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**European Union**  
NextGenerationEU



MINISTRY  
OF EDUCATION  
AND SCIENCE

## *Organic Functional Materials*

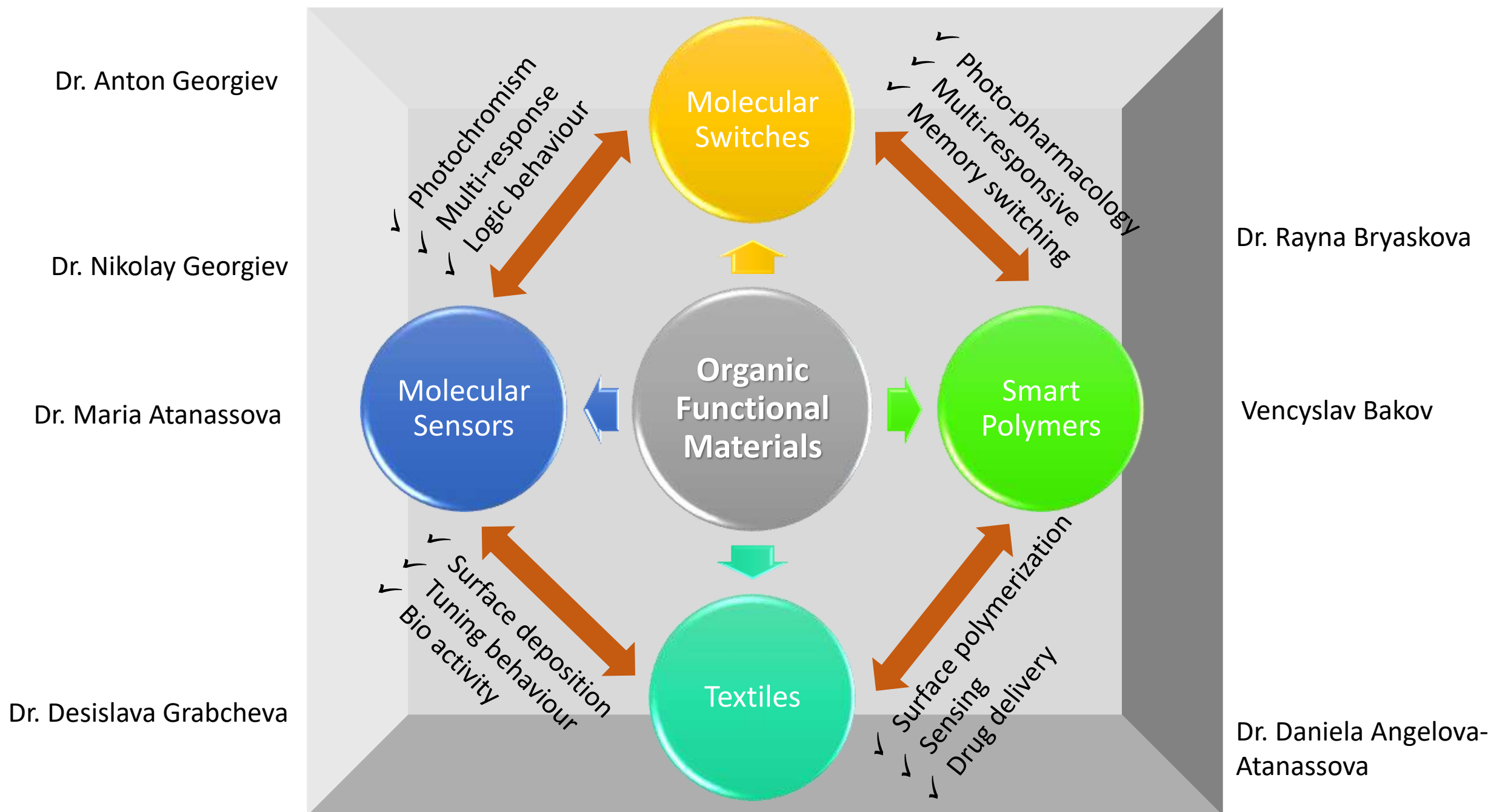
*Part of the project №BG-RRP-2.004-0002, "BiOrgaMCT"*



