BiOrgaMCT
Bioactive Organic and inorganic advanced Materials and Clean Technologies

Funded by the European Union
NextGenerationEU

MINISTRY OF EDUCATION AND SCIENCE

Organic Functional Materials

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

70 years
University of Chemical Technology and Metallurgy

15-17 December 2024, Separeva Banya
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*

Maria Atanasova

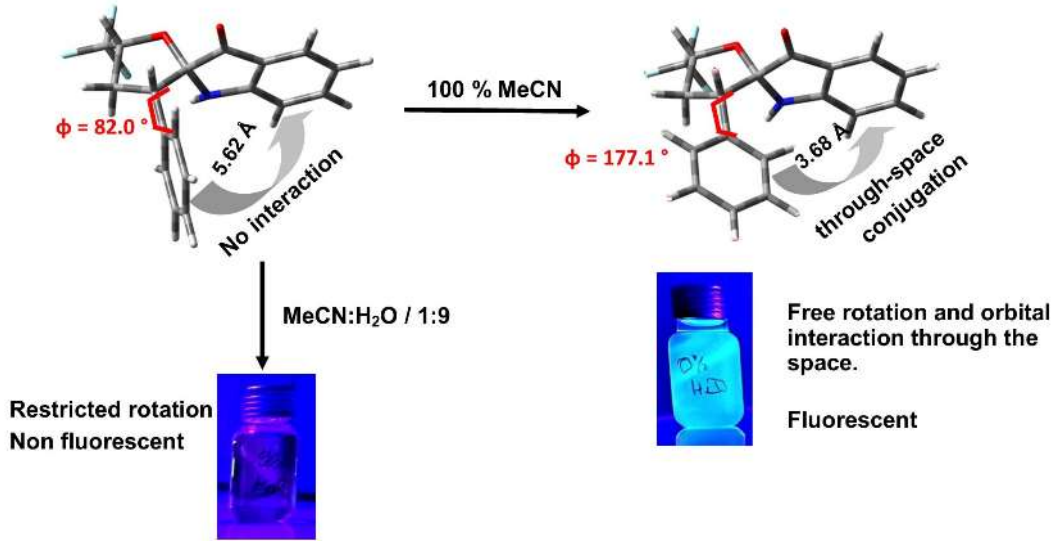
1. Maria Atanassova, Rositsa Kukeva, Vanya Kurteva, *„Chemical and mechanistic modelling of green solvent extraction of metallic species with 4-acylpyrazolones“*, **Journal of Molecular Liquids (Elsevier)** 415 (2024) 126332 https://doi.org/10.1016/j.molliq.2024.126332 **Q1 (Web of Science)**

Desislava Grabcheva (Staneva) collaboration with 3.1.3 group (Bioactive compounds)

1. Staneva, D.; Todorov, P.; Georgieva, S.; Peneva, P.; Grabchev, I. *„Novel Peptide Analogues of Valorphin-Conjugated 1,8-Naphthalimide as Photodynamic Antimicrobial Agent in Solution and on Cotton Fabric“*, **Molecules** (MDPI) 2024, 29, 5421. https://doi.org/10.3390/molecules29225421 **IF = 4.1, Q2 (Web of Science)**

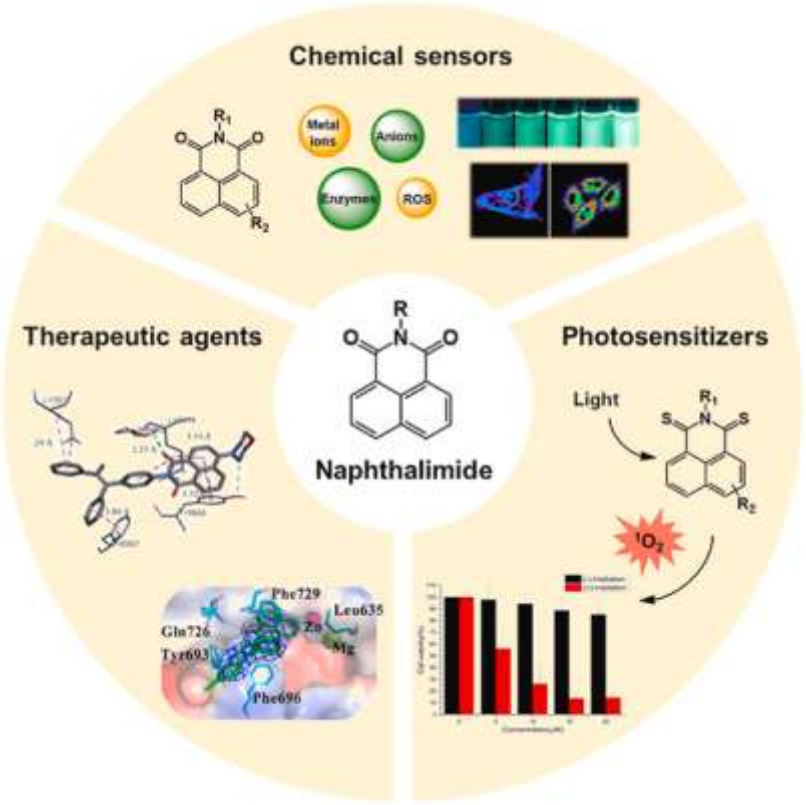
Anton Georgiev

1. Kosuke Nakashima, Aoi Imamura, Yasuyuki Matsushima, Shin-ichi Hirashima, Dancho Yordanov, Tsuyoshi Miura, Anton Georgiev, *“Intramolecular through-space conjugation of chiral C2-spirooxindole”,* **Submitted to the journal (Under Review)** 2024

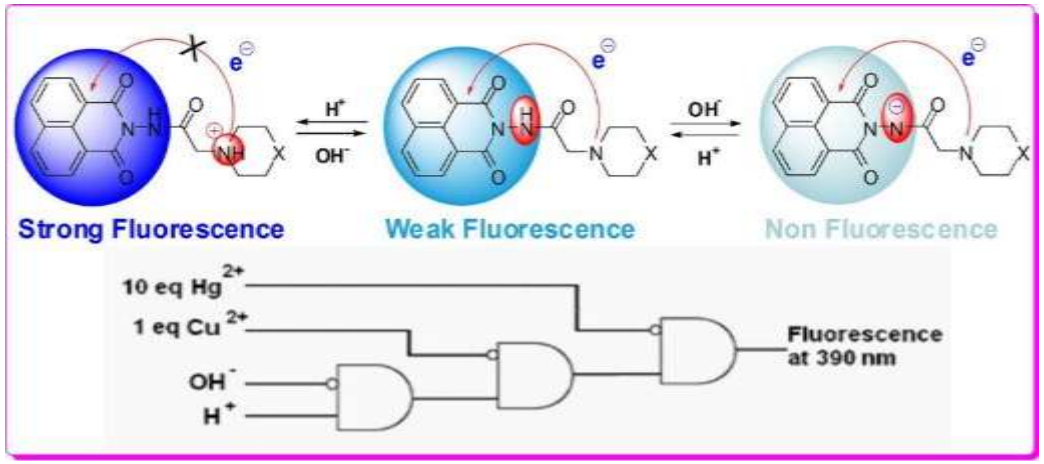


Planned activities in 2025 y:

- ✓ Design and synthesis of novel napthalimide based architecture as molecular sensors and logic gates;
- ✓ Application and testing in real conditions;
- ✓ At least two published papers are expected.

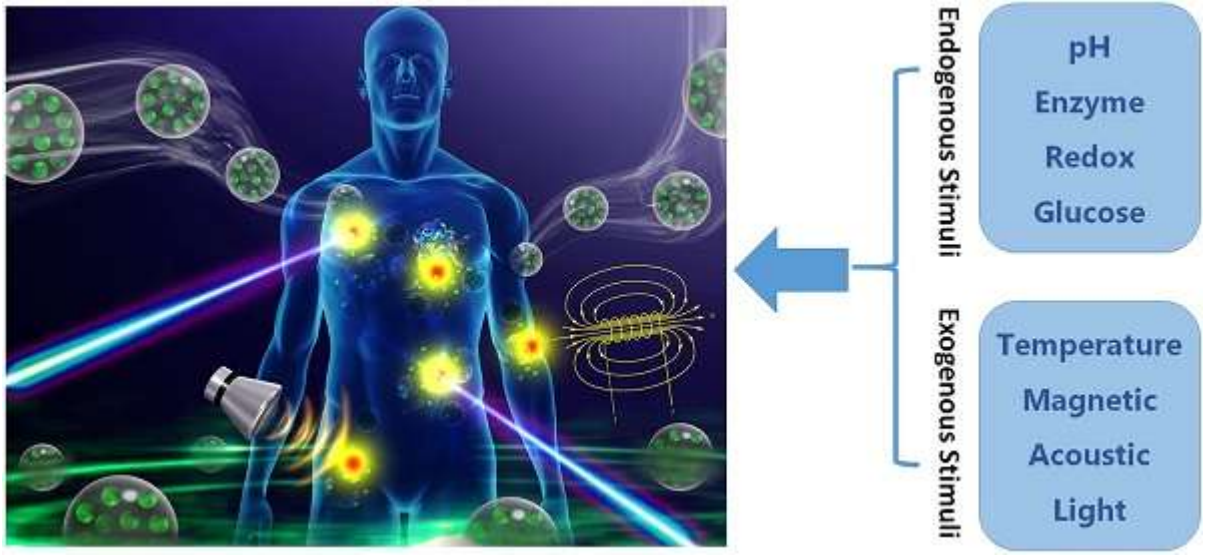


Dyes and Pigments 201, (2022), 110195

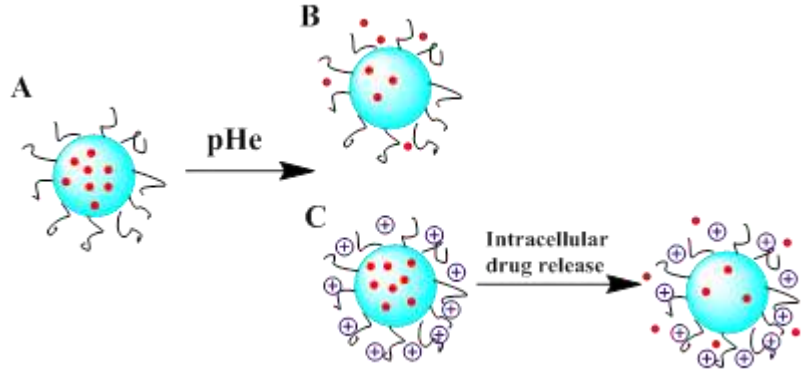


Planned activities in 2025 y:

- ✓ Design and synthesis of polymer systems for drug delivery;
- ✓ Synthesis of nanoparticles;
- ✓ Biological evaluation and two published papers.

