7TH INTERNATIONAL SYMPOSIUM ON AGGREGATION-INDUCED EMISSION

BOOK OF ABSTRACTS

Pisa, Italy · 26th-28th August 2026

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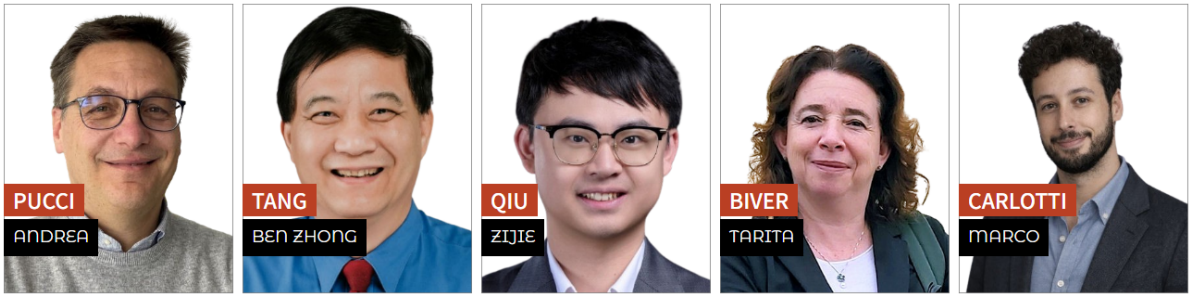

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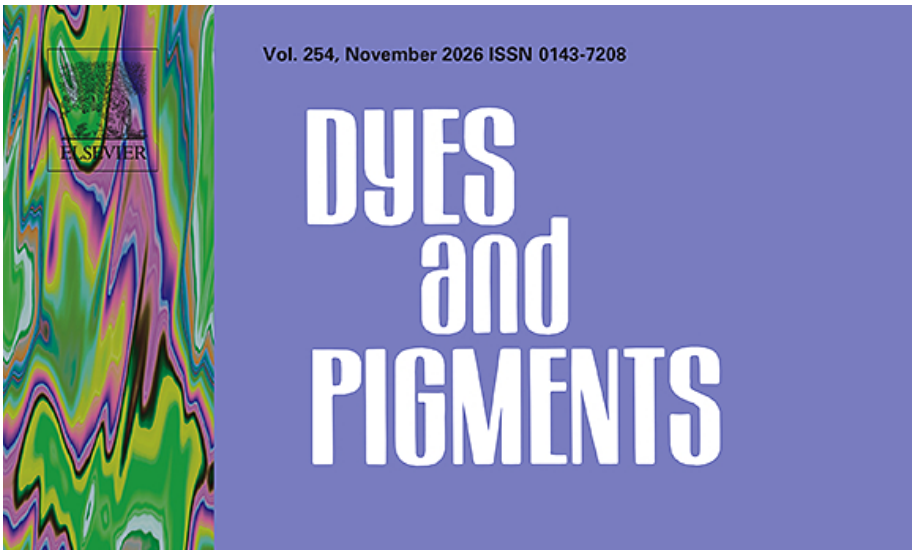
Special issue in occasion of the 7th International Symposium on Aggregation-Induced Emission

Submission deadline: **31 December 2026**

Aggregation-induced emission (AIE) has reshaped the development of luminescent dyes and pigments by demonstrating that molecular aggregation, traditionally associated with emission quenching, can instead be exploited to generate intense and functional light emission in the condensed phase. Since its conceptualization, AIE has grown into a broad research field spanning organic and polymer chemistry, photophysics, supramolecular science, materials engineering, biology, optoelectronics, and emerging aggregate science. This Special Issue is organized on the occasion of AIE7, the 7th International Symposium on Aggregation-Induced Emission, to be held in Pisa, Italy, on 26–28 August 2026 and welcomes contributions from symposium participants as well as from the wider scientific community. The issue aims to collect high-quality original research articles and authoritative reviews addressing the design, synthesis, characterization, processing, and application of AIE-active dyes, pigments, fluorophores, and related functional emissive materials.