University of Chemical  
Technology and  
Metallurgy

5<sup>th</sup> December 2023, Sofia

Laboratory of Organic Functional Materials



### **WP 1 Synthesis of Organic Materials**

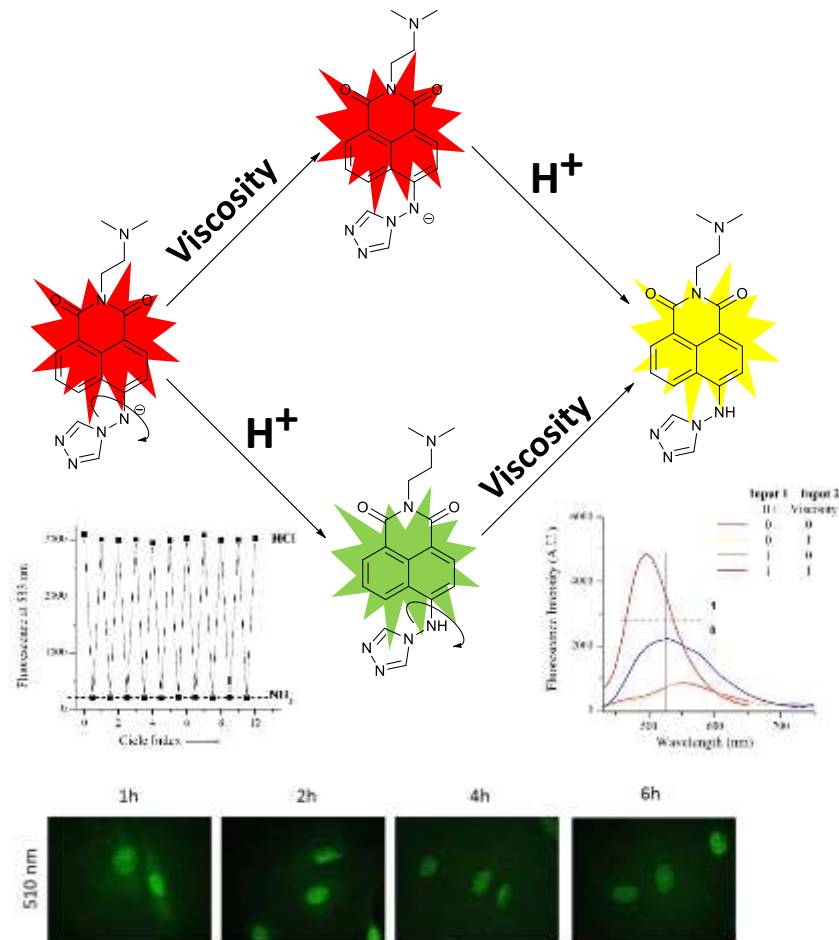
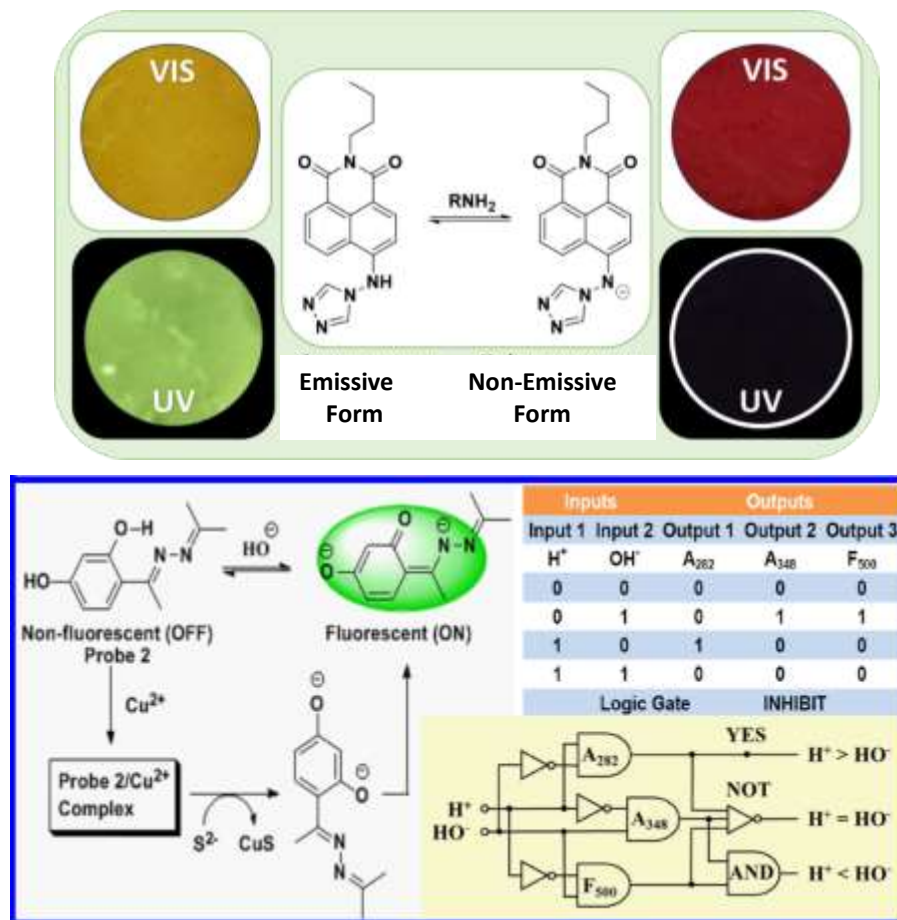
- *Design of new molecules*
- *Synthesis and purification*
- *Structure elucidation*

### **WP 2 Investigation of the Photophysical Properties**

- *Steady-state and transient spectroscopy measurements*
- *Dynamic spectral measurements upon external stimuli*
- *Preparation of 1D and 2D solid-state materials*