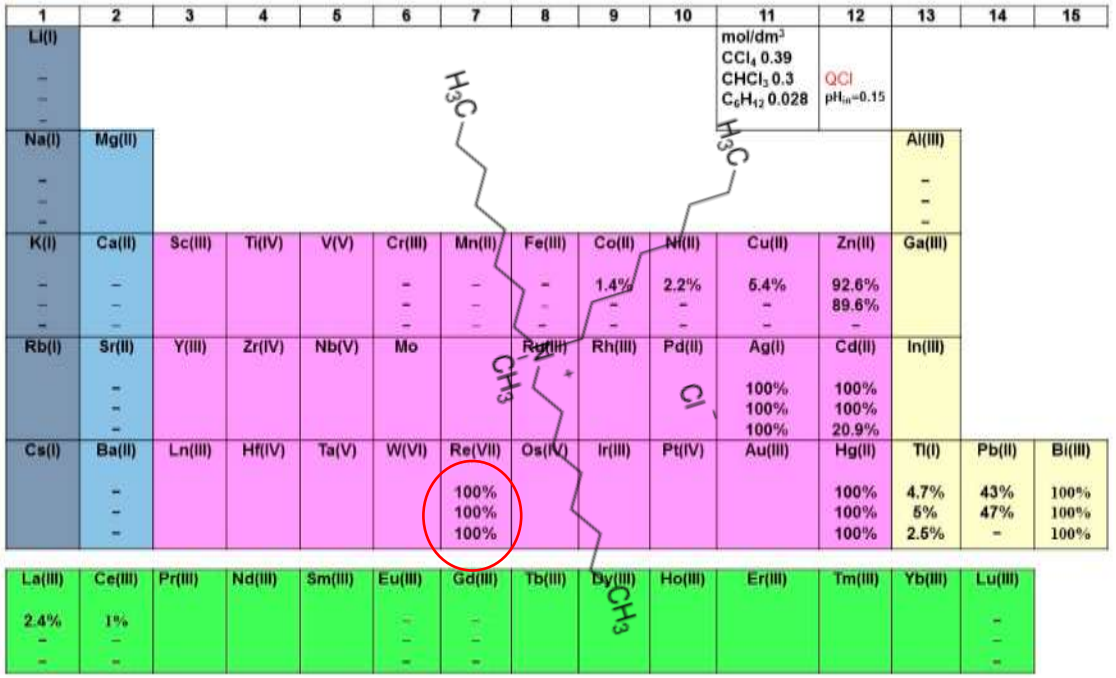


Theranostics 2016; 6(9):1306-1323



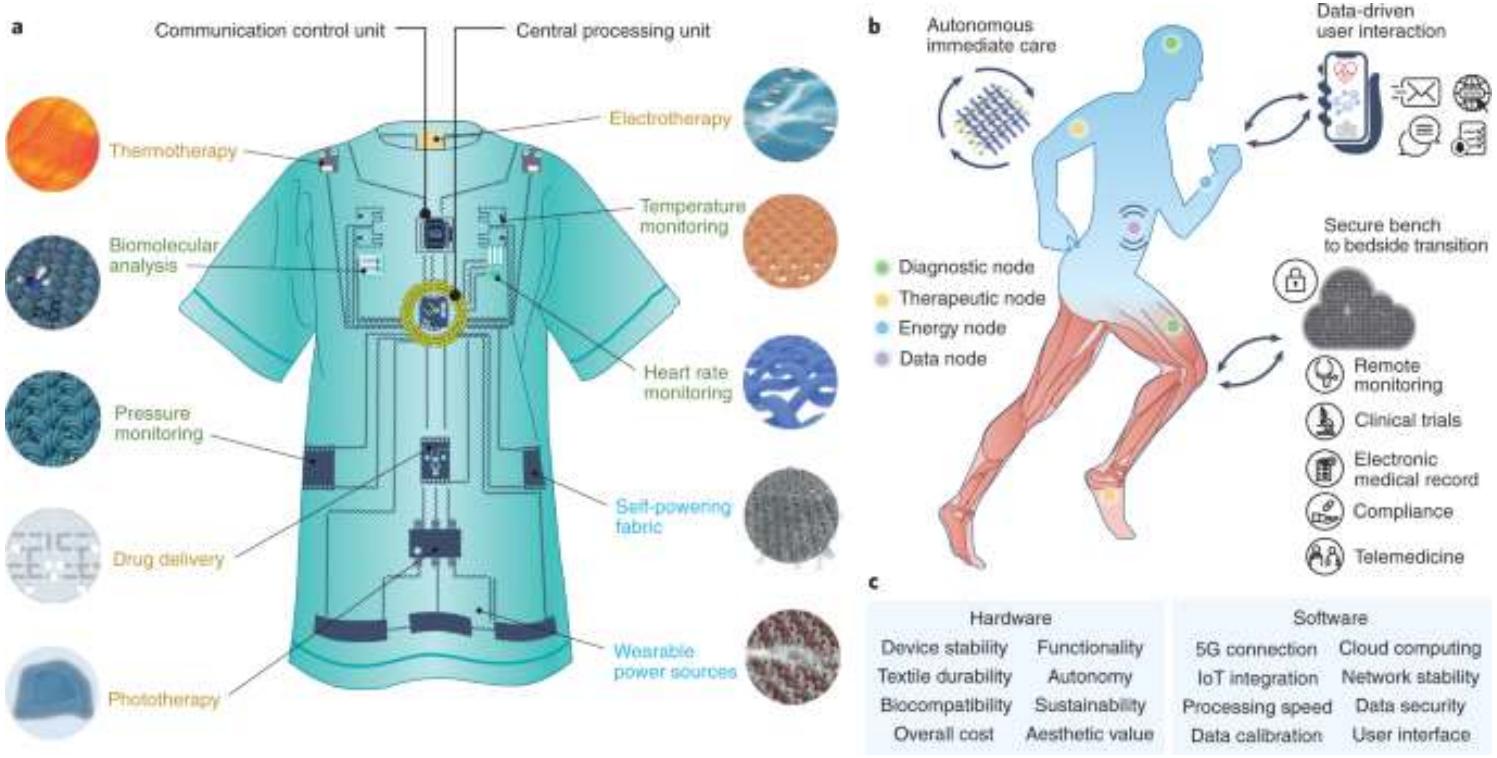
Planned activities in 2025 y:

- ✓ Design and synthesis of novel ligands for extraction of rare metals;
- ✓ Binary system for extraction and testing in real conditions;
- ✓ At least two published papers are expected.



Planned activities in 2025 y:

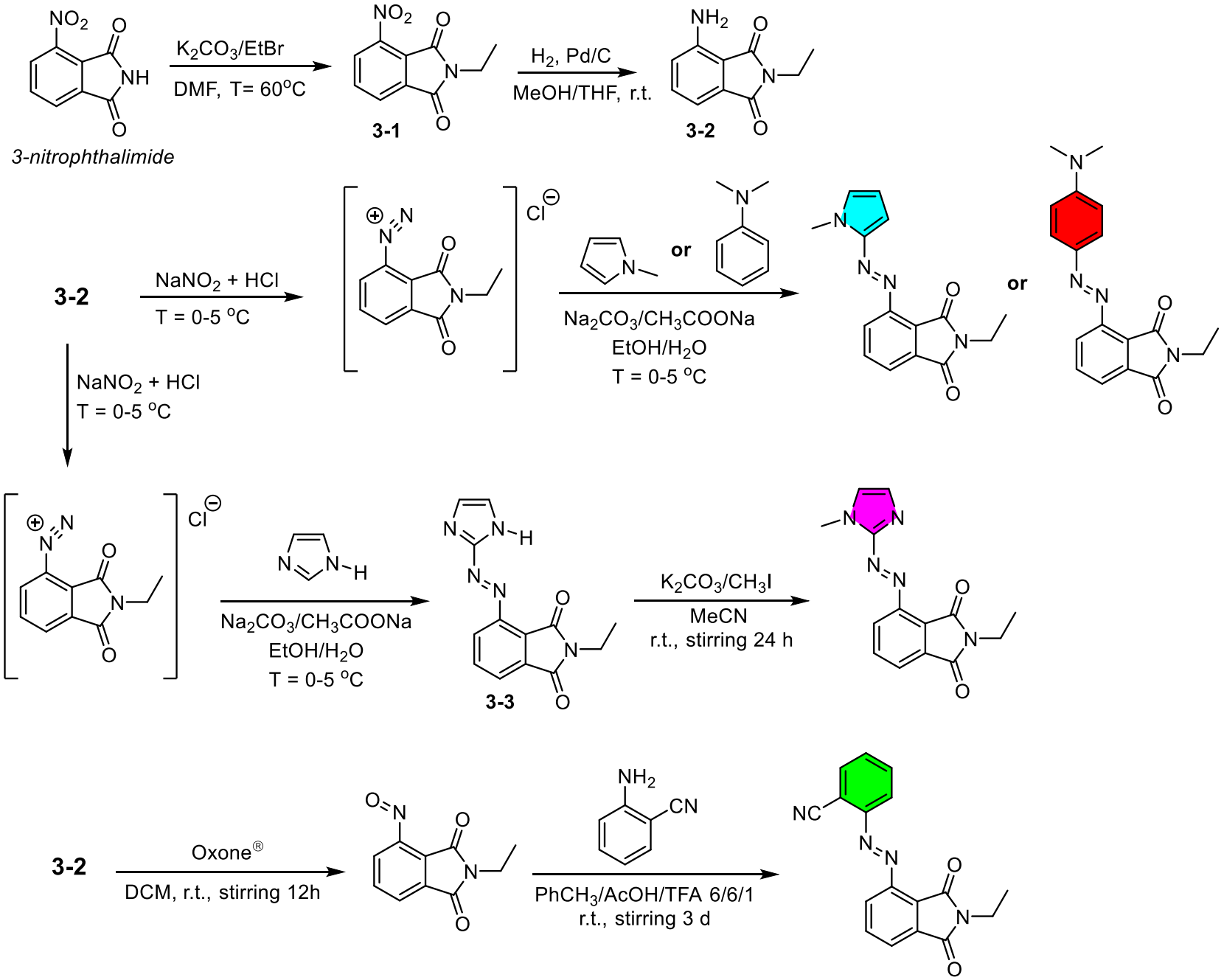
- ✓ Design of novel textile materials for smart performance;
- ✓ Antibacterial and biocompatability;
- ✓ At least two published papers are expected.