Aug 25th			Aug 26th			Aug 27th			Aug 28th	
TUESDAY			**WEDNESDAY**			**THURSDAY**			**FRIDAY**	
		08.30 – 09.00	**Registration**		08.30 – 09.00	**Registration**		08.30 – 09.00	**Registration**	
		09.00 – 09.10	**Opening - CR**							
		09.10 – 9.50	**TANG Opening Lecture - CR**		09.00 – 09.50	**GARCIA-GARIBAY PL1 - CR**		09.00 – 09.50	**ITO H. PL3 - CR**	
			MAT - CR	**BIO - A0**		**MAT - CR**	**BIO - A0**		**MAT - CR**	**THE - A0**
		10:00 – 10.30	**KN1 - QIN**	**KN2 - HONG**	10.00 – 10.30	**KN7 - VOSKHUL**	**KN9 - LODEIRO**	10:00 – 10.30	**KN11 - HIRAI**	**KN12 - KONISHI**
		10.30 – 10.50	IL1 - BAO	IL7 - TIAN	10.30 – 10.50	IL24 - CATALANO	IL29 - KWON	10.30 – 10.50	IL31 - OGAKI	IL35 - ALAM
		10.50 – 11.10	COFFEE BREAK		10.50 – 11.10	COFFEE BREAK		10.50 – 11.10	COFFEE BREAK	
		11.10 – 11:30	IL2 - ONO	IL8 - ZHAO	11.10 – 11:40	**KN8 - RAMSTROM**	**KN10 - ZHANG S**	**11.10 – 11:30**	IL32 - GUALANDI	**KN13 - ADAMO**
		11.30 – 11.50	IL3 - GRIFFINI	IL9 - DING	11.40 – 12.00	IL25 - HELTEN	IL 30 - ZHANG Jianquan	11.30 – 11.50	IL33 - TSUTSUMI	IL36 - JACQUEMIN
		11:50 – 12.10	IL4 - HIRATA	IL10 - LI K	12.00 – 12.20	IL26 - GIESE	O6 - HE Y	11:50 – 12.10	IL34 - BHALLA	IL37 - KUSAMOTO
		12.10 – 12.30	IL5 - ZHANG CHENG	IL11 - ZHANG X	12.20 – 12.40	IL27 - GENOVESE	O7 - MENG	12.10 – 12.25	O8 - BLASI	O10 - MURUGAN
		12.30 – 12.50	IL6 - LUO L	IL12 - YAN	12.40 – 13.00	IL28 - SAGARA		12.25 – 12.40	O9 - CLEMENS	O11 - ZHANG Jianyu
		12.50 – 13.50	**LUNCH**		13.00 – 14.00	**LUNCH**		12.50 – 13.50	**LUNCH**	
		13.50 – 14.20	**POSTER SESSION**		14.00 – 14.50	**FARINOLA PL2 - CR**		13.50 – 14.20	**POSTER SESSION**	
			SYN - CR	**BIO - A0**	15.00 – 18.00	**Guided visit**			**SYN - CR**	**THE - A0**
		14:20 - 14:50	**KN3 - FERY-FORGUES**	**KN4 - YOON**				14:20 – 14:50	**KN14 - TANAKA**	**KN16 - BLANCAFORT**
		14.50 – 15.10	IL13 - TAKEDA	IL20 - ZHANG T				14.50 – 15.10	IL38 - MALPICCI	IL44 - KABE
		15.10 – 15.30	IL14 - ZHANG L	IL21 - LI MH				15.10 – 15.30	IL39 - LUO Z	IL45 - HIRAKAWA
		15.30 – 15.50	IL15 - SHIMIZU	IL22 - SHIGEMITSU				15.30 – 15.50	IL40 - GRAZULEVICIUS	IL46 - ZHANG H
		15.50 – 16.10	IL16 - HAINO	IL23 - QIU				15.50 – 16.10	IL41 - NIU	O13 - ZHANG Z
								16.10 – 16.25	O12 - SONG	O14 - GIANNINI
		16.10 – 16.30	COFFEE BREAK					16.25 – 16.45	COFFEE BREAK	
		16.30 – 17.00	**KN5 - MÜLLER**	**KN6 - LEE**				16.45 – 17.15	**KN15 - ITO S**	**KN17 - YUAN**
		17.00 – 17.20	IL17 - SAKURAI	O2 - LIN				17.15 – 17.35	IL42 - KATO	IL47 - DORDEVIC
		17.20 – 17.40	IL18 - HE F	O3 - KACHWAL				17.35 – 17.55	IL43 - INAGI	IL48 - ITO F
19.00 – 23.00	**Welcome cocktail**	17.40 – 18.00	IL19 - IMOTO	O4 - LIU	20.00	**Gala dinner**		18:00 – 18.15	**Closing - CR**	
		18.00 – 18.15	O1 - TIAN	O5 - SU						