### **WP 3 Study and Evaluation their Working Functions as Molecular Devices**

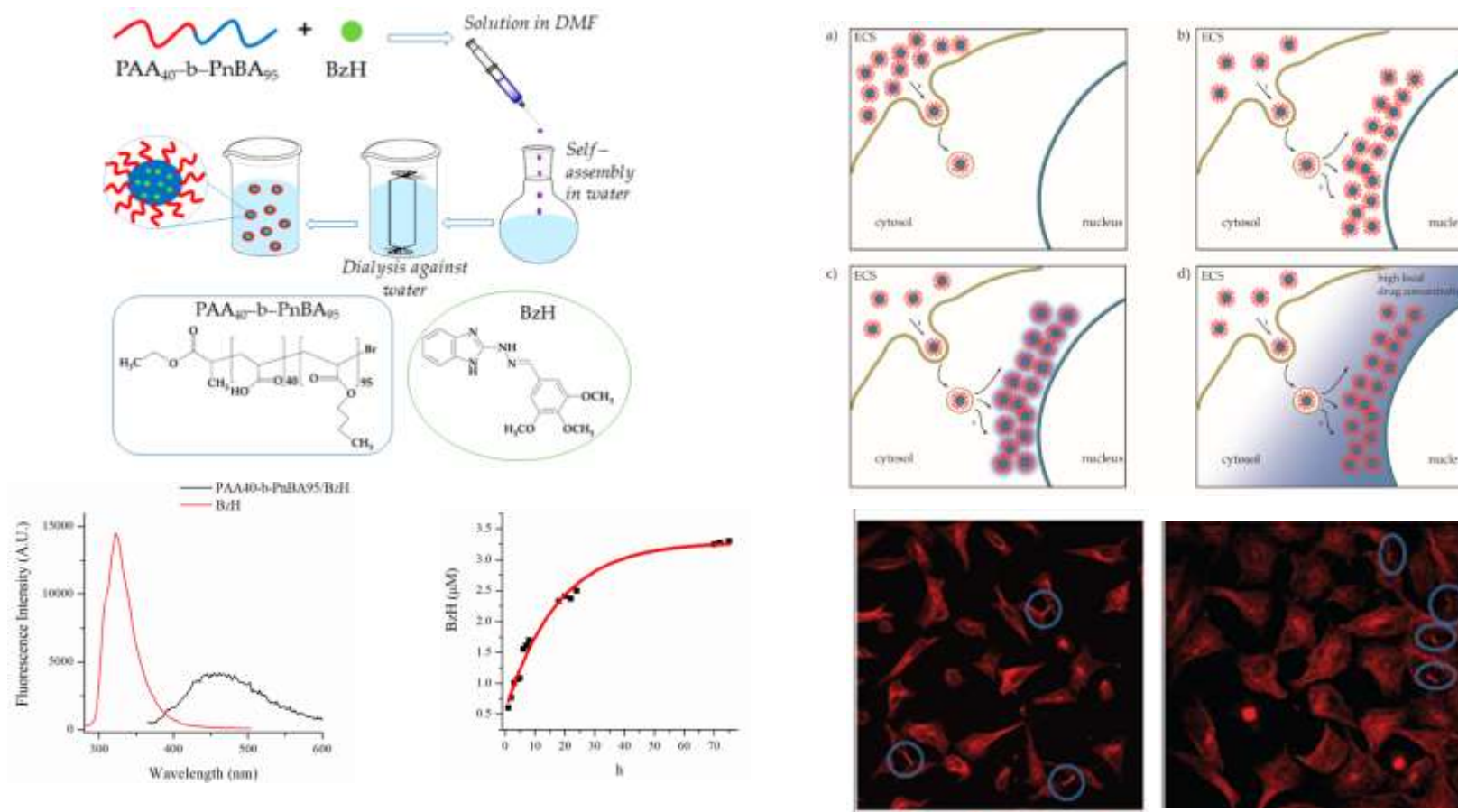
- *Solid-state performance of organic materials (thin films, bulk material, deposition of various substrates)*
- *Investigation microscopic characteristics by TEM, SEM, XRD*
- *Structure-properties relationship evaluation*



NI Georgiev, VV Bakov, VB Bojinov, **A Tutorial Review on the Fluorescent Probes as a Molecular Logic Circuit-Digital Comparator**, *Molecules* 28 (17), 6327

AI Said, NI Georgiev, VB Bojinov, **Simple excited state intramolecular proton transfer (ESIPT) based probe for pH and selective detection of copper (II) ion in aqueous alkaline environment: Sensitivity**, *Journal of Photochemistry and Photobiology A: Chemistry* 446, 115176.

# Fluorescent compounds as diagnostic and theranostic agents

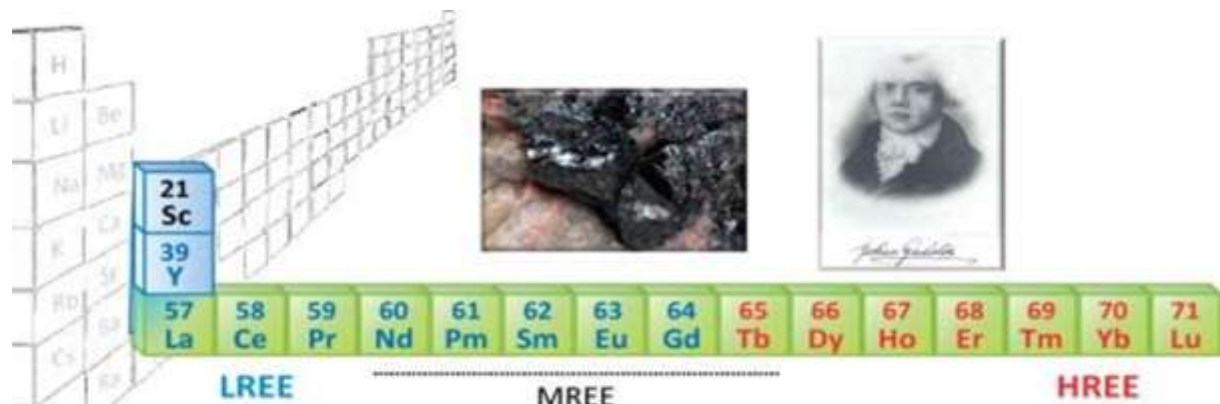


R Bryaskova, N Georgiev, N Philipova, V Bakov, K Anichina, M Argirova, S. Apostolova, I. Georgieva, R. Tzoneva, **Novel Fluorescent Benzimidazole-Hydrazone-Loaded Micellar Carriers for Controlled Release: Impact on Cell Toxicity, Nuclear and Microtubule Alterations in Breast Cancer Cells**, *Pharmaceutics* 15 (6), 1753

NI Georgiev, VV Bakov, KK Anichina, VB Bojinov, **Fluorescent probes as a tool in diagnostic and drug delivery systems**, *Pharmaceutics* 16 (3), 381