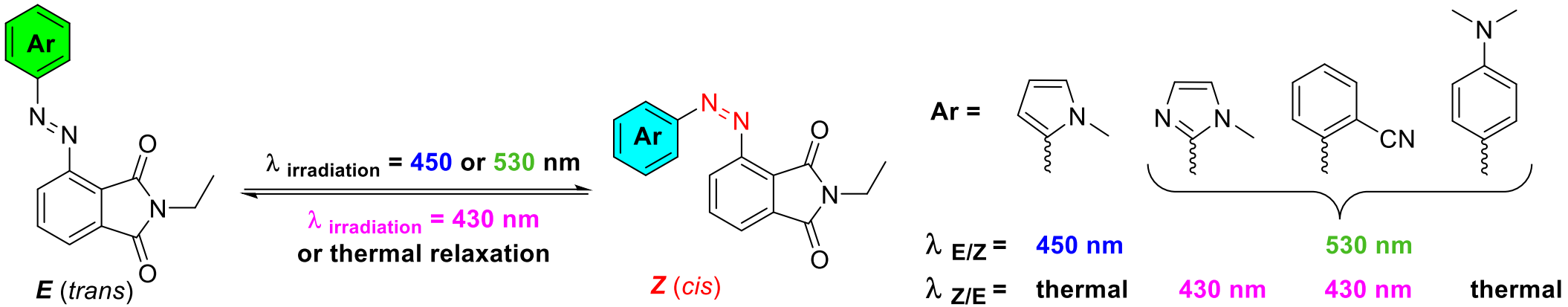


Nat Electron 5, 142–156 (2022)

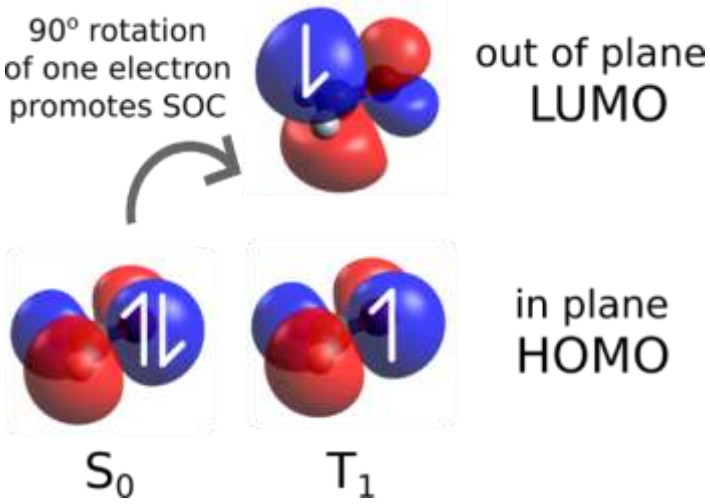
Canan Çelikel, Dilan. 2020. 'Smart E-Textile Materials'. Advanced Functional Materials. IntechOpen

3-Azo Phthalimides by Anton Georgiev



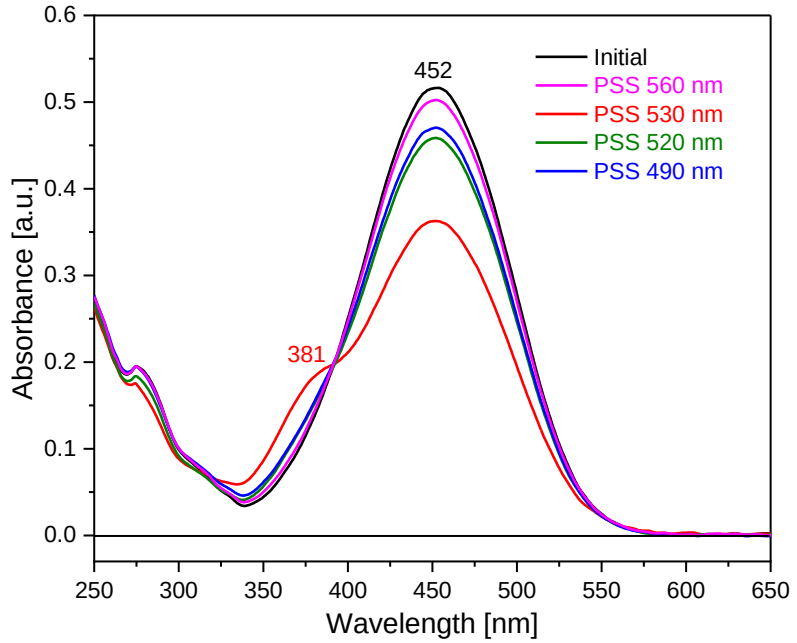


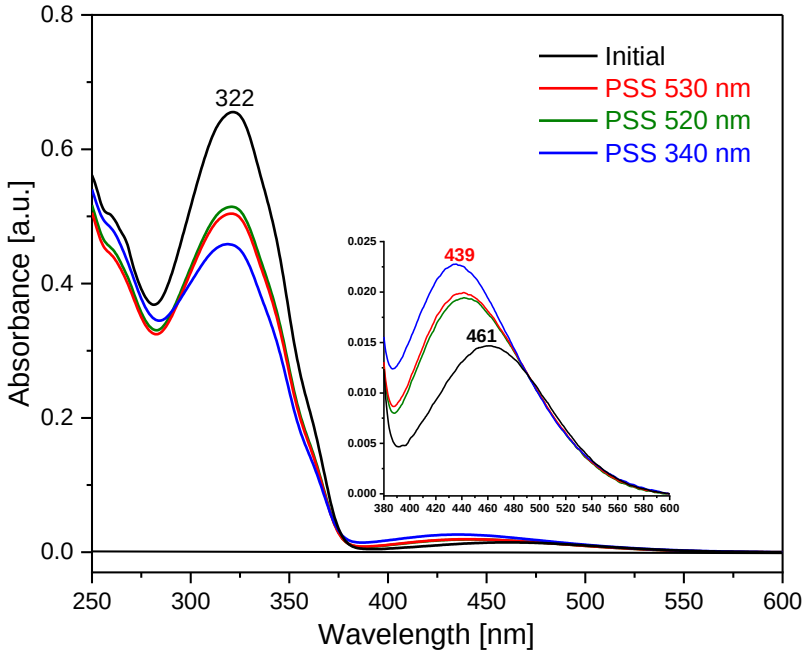
Ortho-functionalized phthalimide azo switches

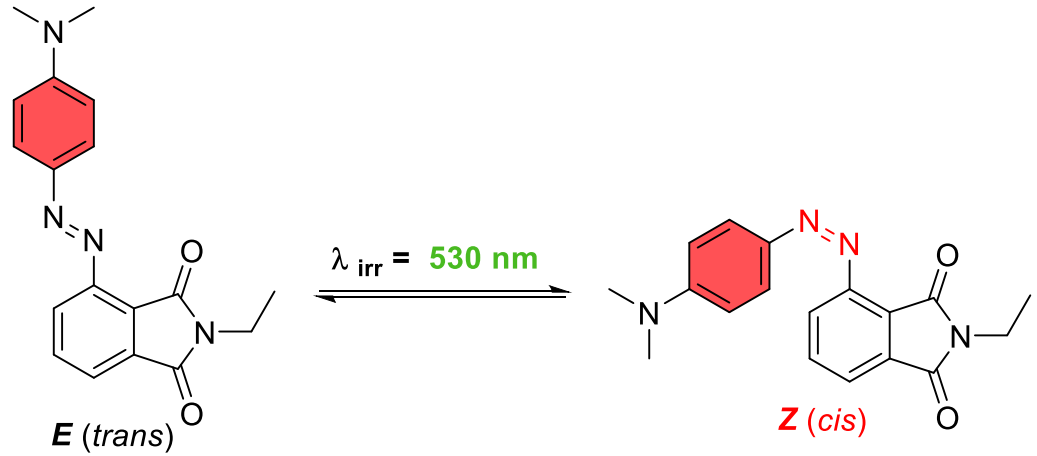


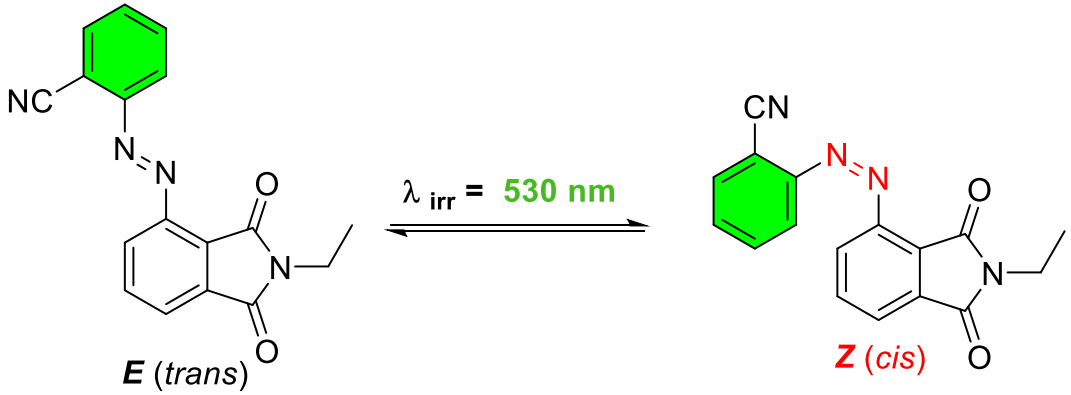
- ✓ **Spin-orbit coupling occurs with ortho-functionalization by σ or π EA.**
- ✓ **Enhances the n- π* bans separation between two switched states.**
- ✓ **Visible light E/Z activated < 500 nm irradiation.**

