

Sofia University Marking Momentum for Innovation and Technological Transfer
(SUMMIT) No. BG-RRP-2.004-0008



Bioactive compounds

Research group №: 3.1.6

Prof. Ivo Grabchev, DSc

Faculty of Medicine, Sofia University “St. Kliment Ohridski”, Sofia, Bulgaria

Sofia, 23 April 2024

Scientific team: Bioactive compounds - 3.1.6

Faculty of Medicine



Prof. Ivo Grabchev



Prof. Albena Yordanova



Dr. Ivan Minkov



Assoc. Prof. Juliana Ivanova

Faculty of Chemistry and Pharmacy



Assoc. Prof. Stanimir Stoyanov



Assoc. Prof. Julian Zagranjarski



Assoc. Prof. Meglena Kandinska



Dr. Stanislava Yordanova

Scientific team: Bioactive compounds - 3.1.6

Young Scientists



PhD student Mag. Konstantin Konstantinov



PhD Mag. Monika Mutovska



PhD student Mag. Hristo Manov

Competence of the scientific team



Prof. Ivo Grabchev is a specialist in the field of synthesis and research of low and high molecular fluorescent compounds, dendrimers and branched polymers and their metal complexes with potential of detecting biologically important metal ions in living organisms or in the environment.

Currently, his scientific interests are also focused on the field of biologically active compounds with antimicrobial and antitumor activity. Antibacterial photodynamic activity has been essential in his research in recent years in connection with the increasing resistance of pathogenic microorganisms to antibiotics used in clinical practice.

He has 222 scientific publications that have been cited more than 3,500 times.



Prof. Albena Jordanova is a biochemist and will study the membrane lipid-protein interactions, the transport of substances across model membranes and their biochemical relationships.



Assoc. prof. Juliana Ivanova synthesizes and characterizes new metal complexes of ligands with antitumor activity and investigates their antioxidant activity.



Dr. Ivan Minkov is a specialist in the air-water interface, monolayers, surface rheology, interfacial enzymatic reactions, and nanocapsules.



Assoc. prof. Yulian Zagranyski is a specialist in fine organic synthesis of heterocyclic fluorescent compounds and their characterisation.



Assoc. prof. Stanimir Stoyanov and Dr. Stanislava Yordanova study the photophysical properties of the organic compounds in different media.



Assoc. prof. Meglena Kandinska work on the synthesis of organic heterocyclic compounds with biological activity

Collaboration

- ✓ At the Sofia University “St. Kliment Ohridski”
- ✓ National Universities and Institutes
- ✓ International Universities
- ✓ International Networks

National Universities and Institutes

✓ University of Chemical Technology and Metallurgy, Sofia (UCTM)



✓ Institute of Biophysics and Biomedical Engineering, BAS



✓ “Stephan Angeloff” Institute of Microbiology, BAS (SAIM)



✓ Institute of Polymers, BAS (IP)



✓ Institute of Molecular Biology, BAS (IMB)



✓ Institute of General and Inorganic Chemistry, BAS (IGIS)



✓ Institute of Experimental Morphology, Pathology and Anthropology



with Museum, BAS, (IEMPAM)



✓ Institute of Optical Materials and Technologies "Acad. Jordan Malinowski", BAS

Collaboration

International Universities

➤ Institute of Science and Technology of Polymers, CSIC, Madrid, Spain



➤ University of Vienna, Austria



➤ Medical University of Vienna, Austria



➤ Chinese Academy of Sciences, Wuhan Institute of Virology, Wuhan, China



Max Planck Institute for Polymer Research, Mainz, Germany



MAX PLANCK INSTITUTE
FOR POLYMER RESEARCH

➤ University of Barcelona, Spain



International Networks



Prof. Grabchev is MC member for Bulgaria at COST Action CA 22131:
„Supramolecular Luminescent Chemosensors for Environmental Security“

33 countries and 140 participant

The main objective is to create a multidisciplinary network of researchers from academia and industry for the development of luminescent sensors for environmental security



Funded by
the European Union



CA22131
Action period 2023-2027

According to the scientific program, research is carried out in four work packages:

- WP 1: Synthesis of new bioactive compounds
- WP 2: Spectroscopic characterization of bioactive compounds
- WP 3: Bioactivity of the compounds
- WP 4: Sensors for metal ions and protons

- ✓ One synthetic laboratory was renovated, and new laboratory equipment was supplied

Before



After



- ✓ Chemicals and materials were purchased for BGN 10,000.