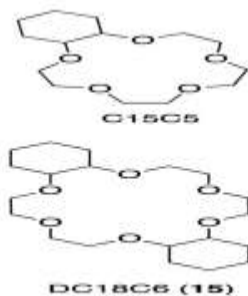
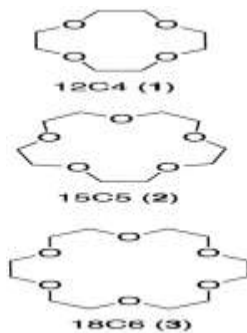
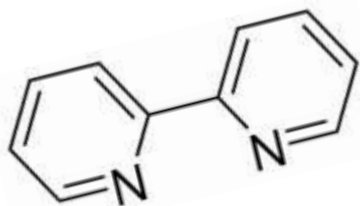
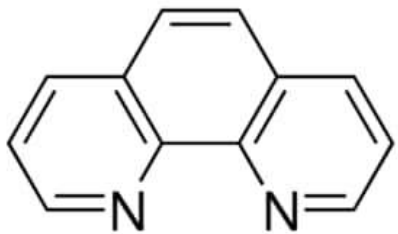


# Solvent extraction of metals with fancy ligands



La-Lu  
Sc, Y, La-Lu

lanthanoids (lanthanides)  
rare earths



Chelating ligands  
+ synergist



Periodic Table of the Elements  
Valence



Separations 2023, 10, 286.  
Molecules 2023, 28, 5121.  
Molecules 2023, 28, 7467.

# Модифициране на памучен плат с омрежени полимери

## 1. Модифициране на памучен плат с полиакриламид при вариране количеството на основния мономер-акриламид и омрежващия мономер

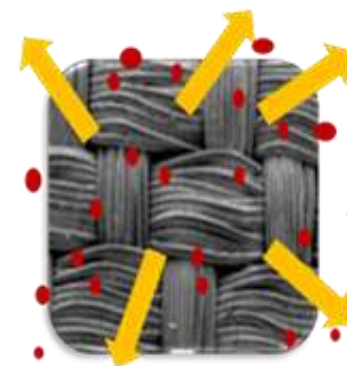
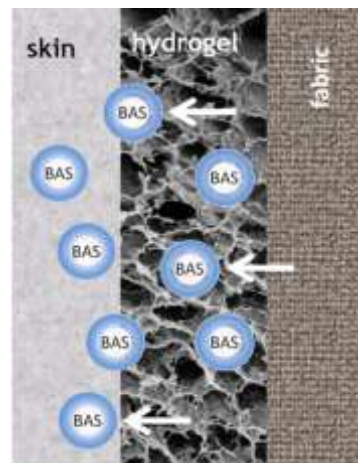
**Цел:** Да се изследва влиянието на получения хидрогел върху отделянето на биологично активното вещество (БАВ или BAS) с времето

Приложение

При заболявания и наранявания на кожата

Козметичен текстил

Трансдермално приложение на БАВ



1. Десорбция на БАВ от повърхността на хидрогела

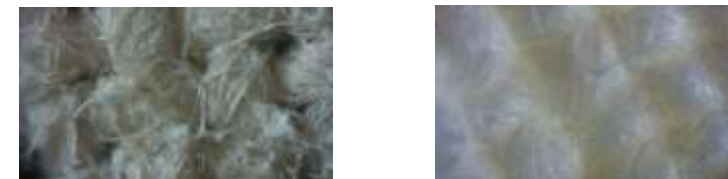
2. Набъбване на хидрогела и дифузия на БАВ

## 2. Получаване на композитен материал от памучен плат с хидрофобни и олиофилни свойства

**Цел:** Приложение на материала при отстраняване на нефт и нефтопродукти от вода.



хидрофобен-олеофилен материал



памучен плат



# Fluorescent rotary switches

## Fluorescent Rotary Switches: Four- vs Three-Substituted Phthalimide Boron Difluoride Schiff Base Complexes

Dancho Yordanov, Rastislav Smolka, Kosuke Nakashima, Shin-ichi Hirashima, Yasuyuki Matsushima, Martin Vala, Jozef Kračovič, Martin Weiter, Tsuyoshi Miura, and Anton Georgiev\*

Cite This: <https://doi.org/10.1021/acs.joc.3c02056>

Read Online

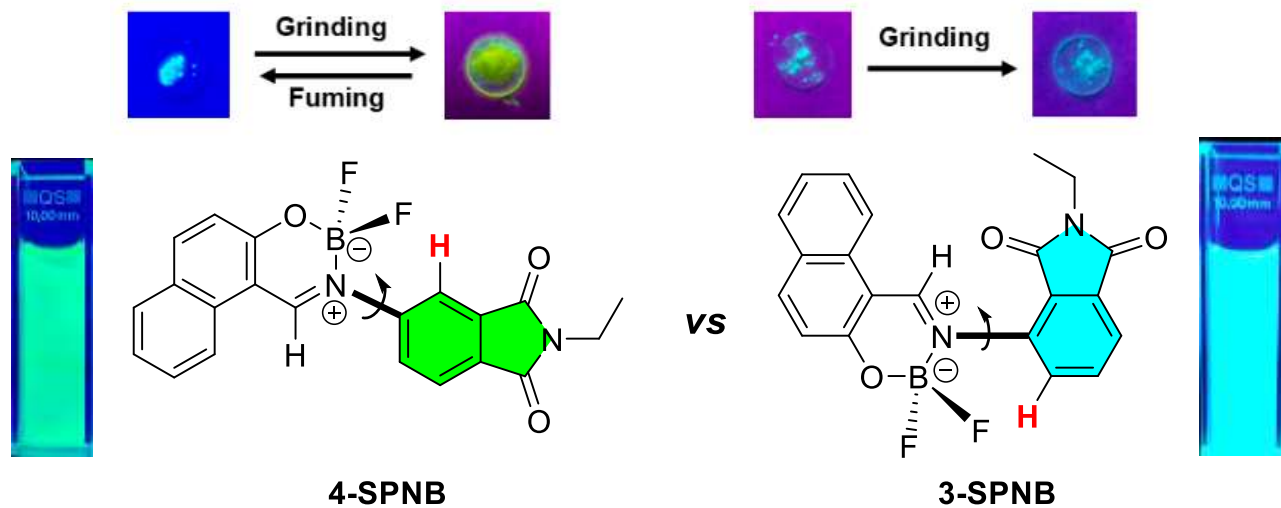
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Metrics & More