3-Azo Phthalimides by Anton Georgiev

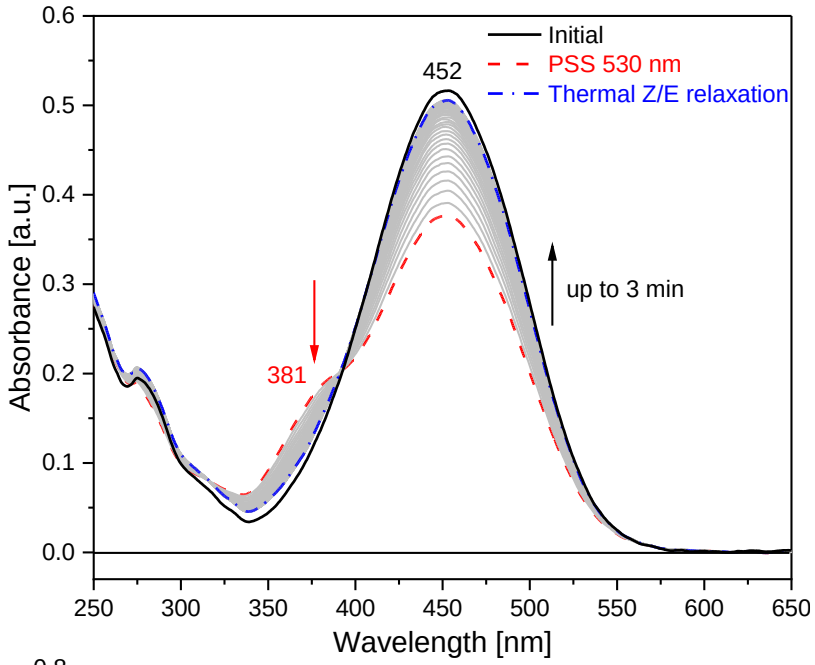








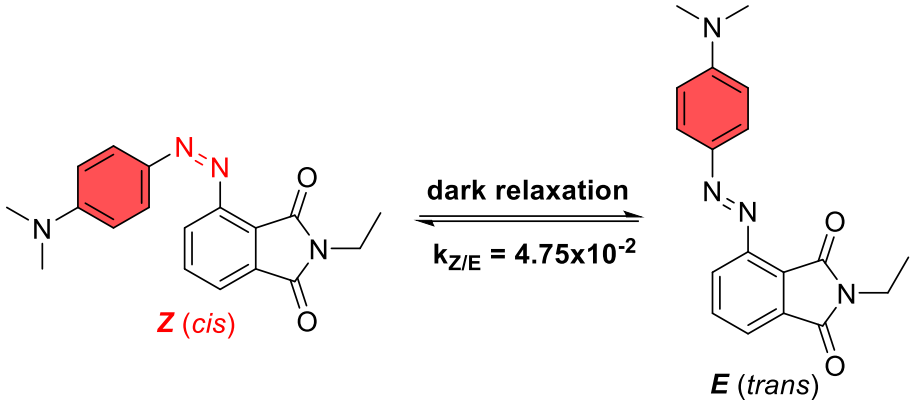
3-Azo Phthalimides by Anton Georgiev

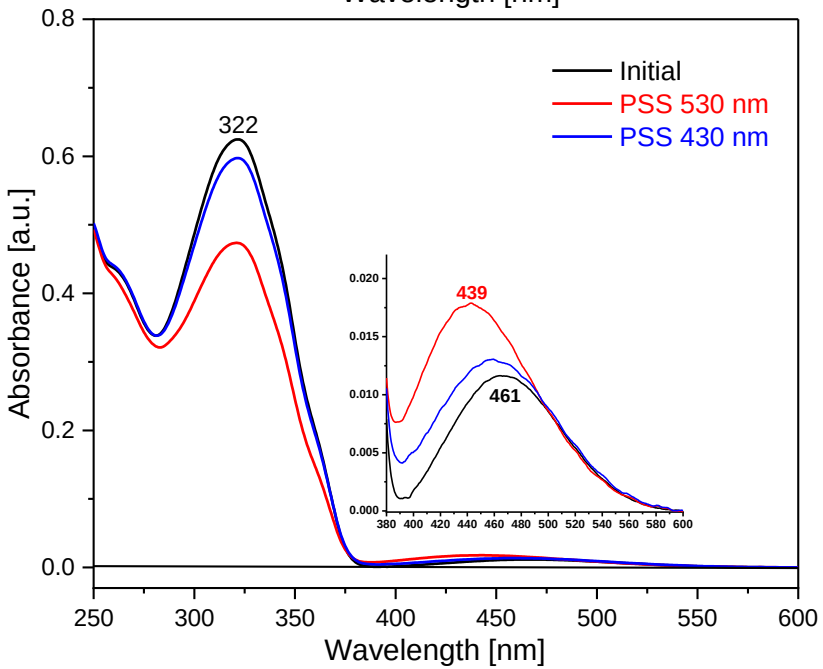


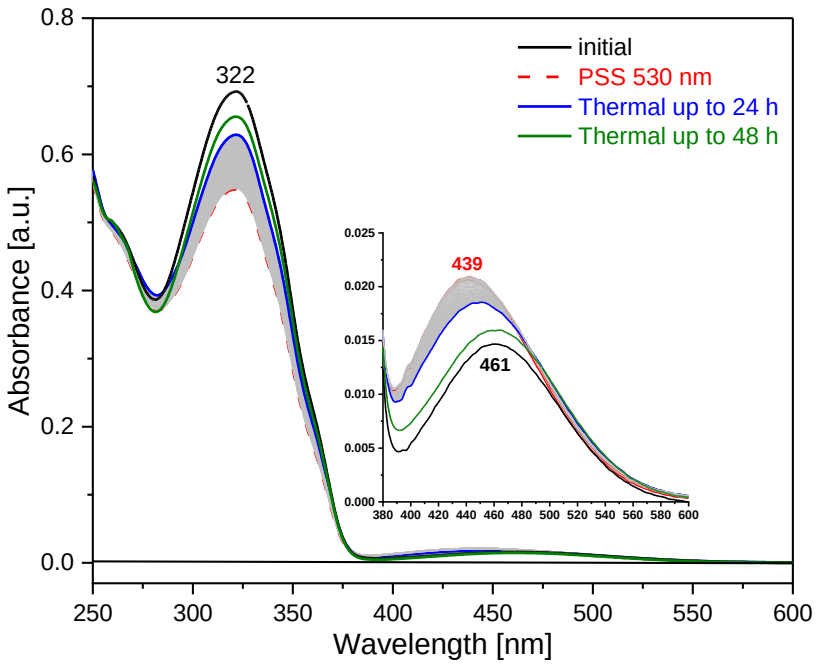
$$\ln\left(\frac{A_0 - A_\infty}{A_t - A_\infty}\right) = k.t \quad \textbf{E/Z conversion}$$

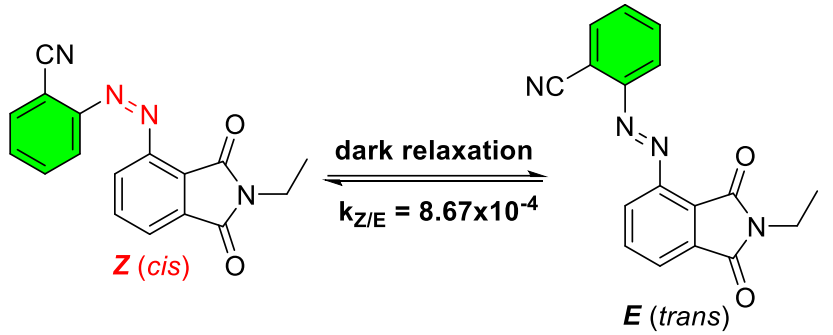
$$\ln\left(\frac{A_\infty - A_0}{A_\infty - A_t}\right) = k.t \quad \textbf{Z/E conversion}$$