Photonic Architectures with Photosynthetic Microorganisms and Molecular Emitters

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The controlled integration of photosynthetic structures, evolutionarily optimized for light harvesting and energy conversion, with tailored photoactive molecules provides access to biohybrid architectures with appealing photonic and optoelectronic properties.
The lecture illustrates this approach through selected examples of increasing complexity. First, the bacterial photosynthetic enzyme named Reaction Center from *Rhodobacter sphaeroides*, responsible for primary photoconversion, is selectively functionalized with synthetic light-harvesting antennas. These molecular antennas broaden the spectral absorption window of the photoenzyme and enhance photoconversion.[1,2]
As a second example, nanostructured biosilica frustules from diatoms are exploited as naturally produced photonic architectures.[3] Their bulk or surface functionalization with fluorescent organic dyes [4] and phosphorescent organometallic complexes [5] affords emissive micro/nanostructures with tuneable optical responses and potential applications as photonic materials.
Finally, intact living diatom cells are engineered through the non-genetic incorporation of molecular fluorophores, enabling Förster resonance energy transfer to chlorophyll. This strategy compensates for spectral gaps in sunlight absorption and enhances photosynthetic efficiency, biomass growth and lipid production.[6]
The lecture will discuss the design principles and synthetic strategies underlying these photoactive biohybrid micro/nano assemblies, highlighting the challenges of integrating molecular emitters into complex biological environments, where photophysical properties depend on local structure and organization. New concepts for photoresponsive materials can be envisaged by combining biotechnological production and modification of photosynthetic microorganisms with photoactive molecules.

[1] F. Milano et al. **2019** *Adv. Funct. Mater.*, 29, 1805521.
[2] F. Milano et al. **2012** *Angew. Chem. Int. Ed.*, 51, 11019.
[3] C. Vicente-Garcia et al. **2024** *ChemPlusChem*, 89, e202400462.
[4] R. Ragni et al. **2018** *Adv. Funct. Mater.*, 28, 1706214.
[5] G. Della Rosa et al. **2019** *ACS Sustainable Chem. Eng.*, 7, 2207–2215.
[6] G. Leone et al. **2021** *Scientific Reports*, 11, 5209.

Aggregation-Induced Amplification in Crystalline Solids

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Signal and chemical amplification are uncommon yet powerful phenomena with broad implications across chemistry, materials science, and biology. Signal amplification arises in systems that transduce an external stimulus and propagate its effect, enabling a single molecular event to trigger multiple chemical transformations. This propagation can occur through diffusion in solution, or through preorganized aggregation in supramolecular assemblies and crystalline solids, where intermolecular coupling facilitates efficient transfer of chemical and energetic information.

In this lecture, we will focus on amplification strategies in crystalline materials that exploit exciton [1] and polaron [2] delocalization. These processes enable remarkable reactivity, including quantum chain reactions that yield up to ~500 chemical events per absorbed photon, as well as single-electron transfer (SET) catalysis under the electron beam of an electron microscope, where as many as 120,000 reactions can be initiated per incident electron. We will begin with an overview of signal amplification in crystalline aggregates and then highlight representative examples that demonstrate the scope and potential of these systems.[3,4]

[1] I. Paul et al. **2024** *Proc. Natl. Acad. Sci. USA.*,*121*, e2401982121.
[2] K. A. Konieczny et al. **2024** *ACS Central Science*, *10*, 2346.
[3] K. A. Konieczny et al. **2025** *J. Am. Chem. Soc.*, *147,* 44285.
[4] I. Paul et al. **2026** *CHEM*, 102957.

Mechanochemically Driven Stimuli-Responsive Luminescent Materials: From Crystalline Systems to Polymers

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Mechanochemistry aims to exploit mechanical force as a driving input for chemical reactions, in addition to conventional stimuli such as heat, light, and electricity. In parallel, stimulus-responsive luminescent materials that change their emission properties in response to mechanical stimuli have attracted considerable attention, owing to their potential for visualizing subtle mechanical forces and for designing functional materials.
In this lecture, I present our recent research on the control of luminescent behavior induced by mechanical stimuli, spanning from crystalline small molecules to polymeric materials. Particular emphasis is placed on mechanically induced crystal-phase transitions observed in gold isocyanide complexes, and on how changes in crystal structure and Au–Au interactions influence emission wavelength and intensity.[1] Furthermore, we discuss our studies on polymeric materials in which mechanoradicals generated by mechanical force are trapped by luminescent probes.[2,3] This strategy provides a simple and effective approach to synthesizing novel luminescent polymers.