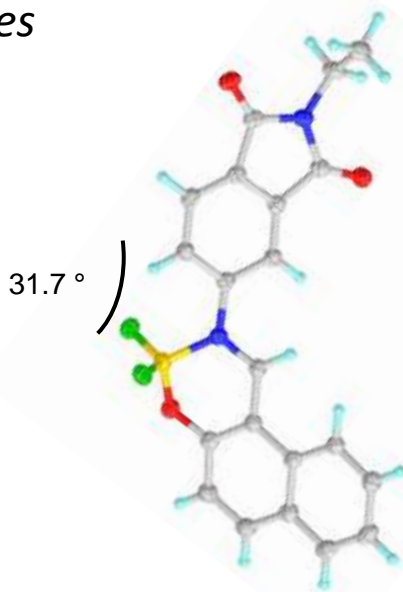
Article Recommendations

Supporting Information

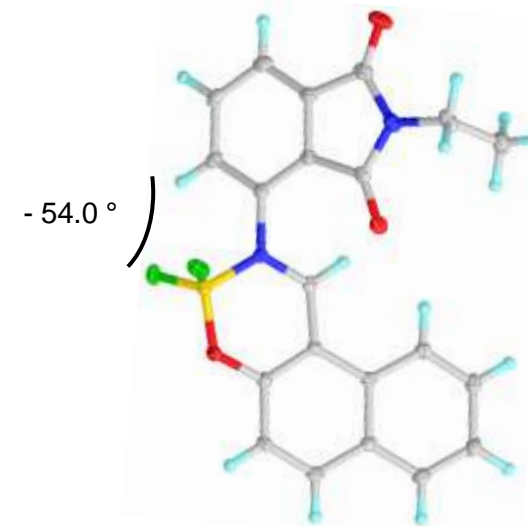
**ABSTRACT:** The influence of the substitution pattern in phthalimide boron difluoride Schiff base complexes as fluorescent molecular rotors has been investigated. Due to their ground-state zwitterionic structures, they have exhibited negative solvatochromism in absorption and blue-green emission with moderate to satisfactory photoluminescence quantum yields in solution. Ground-state and excited-state theoretical calculations and time-resolved emission spectroscopy revealed that the excited-state rotation is triggered by planar-induced charge transfer, resulting in switched emission toward the green region. Fluorescence lifetime measurements and species-associated emission spectra exhibited two emitting excited species in equilibrium via a planar transition-state barrier. The substitution pattern models showed different behavior in solid-state mechanochromatic switching and were analyzed by subcell unit packing obtained from X-ray structure data. We have attempted to gain in-depth insight into the fluorescence mechanism and photoluminescence properties associated with the substitution pattern of the phthalimide motif in order to understand the structure–property–function relationship.