$$\frac{ln2}{k} = t_{1/2} \quad \textbf{half-life of the reaction}$$

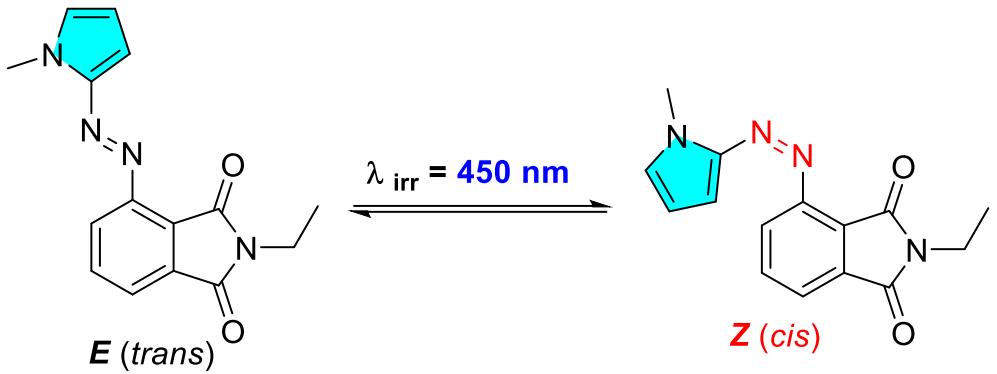


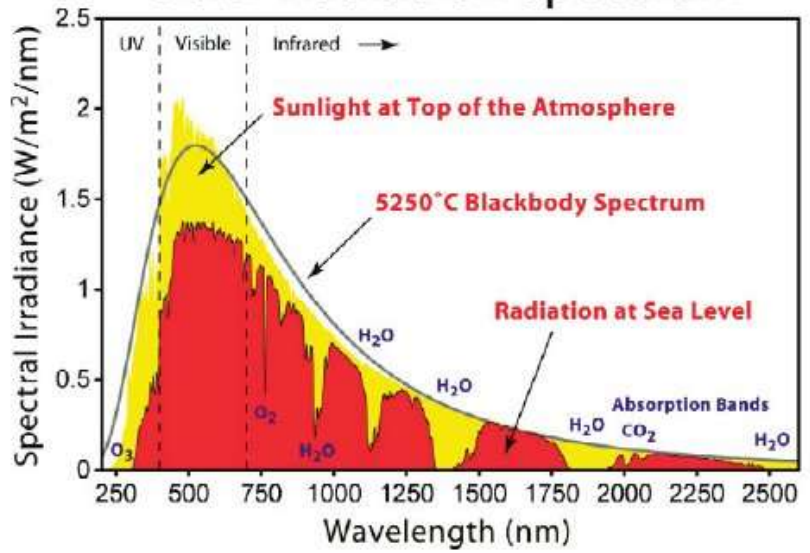


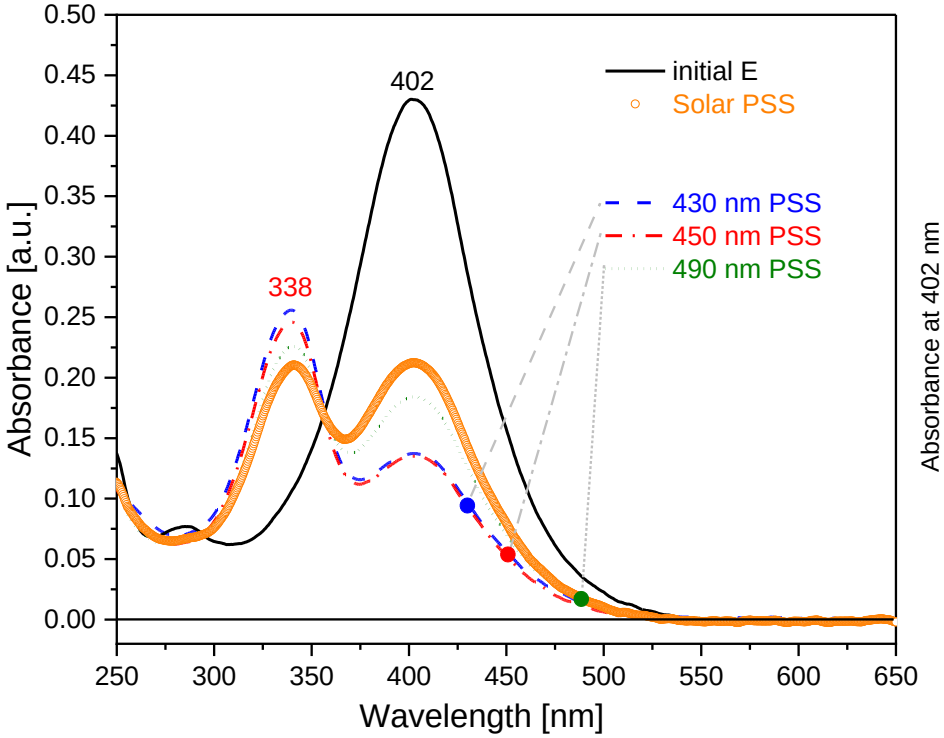


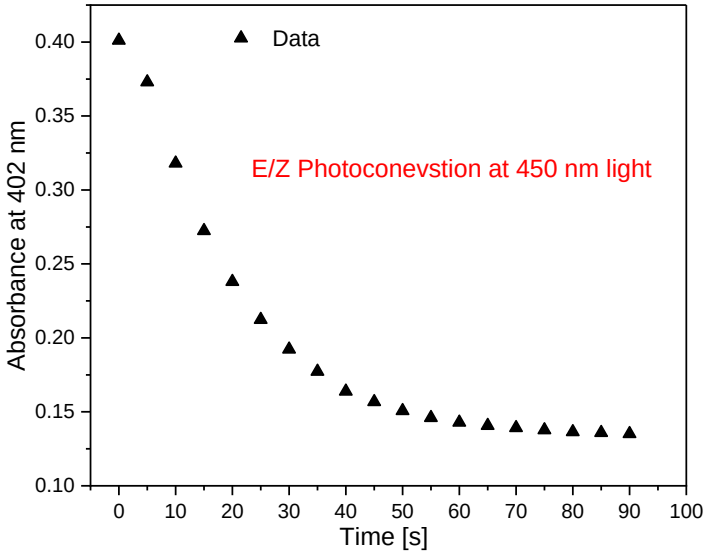


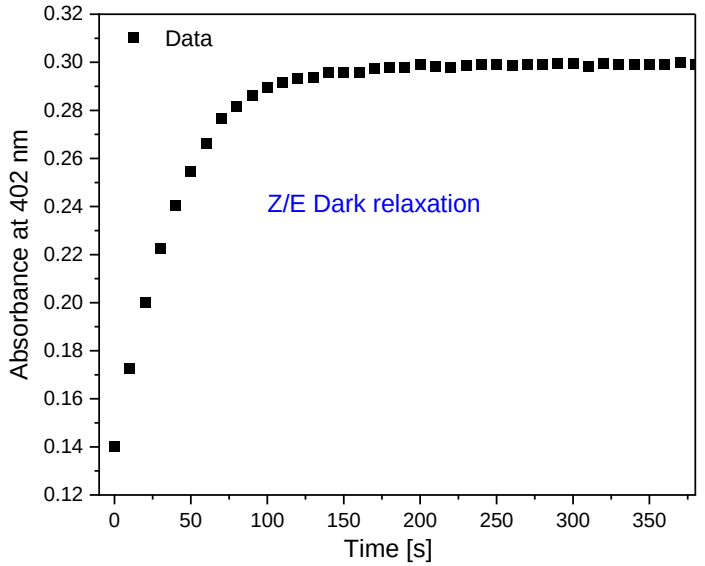
Ortho-functionalized azo switches covered visible spectral solar region