Science activity

- ✓ Synthesis of new fluorescent dendrimers with antimicrobial photodynamic activity
- ✓ Synthesis of new metal complexes of bioactive low molecular weight ligands
- ✓ Synthesis of new fluorescent metallodendrimers and metallopolymers, containing Zn(II) or Cu(II) ions
- ✓ Photophysical characterization of new compounds and their metal complexes in organic solvents with different polarity
- ✓ Investigation of the light influence on the generation of reactive oxygen species from the newly synthesized compounds in solution and on a solid matrix
- ✓ Dyeing and colorimetric characterization of textile materials with any of the resulting compounds

Science activity

- ✓ *In vitro* study of the antimicrobial activity of newly synthesized low molecular weight compounds, dendrimers and polymers.
- ✓ Investigation of the influence of light on the antimicrobial activity of newly synthesized low molecular weight compounds, dendrimers and polymers
- ✓ *In vitro* evaluation of antitumor and antioxidant activity of the new metal complexes compared to the parent ligands
- ✓ *In vitro* study of the antimicrobial activity of textile materials

Results

During the reporting period, members of WG 3.1.6 - *Bioactive compounds* have published 22 papers in scientific journals indexed in WOS, and 6 of them have acknowledged the project.

The detailed presentation of the obtained scientific results will be presented by the members of the scientific group on 24 April at the Faculty of Chemistry and Pharmacy.

Papers with acknowledgement of the project

1. A. I. Said, D. Staneva, **I. Grabchev**, New Water-Soluble Poly (propylene imine) Dendrimer Modified with 4-Sulfo-1,8-naphthalimide Units: Sensing Properties and Logic Gates Mimicking, *Sensors*, 2023, 23 (11), 5268.
2. D. Staneva, D. Atanasova, **I. Grabchev**. Fluorescent Composite Cotton Fabric Modified with Crosslinked Chitosan for Theranostic Applications. *Applied Sciences*. 2023; 13(23), 12660. <https://doi.org/10.3390/app132312660>
3. Vasilev, A.A.; **Kandinska, M.I.**; Kostadinov, A.; Dietz, L.; Balushev, S. (E)-3-Heptyl-2-(4-thiomorpholinostyryl)benzo[d]thiazol-3-ium Iodide as Solvatochromic and Fluorogenic Dye for Spectroscopy Applications. *Molbank* 2023, 2023, M1727. <https://doi.org/10.3390/M1727>
4. **Mutovska, M.**; Skabeev, A.; **Konstantinov, K.**; Cabanetos, C.; **Stoyanov, S.**; **Zagranyarski, Y.** One-pot synthesis of fused-rings heterocyclic systems based on symmetrically benzofuran annulated 1,8-naphthalimides. *Dye. Pigment*. 2023, 220, 4–10, doi:10.1016/j.dyepig.2023.111701.
5. A. I.Said, **M. Kandinska**, A. Vasilev, **I. Grabchev**, Styryl hemicyanine-DNA assembly for selective Hg²⁺ sensing and molecular computing, *Journal of Photochemistry and Photobiology A: Chemistry* 2024, 452, 115590, <https://doi.org/10.1016/j.jphotochem.2024.115590>
6. Peychev B, Arabadzhieva D, **Minkov IL**, Mileva E, Slavchov RI. Quantifying the Hydrophobic Effect per CF₂ Moiety from Adsorption of Fluorinated Alcohols at the Water/Oil Interface. *Molecules*. 2024; 29(7):1421. <https://doi.org/10.3390/molecules29071421>

Other papers from the period with the participation of the team members

1. A. A. Adam, M. S. Refat, A. Gaber, **I. Grabchev**, Complexation of alkaline earth metals Mg^{2+} , Ca^{2+} , Sr^{2+} and Ba^{2+} with adrenaline hormone: synthesis, spectroscopic and antimicrobial analysis, Bull. Chem. Soc. Ethiop. 2023, 37(2), 357-372.
2. A. I Said, D. Staneva, S. Angelova, **I. Grabchev**, Self-Associated 1,8-Naphthalimide as a Selective Fluorescent Chemosensor for Detection of High pH in Aqueous Solutions and Their Hg^{2+} Contamination. Sensors, 2023, 23, 399.
3. **I. Grabchev**, S. Angelova, D. Staneva, D. Yellow-Green and Blue Fluorescent 1,8-Naphthalimide-Based Chemosensors for Metal Cations. Inorganics 2023, 11, 47
4. S. Georgieva, P. Todorov, D. Staneva, P. Grozdanov, I. Nikolova, **I. Grabchev**, Metal–Peptide Complexes with Antimicrobial Potential for Cotton Fiber Protection. J. Funct. Biomater. 2023, 14, 106.
<https://doi.org/10.3390/jfb14020106>
5. Pragti, S. Nayek, S. Singh, A. Sonawane, **I. Grabchev**, R. Ganguly, S Mukhopadhyay, Studies on anticancer properties with varying co-ligands in a Ru(II) arene benzimidazole system, Dalton Transactions, 2023,52, 7104-7118
6. D. Staneva, D. Atanasova, D. Angelova, P. Grozdanov, I. Nikolova, **I. Grabchev**, Antimicrobial Properties of Chitosan-Modified Cotton Fabric Treated with Aldehydes and Zinc Oxide Particles. Materials. 2023; 16(14):5090.