## Fluorescent Rotary Switches

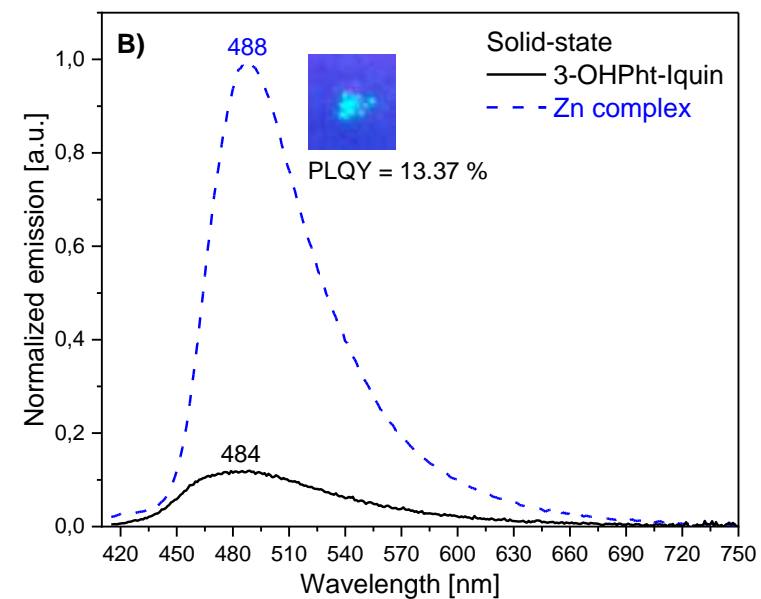
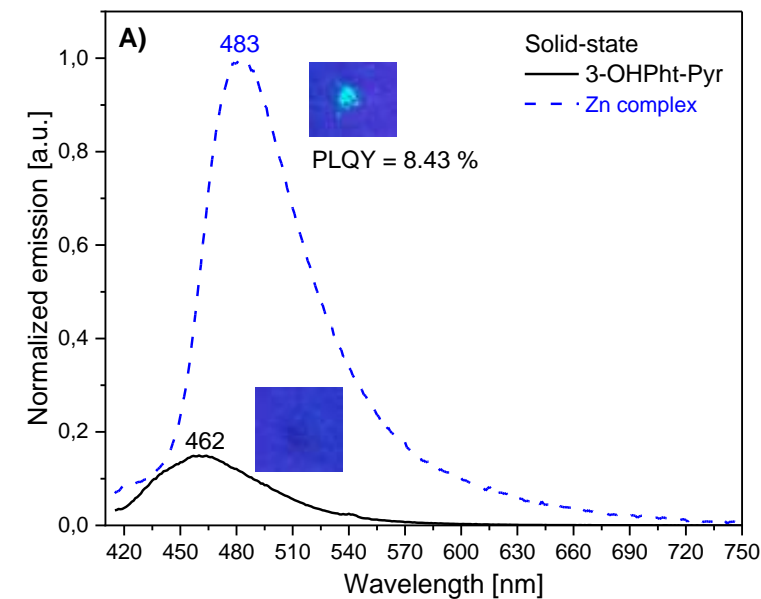
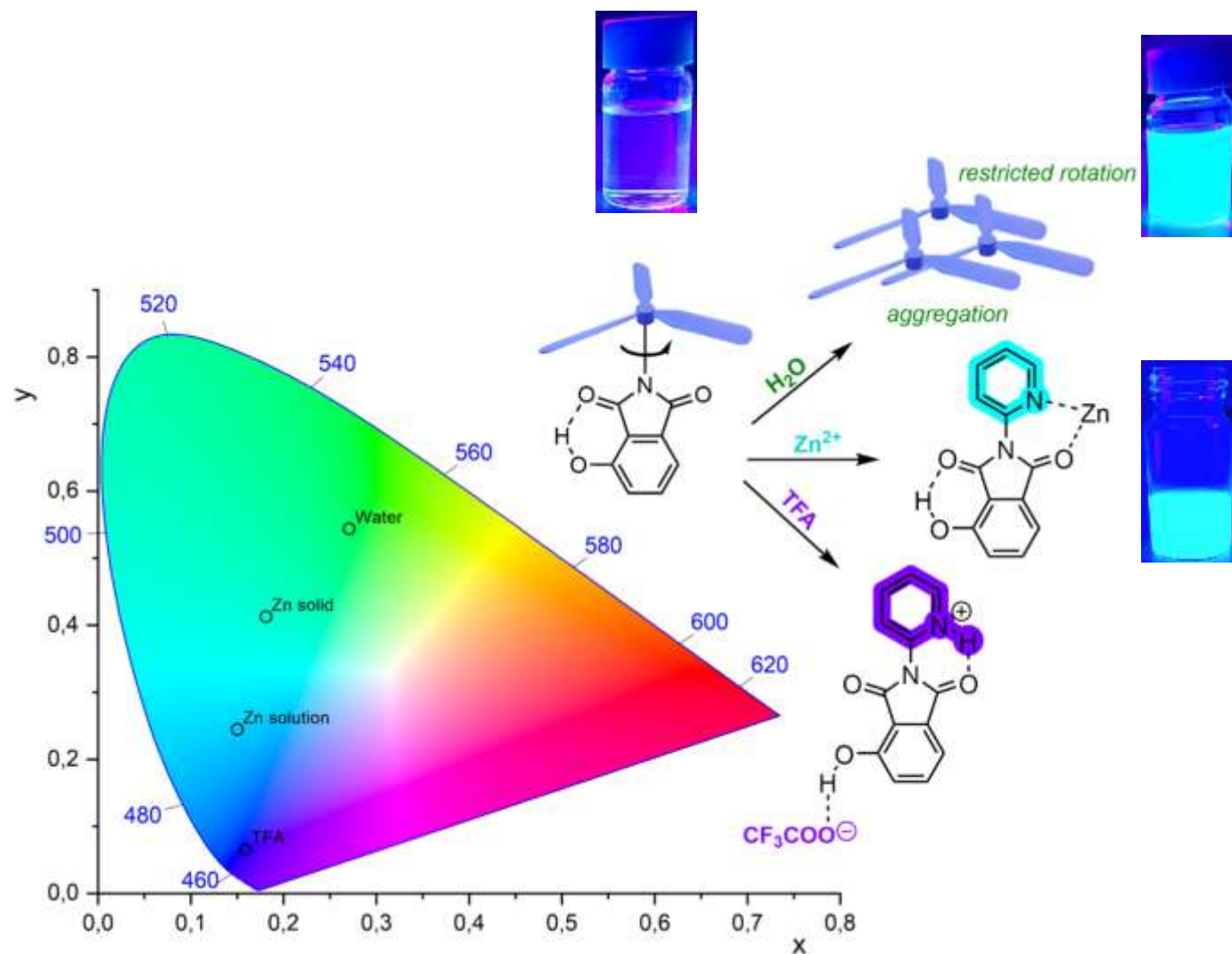


## X-Ray structures





# Multicolour Switching

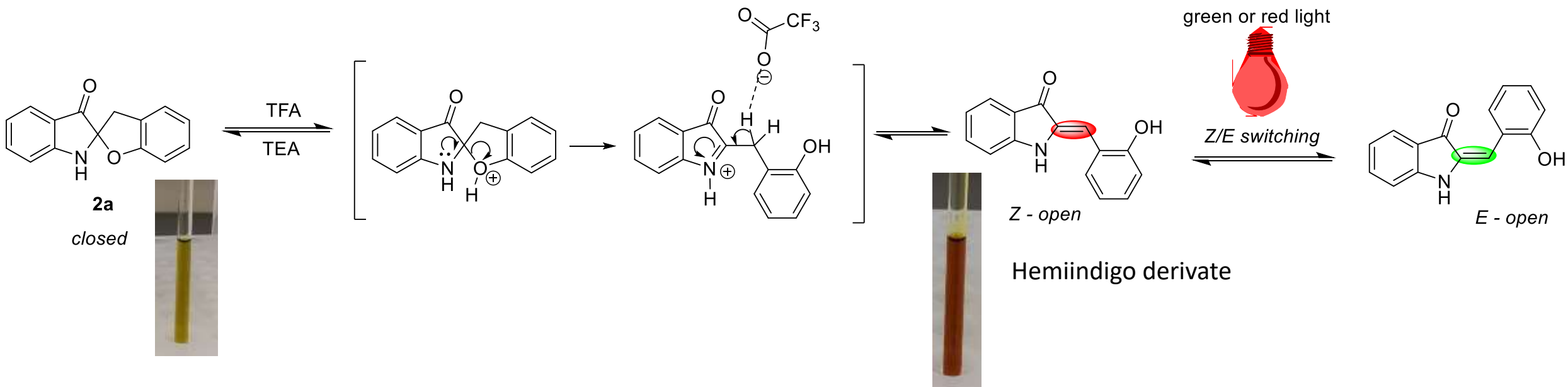
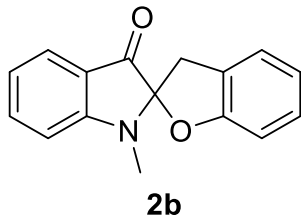
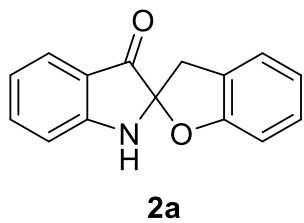