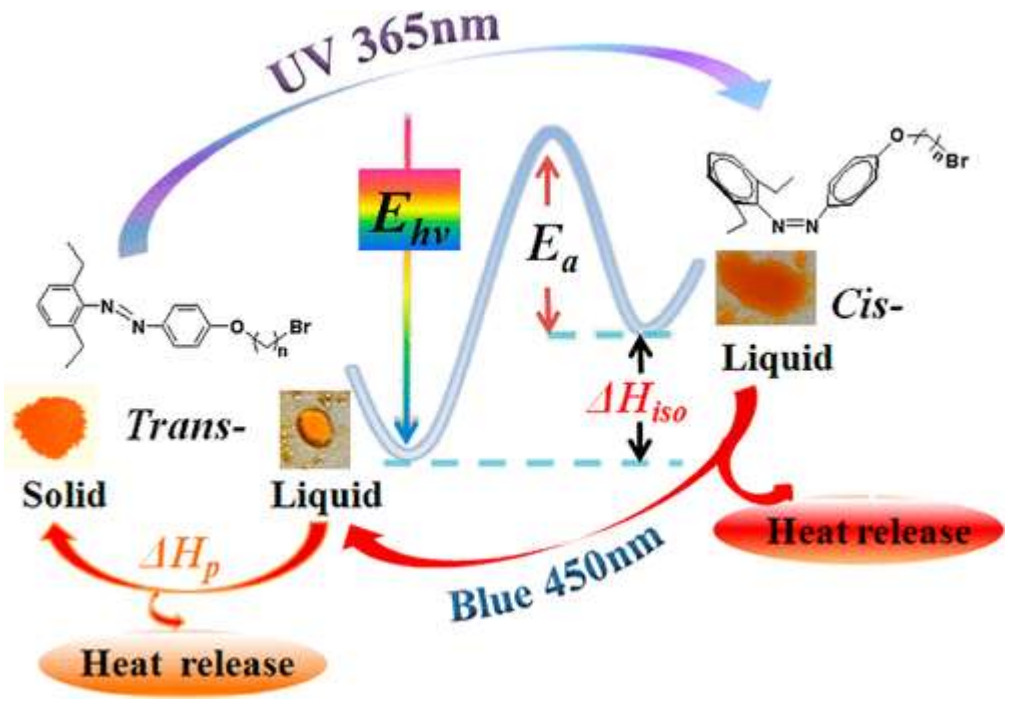




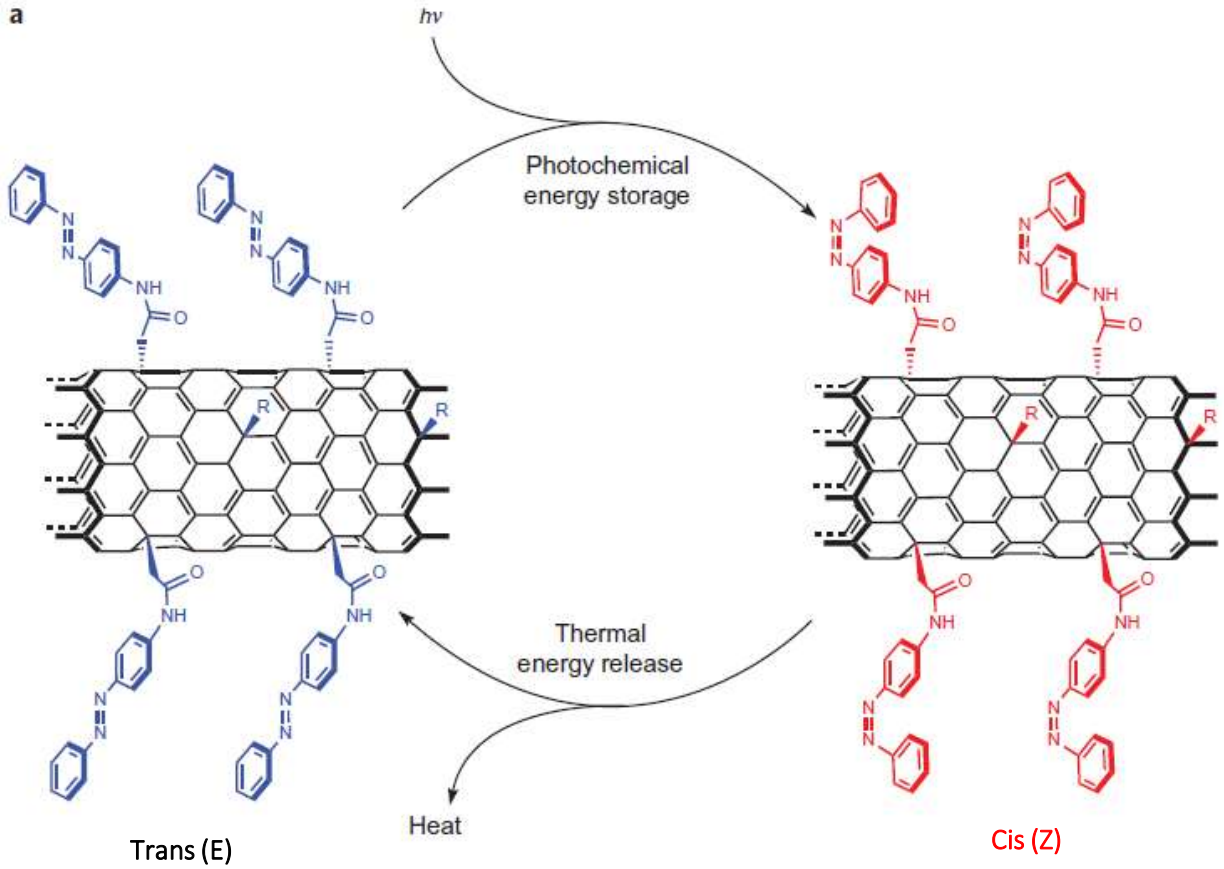




Molecular photoswitches: energy storage

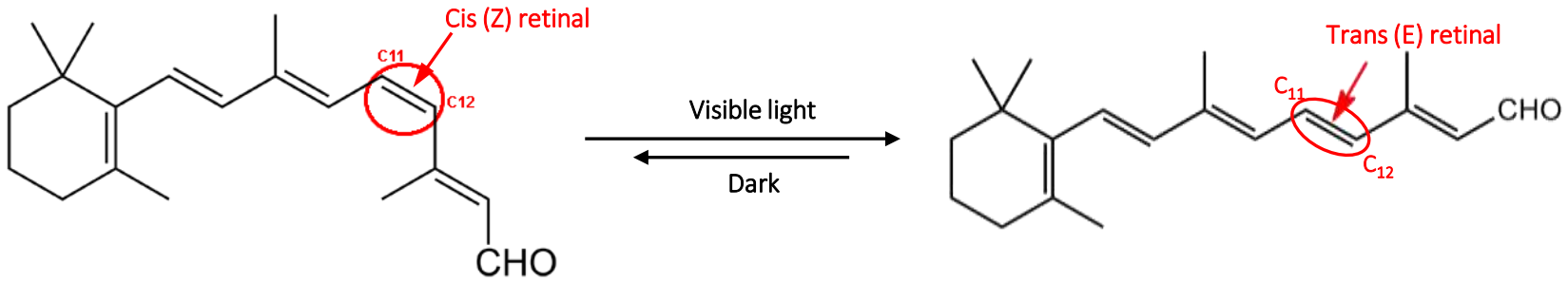


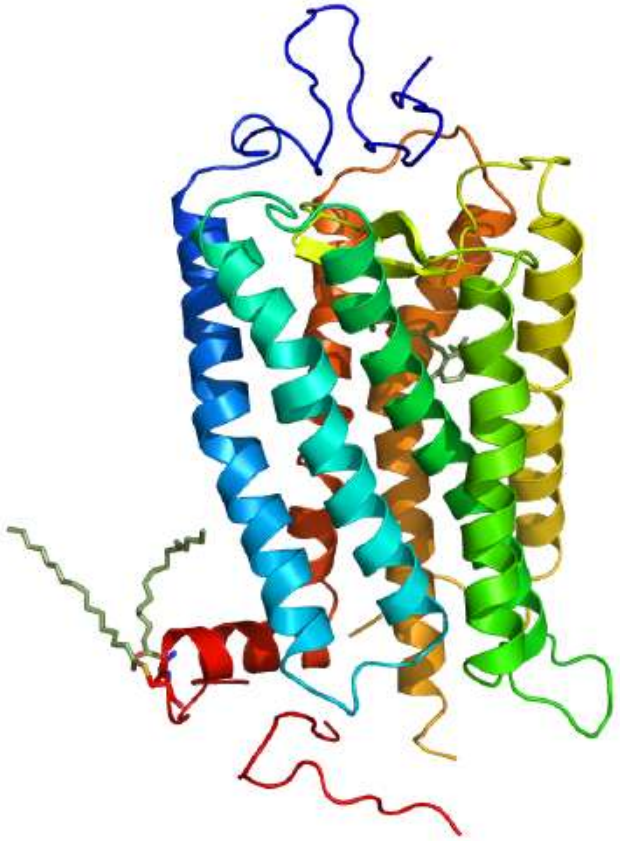
ACS Appl. Mater. Interfaces 2022, 14, 31, 35623–35634

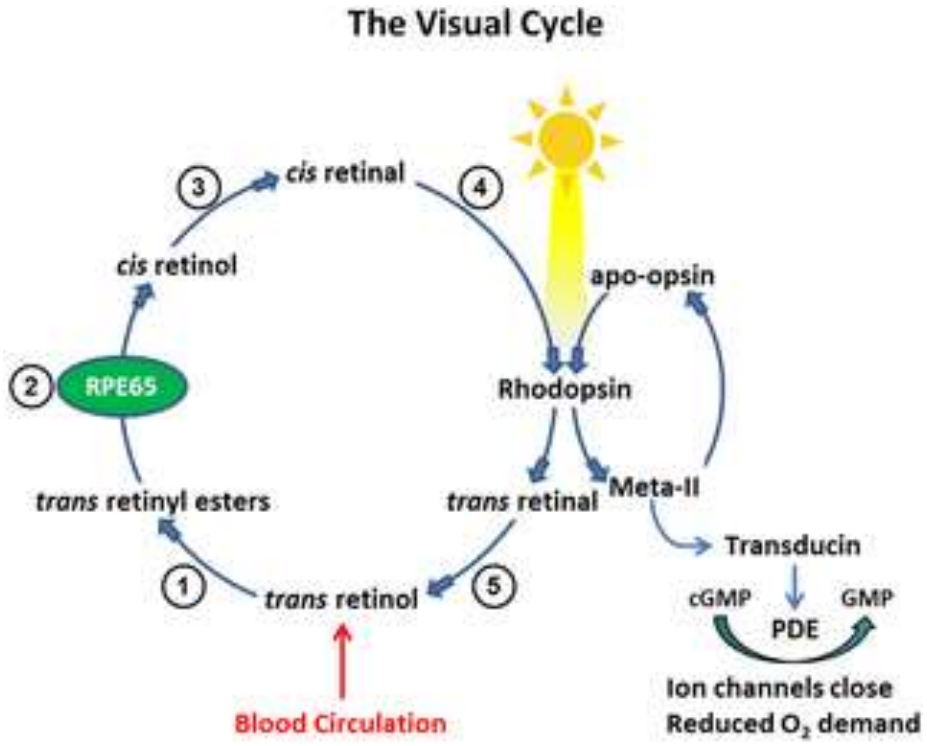


T.J. Kucharski et.al., Nature Chemistry *6, 441-447 (2014)*

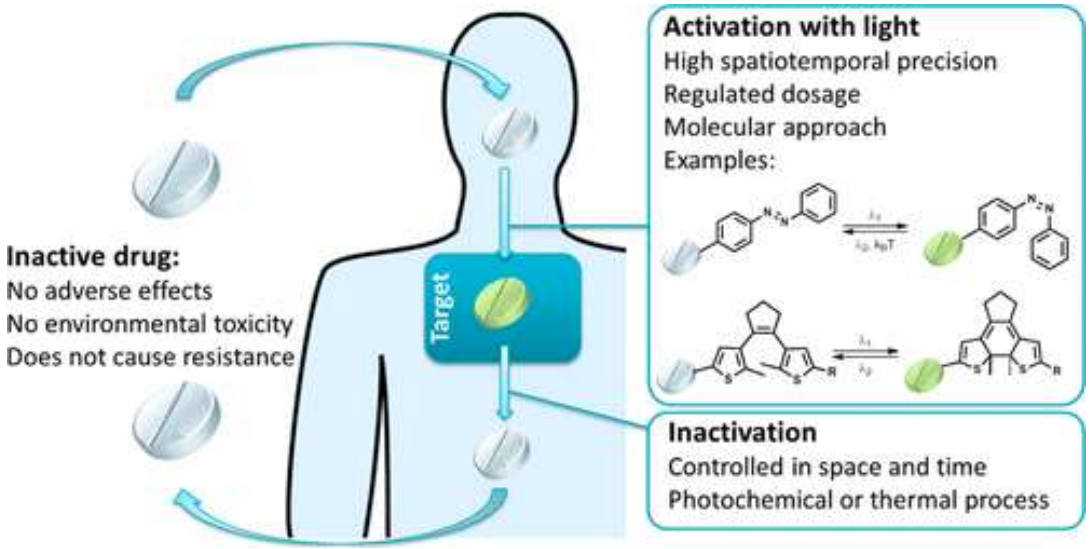
Artificial Molecular Photoswitches: vision cycle and restoration

