosphorescent Temperature Sensor,* Photonics **2024**, 11, 694

In this paper we present the principle of operation, fabrication and performance of a phosphorescent optical-fiber quasi-distributed sensor with contactless smartphone interrogation. An array of short strong corrugated long-period gratings (C-LPG) is used as a platform to spatially locate and to excite the phosphors whose time responses are temperature-dependent. The C-LPG array was fabricated using a pulsed CO_2 laser. The quasi-distributed sensing array is excited by a UV LED and the normalized differential rise/decay time response measured by a smartphone is used as a measure of the temperature. The sensing spots have a volume

smaller than 0.5 μL, can be separated by several millimeters to several meters and the interrogation can be simultaneous or in a sequence. The response and the sensitivity to temperature have been measured. The sensing array has been shown to measure abrupt and gradual temperature changes in space as well as time-dependent processes in the 0 °C to 100 °C range and with a measurement time of 1 s.

- **Полезен модел, за което е издаден защитен документ по надлежния ред (показател Г9):**

20. МОДУЛНА АВТОМАТИЗИРАНА ЕЛЕКТРОННА СТАНЦИЯ ЗА МОНИТОРИНГ НА ПАРАМЕТРИ НА АТМОСФЕРНИЯ ВЪЗДУХ, Атанас Танов Терзийски; Изобретатели: Атанас Терзийски, Стоян Тенев, Ирена Костова, ПАТЕНТНО ВЕДОМСТВО НА РЕПУБЛИКА БЪЛГАРИЯ, Защитен номер 3806, 2020

The utility model is in the field of atmospheric air monitoring stations, in particular to an automated electronic atmospheric air monitoring station and finds application in meteorology and environmental protection. The task of the utility model is to create a modular station for monitoring of the atmospheric air, which is able to automatically take readings on several parameters, by sending them to a database server in connection via an Internet module, providing for subsequent visualization and data analyses. The station, according to the utility model, should be adaptable to work in outdoor weather conditions, which does not require periodic maintenance or regular check-up.

The presented works include:

1. Scientific articles – 23, of which:

- articles in publications with impact factor – 11 with a total impact factor of 28.8;

- independent – 1;

- with one co-author – 1;

- with two co-authors – 4;

- with three or more co-authors – 17.

2. One independent book based on a defended dissertation

3. One Bulgarian utility model with three authors