Rastislav Smolka, ..., Anton Georgiev, "Control over rotary motion and multicolour switching in 3-hydroxyphthalimide fluorophores: An interplay between AIE and ESIPT", *Dyes and Pigments*, Volume 215, 2023, 111279, <https://doi.org/10.1016/j.dyepig.2023.111279>

1. Dancho Yordanov, Rastislav Smolka, Kosuke Nakashima, Shin-ichi Hirashima, Yasuyuki Matsushima, Martin Vala, Jozef Krajčovič, Martin Weiter, Tsuyoshi Miura, and Anton Georgiev, “*Fluorescent Rotary Switches: 4- vs 3-Substituted Phthalimide Boron Difluoride Schiff Base Complexes*”, **The Journal of Organic Chemistry (ACS)**, 2023 <https://doi.org/10.1021/acs.joc.3c02056>
2. Rastislav Smolka, Dancho Yordanov, Kosuke Nakashima, Martin Vala, Jozef Krajčovič, Martin Weiter, Anton Georgiev, “*Control over rotary motion and multicolour switching in 3-hydroxyphthalimide fluorophores: An interplay between AIE and ESIPT*”, **Dyes and Pigments**, Volume 215, 2023, 111279, <https://doi.org/10.1016/j.dyepig.2023.111279>
3. Awad I. Said, Nikolai I. Georgiev, Vladimir B. Bojinov, “*Simple excited state intramolecular proton transfer (ESIPT) based probe for pH and selective detection of copper(II) ion in aqueous alkaline environment: Sensitivity, selectivity and logic behavior*”, **Journal of Photochemistry and Photobiology A: Chemistry**, Volume 446, 2024, 115176, <https://doi.org/10.1016/j.jphotochem.2023.115176>
4. Georgiev, N.I.; Bakov, V.V.; Anichina, K.K.; Bojinov, V.B. „*Fluorescent Probes as a Tool in Diagnostic and Drug Delivery Systems*“, **Pharmaceuticals** 2023, 16, 381. <https://doi.org/10.3390/ph16030381>
5. Bryaskova, R.; Georgiev, N.; Philipova, N.; Bakov, V.; Anichina, K.; Argirova, M.; Apostolova, S.; Georgieva, I.; Tzoneva, R., “*Novel Fluorescent Benzimidazole-Hydrazone-Loaded Micellar Carriers for Controlled Release: Impact on Cell Toxicity, Nuclear and Microtubule Alterations in Breast Cancer Cells*”, **Pharmaceutics** 2023, 15, 1753. <https://doi.org/10.3390/pharmaceutics15061753>
6. Georgiev, N.I.; Bakov, V.V.; Bojinov, V.B. “*A Tutorial Review on the Fluorescent Probes as a Molecular Logic Circuit—Digital Comparator*”, **Molecules** 2023, 28, 6327. <https://doi.org/10.3390/molecules28176327>

7. Atanassova, M.; Kurteva, V., “Mutual Solubilities between Ethylene Glycol and Organic Diluents: Gas Chromatography and NMR”, **Molecules** **2023**, **28**, 5121. <https://doi.org/10.3390/molecules28135121>
8. Atanassova, M.; Kukeva, R., “Improvement of Gd(III) Solvent Extraction by 4-Benzoyl-3-methyl-1-phenyl-2-pyrazolin-5-one: Non-Aqueous Systems”, **Separations** **2023**, **10**, 286, <https://doi.org/10.3390/separations10050286>
9. Atanassova, M.; Kukeva, R.; Kurteva, V., “New Sustainable Solvent Extraction Pathways for Rare Earth Metals via Oximes Molecules”, **Molecules** **2023**, **28**, 7467, <https://doi.org/10.3390/molecules28227467>
10. Staneva, D.; Atanasova, D.; Grabchev, I. Fluorescent Composite Cotton Fabric Modified with Crosslinked Chitosan for Theranostic Applications. **Appl. Sci.** **2023**, **13**, 12660. <https://doi.org/10.3390/app132312660>

# Current investigations





## 1st Autumn workshop on functional organic materials for sustainable future 15.–16. November 2023, Brno

### Wednesday 15th November

**Chair: Prof. Jozef Krajčovič** Place: Conference room 5th floor

13:30–13:45	Prof. Jozef Krajčovič	Opening talk
13:45–14:00	Mihai Irimia-Vladu	Natural Dielectric Materials for Organic Field Effect Transistors
14:00–14:15	Serpil Tekoglu	Biocompatible conductive polymers for sustainable technologies
14:15–14:30	Cigdem Yumusak	Hydrogen bonded organic semiconductor pigments
14:30–14:45	Pavel Kocán	Functionalized diketopyrrolopyrroles as building blocks of on-surface grown nanostructures