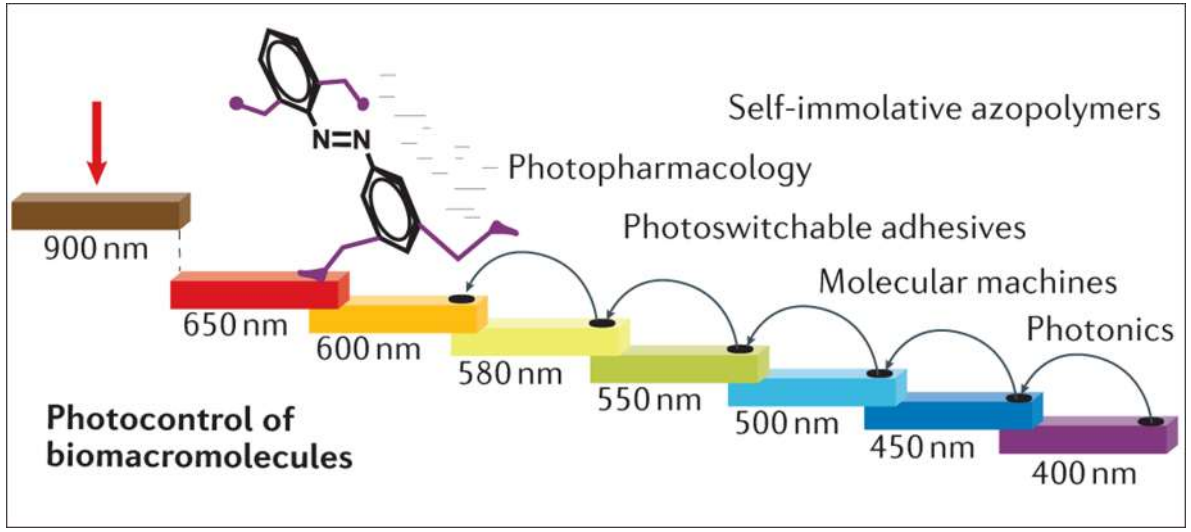


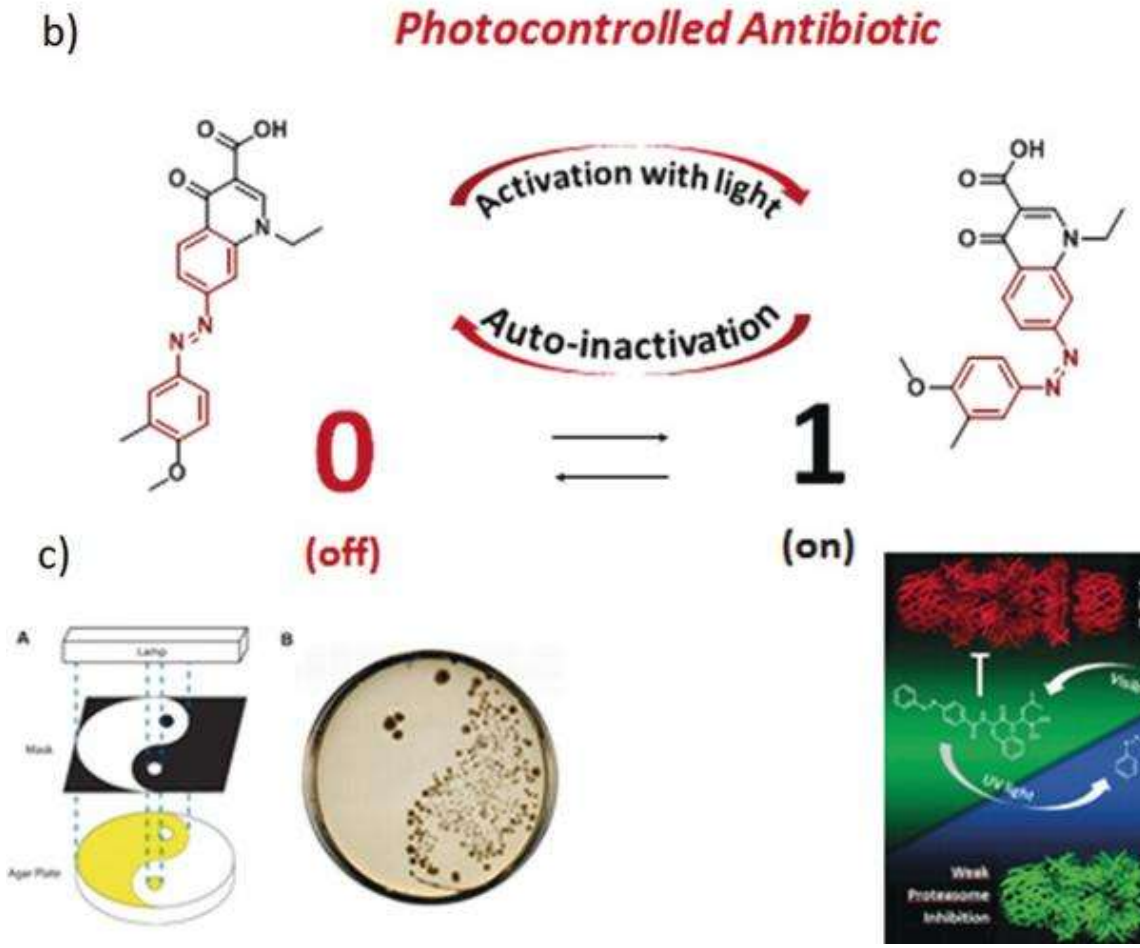




Photopharmacology

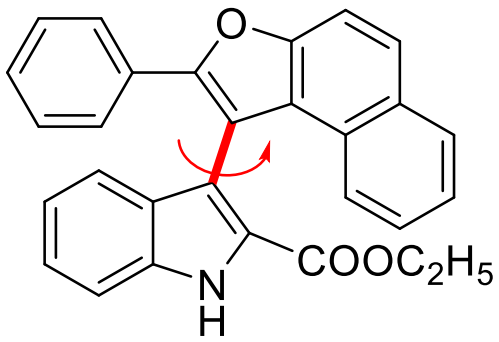






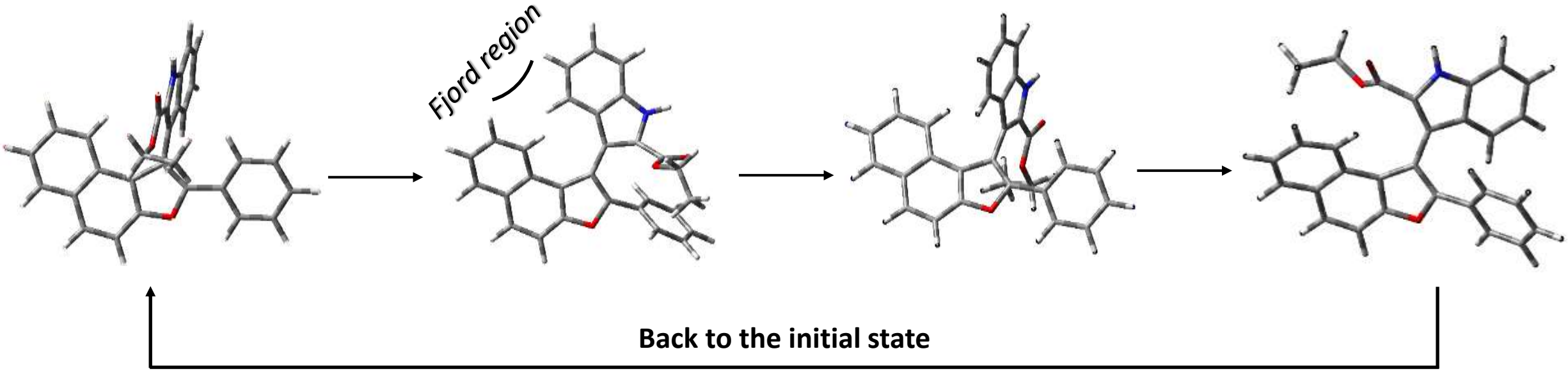
B. L. Feringa, Angew. Chem. Int. Ed. 2017, 56, 11060.