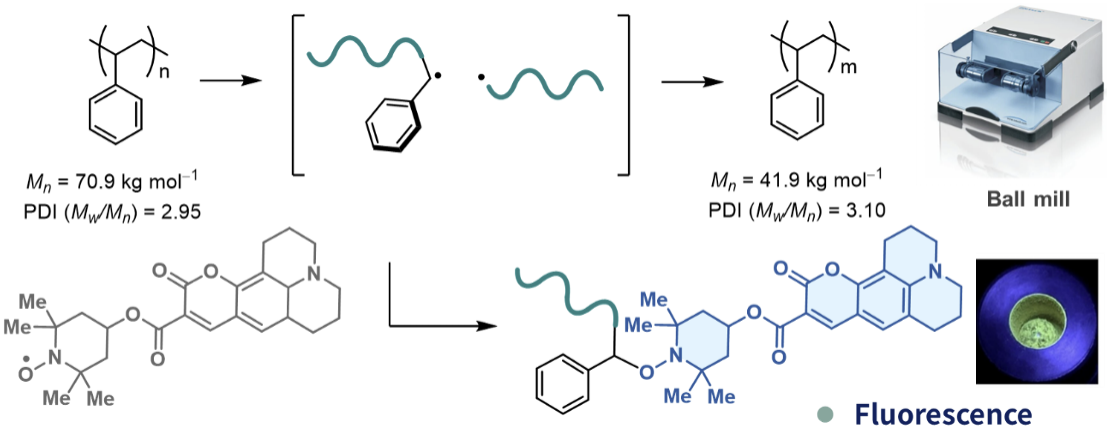

Figure 1. Mechanoradical Generation through Polymer Chain Scission and the Induction of Luminescence.

[1] H. Ito et al. **2008** *J. Am. Chem. Soc.*, 130, 10044–10045.
[2] K. Kubota et al. **2021** *Angew. Chem. Int. Ed.*, 60, 16003–16008.
[3] J. Jiang et al. **2025** *J. Am. Chem. Soc.*, 147, 32502–32521.

Beyond AIE: The Emergence of Aggregate Science as a New Paradigm

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For centuries, the reductionist view that “the whole equals the sum of its parts” has guided materials design. Nature, however, often defies this logic: an aggregate can display emergent properties absent in its individual parts. Aggregation-induced emission (AIE) exemplifies this “anomaly”: nonluminescent molecules become emissive upon aggregation, achieving a qualitative “0-to-1” leap. Since it was proposed as a concept in 2001, AIE has been mechanistically understood as arising from the restriction of molecular motion (RMM) in the excited state: in dilute solutions, molecular rotors and vibrators dissipate exciton energy through active motions and nonradiative decay; upon aggregation, motions are restricted by molecular packing and noncovalent interactions, impeding nonradiative channels and opening radiative pathways. This has expanded AIE into aggregation-enabled luminescent systems, including clusteroluminescence (CL), room-temperature phosphorescence (RTP), and circularly polarized luminescence (CPL). With accumulated knowledge in AIE, attention has broadened toward aggregation-generated function (AGF): molecular motions can be harnessed to convert excited-state energy into heat, enabling emergent photothermal (PT), photoacoustic (PA), and photocatalytic (PC) activities for solar energy conversion, deep-tissue imaging, and intelligent actuation. These advances have shifted scientific attention from isolated molecules to complex aggregates, calling for a paradigm shift, from molecularism to aggregation, or from molecular science to aggregate science (AS). A deeper understanding of AS will enable new scientific discoveries and technological innovations, enabling people to imagine a future designed not merely with matter but with the sophisticated organizational logic that endows it with “life-like” functions.

KEYNOTE

Organic molecules for aggregation induced emission: a theoretical view

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Organic luminophores displaying one or more forms of luminescence enhancement in solid state are extremely promising for the development of new functional materials with applications in many modern technologies. Yet, the effort to harness their large potential is limited by a lack of knowledge of the microscopic mechanisms and their modulation induced by the molecular environment, that are, at last, responsible for the macroscopic response. In this sense, a well-defined theoretical framework able to provide mechanistic explanations, including a quantitative prediction of the experimental observables, can provide valuable insights.
In this talk, we illustrate some of our recent developments about the current theoretical understanding of aggregation-induced emission (AIE), with a particular accent on the quantum chemistry methods that are more suitable to model the associated molecular systems, their close local environment and the effect of an external stimulus.[1,2]
A sketch of a general framework [3] is then attempted via the analysis of a few AIE molecular systems.