**COFFEE BREAK**

**Chair: Cigdem Yumusak** Place: Conference room 5th floor

15:15–15:30	Pavel Sobotik	Scanning tunneling microscopy of 2D phthalocyanine arrays on metal passivated silicon surfaces
15:30–15:45	Anton Georgiev	Fluorescent molecular switches
15:45–16:00	Atanas Kurutos	Biocompatible Fluorescent Probes Emitting in the Visible, Near-Infrared Region, and Beyond: From Small Molecules to Supramolecular Assemblies
16:00–16:15	Felix Mayr	Simple and sensitive substrates for surface-enhanced Raman scattering (SERS) at near-infrared excitation

Since 19:00

**DINNER**



10:30–11:00

**COFFEE BREAK**

**Chair: Roberta Ragni** Place: Conference room 5th floor

11:00–11:15	Matej Uhlir	Skills and experiences with theoretical approaches used in materials research focused on optoelectronics at the IPCHCHP of FCHPT STU in Bratislava
11:15–11:30	Erik Klein	Theoretical investigation of hydrogen atom, proton and electron transfer thermodynamics in recent research
11:30–11:45	Prof. Bojan Petrovic	Application of microfluidics in salivary diagnostics
11:45–12:00	Sanja Kojic	Application of textile and green materials in biomedicine

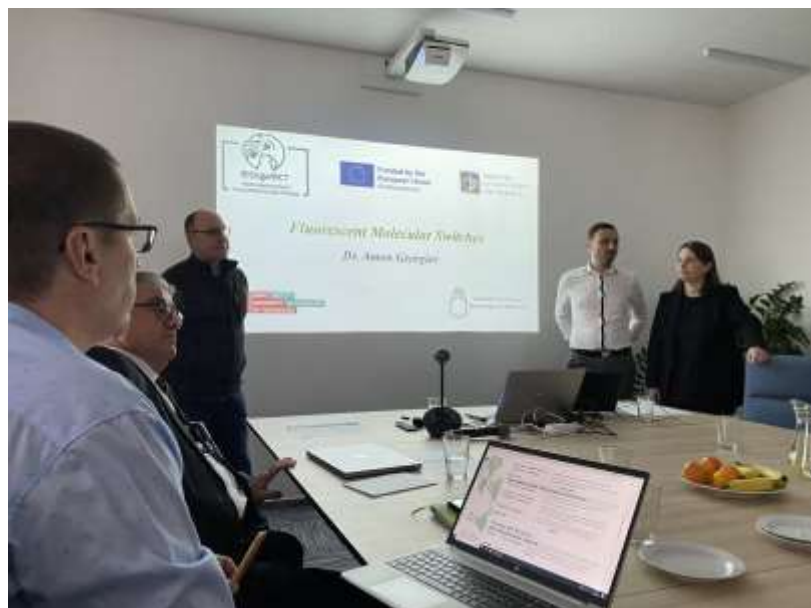
**LUNCH**

**Chair: Anton Georgiev** Place: Conference room 5th floor

13:30–13:50	Šárka Tumová, Aneta Marková, Matouš Kratochvíl, Rastislav Smolka	Material science toward functional high-tech devices
13:50–13:55	Christoph Ulbricht	PEDOT by CVD – An Outlook
13:55–14:00	Stefano Favero Costa	A bifacial tandem organic/perovskite solar cell
14:00–14:05	Tena Markulin	Growth of perovskite nanocrystals in lead halide-amino acid precursor films
14:05–14:10	Stefan Moser	Measuring Techniques of the External Quantum efficiency (EQE)

14:10–14:40

**COFFEE BREAK**

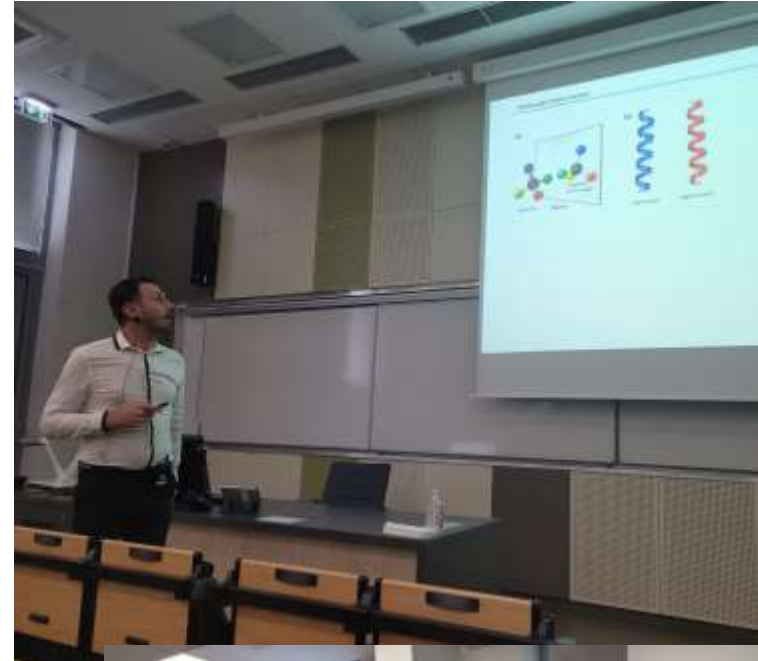


Established European network for Functional Organic Materials by 1st meeting.





Dissemination of the results : Master students lecture on Advance Organic Chemistry



## Invited Scientist: Brno, Czech Republic







The results are developed as part of contract №: BG-RRP-2.004-0002-C01, **Laboratory of Organic Functional Materials** (Project BiOrgaMCT), Procedure BG-RRP-2.004 “Establishing of a network of research higher education institutions in Bulgaria”, funded by BULGARIAN NATIONAL RECOVERY AND RESILIENCE PLAN