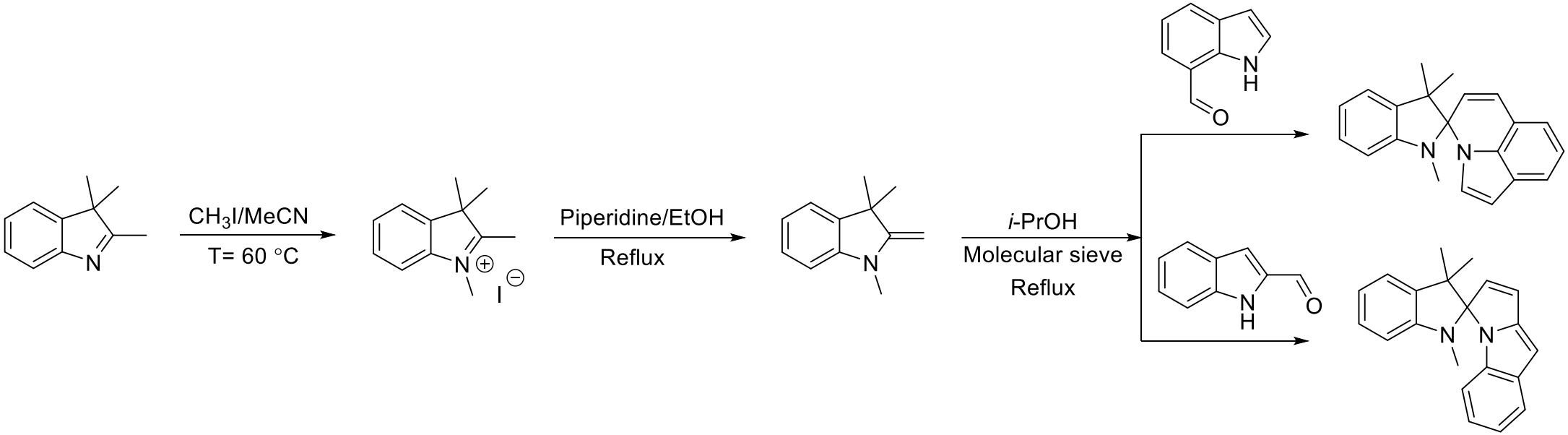
C3-indole Rotary switches

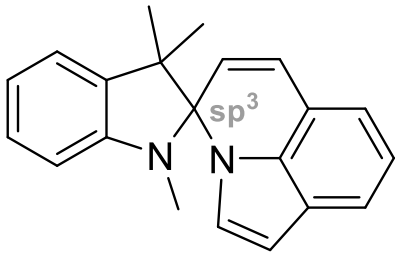


From Blue to White light controlled fluorescence

Atropisomers (axial chirality) – optically active



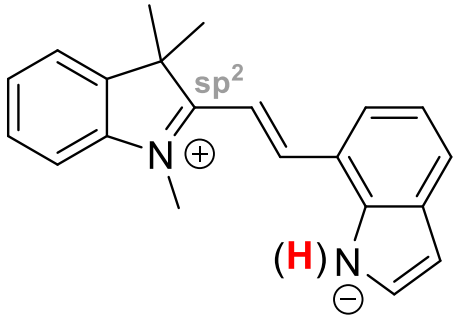




closed
colourless

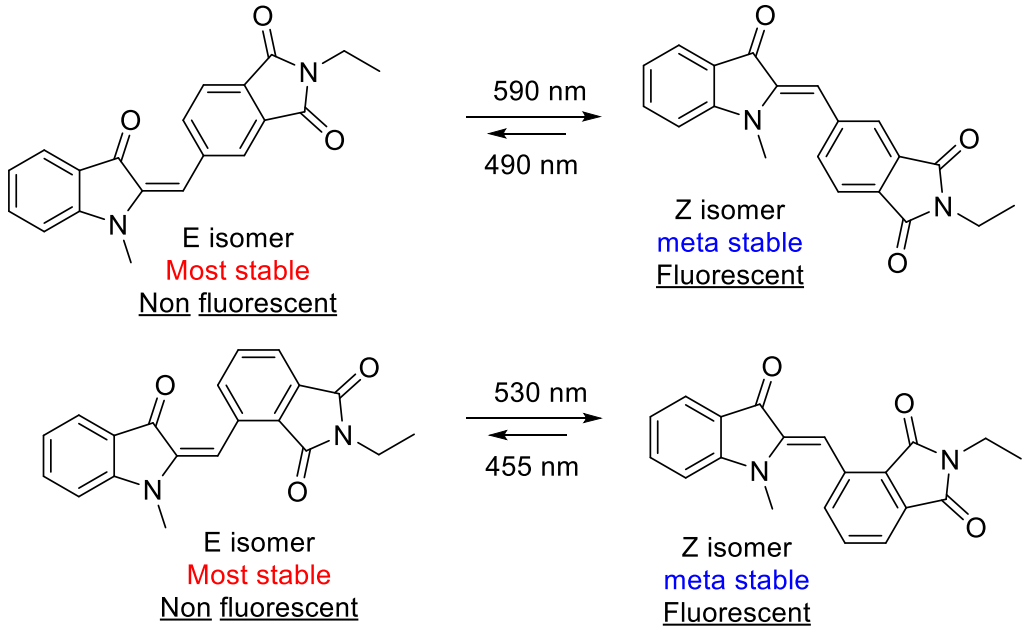
λ_{irr} = **340 nm** or **H-A**

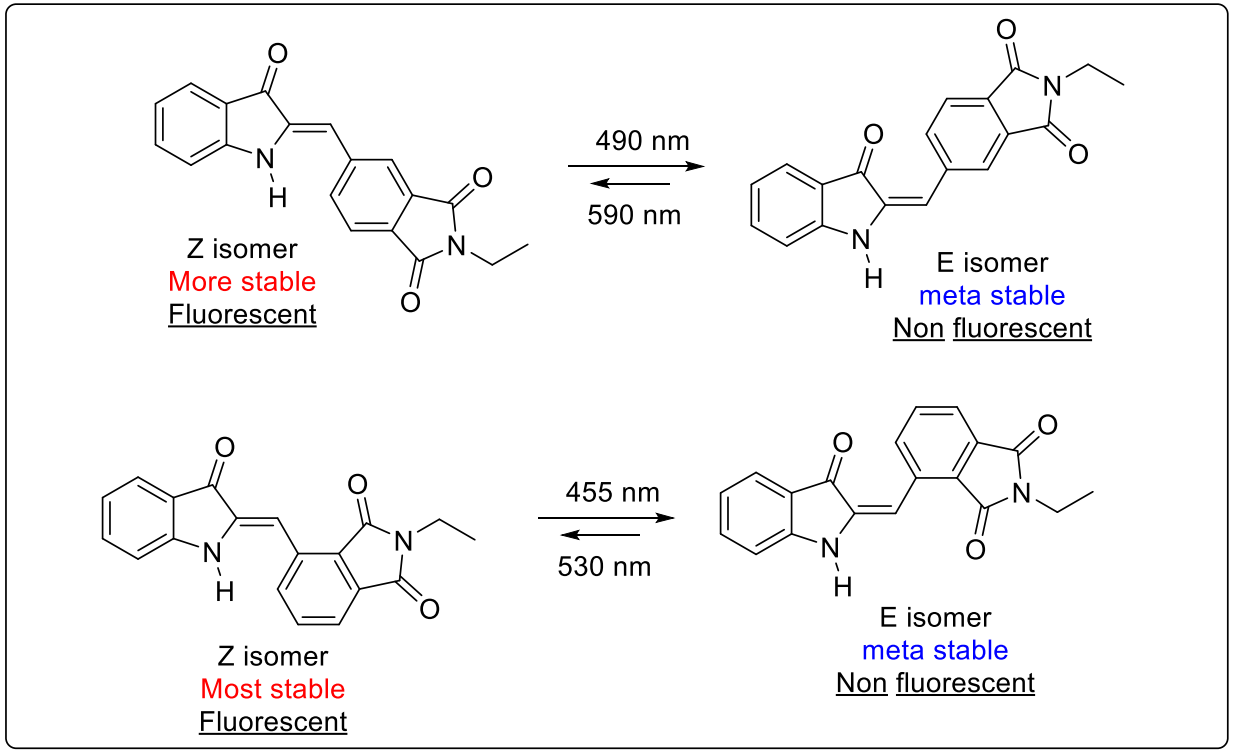
λ_{irr} = **530 nm** or **H-B**



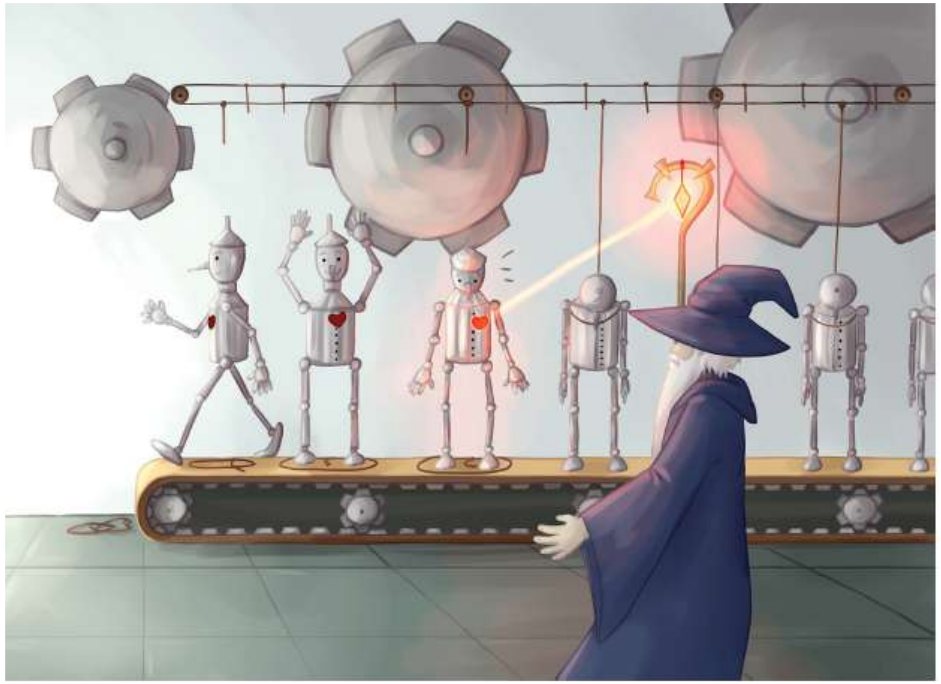
open
coloured (merocyanine)

Oxindole fluorescent switches by Anton Georgiev

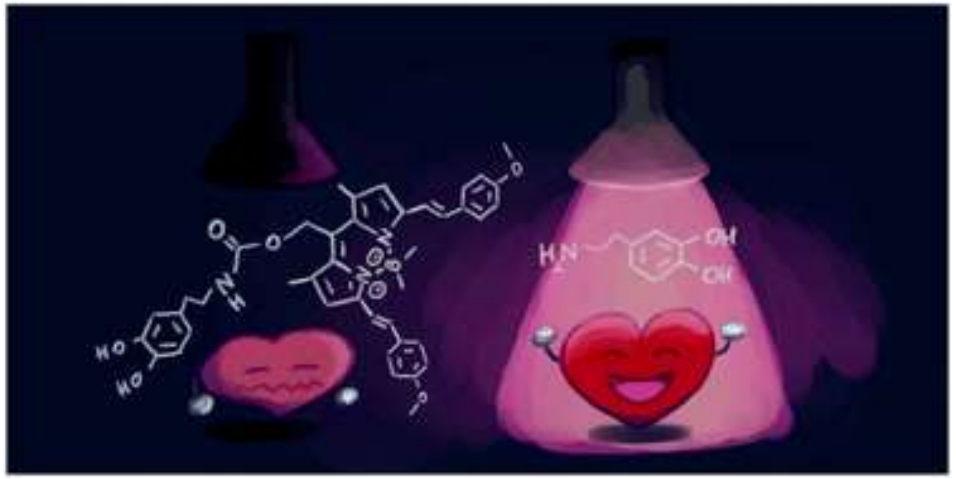


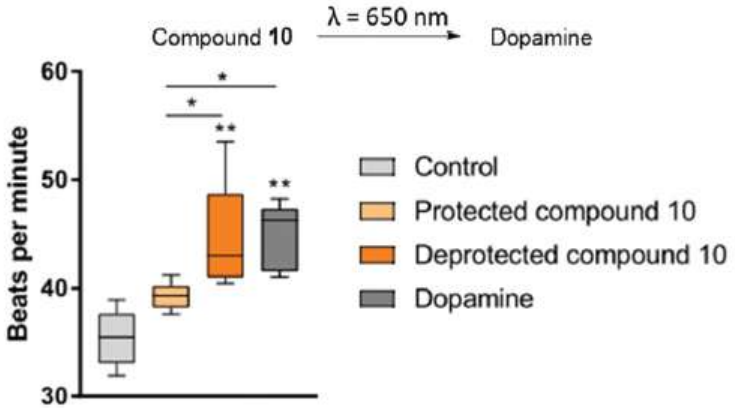


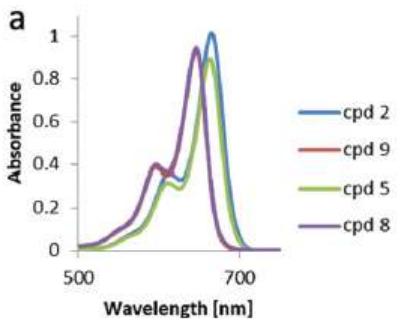
BODIPY cargo transport : biological application in controlling heart rhythm

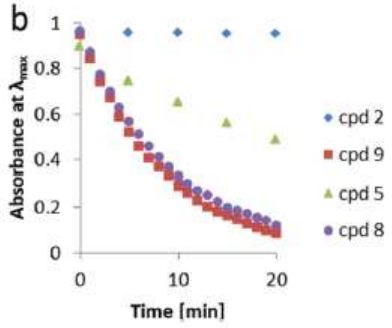


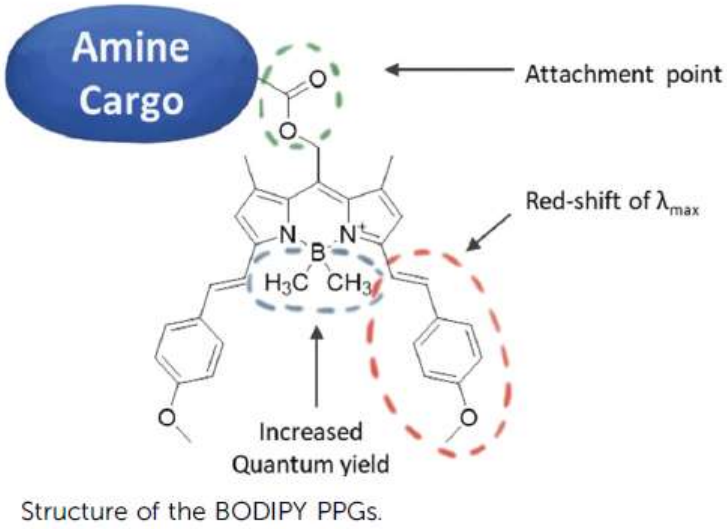
Photoremovable protecting groups











Structure of the BODIPY PPGs.

Ben Feringa. *et al. " Red-light-sensitive BODIPY photoprotecting groups for amines and their biological application in controlling heart rhythm"*, **Chem. Commun.**, 56, 5480 (2020).

Anton Georgiev

1. Kosuke Nakashima, Dancho Yordanov, Yasuyuki Matsushima, Shin-ichi Hirashima, Tsuyoshi Miura, Anton Georgiev, *"Rearrangement of C2-Spirooxindoles: Conversion to the 2-Hydroxyhemi-Indigo and Chromenoindole",* **The Journal of Organic Chemistry (American Chemical Society)** 2024 89 (17), 12401-12409, https://doi.org/10.1021/acs.joc.4c01362 **Q1 (Web of Science)**
2. 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 (American Chemical Society)** 2023, 88, 24, 17206–17214, https://doi.org/10.1021/acs.joc.3c02056 **Q1 (Web of Science)**
3. Dancho Yordanov, Rastislav Smolka, Martin Vala, Martin Weiter, Anton Georgiev, *"Versatile photoluminescence behavior of polycyclic hydroxybenzimidazoles driven by intermolecular hydrogen bonding",* **Optical Materials (Elsevier)** 2024 157 (2) , **116274**. https://doi.org/10.1016/j.optmat.2024.116274 **Q1 (Web of Science)**
4. Tatiana Munteanu, Dancho Yordanov, Gabriel Canard, Olivier Siri, Denis Jacquemin, Anton Georgiev and Simon Pascal, *"Feasibility of multiple excited-state proton transfer processes in hydroxyquinoline-containing benzobisimidazole dyes",* **New Journal of Chemistry (Royal Society of Chemistry)**, 2024, 48, 13289-13295, https://doi.org/10.1039/D4NJ01787K **Q2 (Web of Science)**
5. Dominik Veselý, Dancho Yordanov, Martin Vala, Martin Weiter, Jozef Krajčovič, Anton Georgiev, "*Acid-base fluorescence switching and aggregation induced emission (AIE) of phenylene-thienyl chalcones*", **Journal of Molecular Liquids (Elsevier)** 397 (2024) 124119, https://doi.org/10.1016/j.molliq.2024.124119 **Q1 (Web of Science)**
6. 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 (Elsevier)** 215 (2023) 111279, https://doi.org/10.1016/j.dyepig.2023.111279 **Q1 (Web of Science)**

Nikolay Georgiev, Rayna Bryaskova and Vecislav Bakov

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8. Georgiev, N.I.; Bakov, V.V.; Anichina, K.K.; Bojinov, V.B. *„Fluorescent Probes as a Tool in Diagnostic and Drug Delivery Systems"*, **Pharmaceuticals (MDPI)** 2023, 16, 381. https://doi.org/10.3390/ph16030381 **Q2 (Web of Science)**
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