Other papers from the period with the participation of the team members

7. Ishkitiev, N.; Miteva, M.; Micheva, M.; Stoyanova, T.; Lozanova, V. V.; Lozanov, V. S.; Mihaylova, Z.; Cheshmedzhieva, D. V.; **Kandinska, M.**; Rangelov, M.; Todorova, N.; Ilieva, . S.; Balushev, S.; Gargallo, R.; Calenic, B.; Constantinescu, I.; Landfester, K.; Vasilev, A. A. Aggregation induced nucleic acids recognition by homodimeric asymmetric monomethyne cyanine fluorochromes in mesenchymal stem cells. International Journal of Biological Macromolecules 2023, 250, 126094, ISSN 0141-8130.

<https://doi.org/10.1016/j.ijbiomac.2023.126094>.

8. Wang, X.; Burdzhiev, N.T.; Hu, H.; Li, Y.; Li, J.; Lozanova, V.V.; **Kandinska, M.I.**; Wang, M. Novel Tetrahydroisoquinoline-Based Heterocyclic Compounds Efficiently Inhibit SARS-CoV-2 Infection InVitro. Viruses 2023, 15, 502. <https://doi.org/10.3390/v15020502>

9. **Kandinska, M.I.**; Burdzhiev, N.T.; Cheshmedzhieva, D.V.; Ilieva, S.V.; Grozdanov, P.P.; Vilhelmova-Ilieva, N.; Nikolova, N.; Lozanova, V.V.; Nikolova, I. Synthesis of Novel 1-Oxo-2,3,4-trisubstituted Tetrahydroisoquinoline Derivatives, Bearing Other Heterocyclic Moieties and Comparative Preliminary Study of Anti-Coronavirus Activity of Selected Compounds. Molecules 2023, 28, 1495.

<https://doi.org/10.3390/molecules28031495>

10. Petrova E, Gluhcheva Y, Pavlova E, Vladov I, Dorkov P, Schaier M, Pashkunova-Martic I, Helbich TH, Keppler B, **Ivanova J.** Effects of Salinomycin and Deferiprone on Lead-Induced Changes in the Mouse Brain. Int J Mol Sci. 2023 24(3):2871. <https://doi: 10.3390/ijms24032871>.

Other papers from the period with the participation of the team members

11. Kaplanai, E.; Tonis, E.; Drymona, M.; **Zagranyarski, Y.**; Tzeli, D.; Vougioukalakis, G.C. Microwave-Assisted, Copper-Catalyzed Domino O–H/C–H Arylation Reaction toward the Synthesis of Oxygen-Doped Polyaromatic Molecules. *J. Org. Chem.* 2023, 88, 11552–11561, doi:10.1021/acs.joc.3c00830.
12. Wu, Z.; Skabeev, A.; **Zagranyarski, Y.**; Duan, R.; Jin, J.; Kwak, M.; Basché, T.; Müllen, K.; Li, C. High-Performance Near-Infrared Chlorinated Rylenecarboximide Fluorophores via Consecutive C–N and C–C Bond Formation. *Angew. Chemie Int. Ed.* 2023, 62, 5–9, <https://doi:10.1002/anie.202315156>.
13. **Mutovska, M.**; Simeonova, N.; **Stoyanov, S.**; **Zagranyarski, Y.**; Stanchovska, S.; Marinova, D. Naphthalene Monoimides with Peri-Annulated Disulfide Bridge—Synthesis and Electrochemical Redox Activity. *Materials (Basel)*. 2023, 16, 7471, <https://doi:10.3390/ma16237471>.
14. **Zagranyarski, Y.**; Cheshmedzhieva, D.V.; **Mutovska, M.**; Ahmedova, A.; **Stoyanov, S.** Dioxepine-Peri-Annulated PMIs—Synthesis and Spectral and Sensing Properties. *Sensors* 2023, 23, 2902, <https://doi:10.3390/s23062902>.
15. Sánchez, D.P.; Josse, P.; **Mutovska, M.G.**; Siegler, B.; Allain, M.; Morice, K.; Blanchard, P.; Gohier, F.; Le Bahers, T.; Monnereau, C.; **Y. Zagranyarski, D.** Lungerich, Cl. Cabanetos, Radical-Formation Management: Towards Aza-Analogues of the Benzothioxanthene Imide. *Chemistry Europe* 2024, 2, 1–5, <https://doi:10.1002/ceur.202300071>.
16. Wu, Z.-H.; Zhu, X.; Yang, Q.; **Zagranyarski, Y.**; Mishra, K.; Strickfaden, H.; Wong, R.P.; Basché, T.; Koynov, K.; Bonn, M.; Ch. Li, X. Liu, and K. Müllen, Near-Infrared Perylenecarboximide Fluorophores for Live-Cell Super-Resolution Imaging. *J. Am. Chem. Soc.* 2024, 146, 7135–7139, <https://doi:10.1021/jacs.3c13368>.

Thank



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