[1] M. Turelli et al. **2023** *Phys. Chem. Chem. Phys.*, 25, 17769.
[2] Q. Wang et al. **2024** *J. Mol. Mod.*, 30, 387.
[3] B. Bertoncini et al. **2026** *Chem. Asian J.*, 21, e01000.

Emergence of optical properties in molecular materials - aggregation-induced emission and through-space interactions

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There is great current interest in understanding how the properties of molecules are modulated by aggregation, leading to the emergence of new properties at the molecular material level. We will review our Restricted Access to a Conical Intersection [1,2] model to explain Aggregation-Induced Emission (AIE) and discuss how the combination of AIE and intramolecular through-space interactions results in the photophysical properties of molecular aggregates and crystals, producing unconventional emission.

[1] R. Crespo-Otero et al. **2022**. *A Global Potential Energy Surface Approach to the Photophysics of AIEgens*. In Handbook of Aggregation-Induced Emission (eds Y. Tang and B.Z. Tang).
[2] R. Crespo-Otero et al. **2019** *Chem. Asian J.,* 14, 700.

Highly efficient solid-state emitters: the unexpected red shine of AIPE-active tricarbonylrhenium(I) complexes

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Solid-state red emitters are the subject of intense research for applications in the fields of luminescent materials, sensing and bio-imaging. However, their development is delicate because, in general, the more the emission is shifted towards the red, the more its efficiency decreases. Tricarbonylrhenium(I) complexes are no exception to this rule. These new solid-state emitters may exhibit strong aggregation-induced phosphorescence emission (AIPE),[1,2] as well as mechanoresponsive luminescence (MRL), *i.e.* a particular sensitivity to mechanical stimuli.[3] However, obtaining effective red emitters in this series of compounds remains a challenge.

We describe here the rational design of Re(I) complexes based mainly on (3-(2-pyridyl)-1,2,4-triazole) (pyta) ligands. In the chlorido series, simple chemical modifications resulted in a set of molecules that emit from green to red. However, the red shift of the emission was accompanied by a drastic decrease in the photoluminescence quantum yield (PLQY). In contrast, phosphino complexes showed a staggering PLQY of up to 43%, a performance rarely achieved in this spectral region (Fig. 1). Some of our complexes were very well adapted to AIE experiments, which shows their potential relevance for related applications. It is shown here that the chemical and photochemical stability of the Re(I)complexes, as well as their unique spectroscopic properties, make them the leaders of a new generation of emitters, covering the entire visible range.

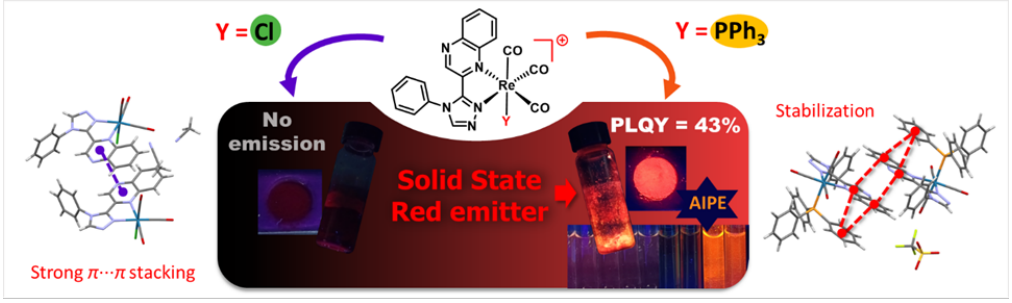

Figure 1. Summary of the solid-state spectroscopic properties of chlorido and phosphino Re(I) complexes.

[1] S. Fery-Forgues. *AIPE-active tricarbonylrhenium(I) complexes*. B. Z. Tang et al. (eds). Encyclopedia of Aggregation-Induced Emission. Springer Nature Singapore Pte Ltd. **2025**.
[2] C. Vanucci-Bacqué et al. **2025** *Spectrochim. Acta A*, *334*, 125932.
[3] S. Le Garrec et al. **2024** *Dalton Trans.*, *53*, 16512–16529.

Preparation of Novel Chiral Silica for Circularly Polarized Luminescence Materials

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Circularly polarized luminescence (CPL) is expected to find applications in next-generation 3D displays, encryption technologies, and optical communications. Conventional CPL materials are typically prepared using molecules with chiral aromatic structures, which require tedious synthetic steps and are not cost-effective. To address this issue, we focused on chiral silica with a preferred-handed helical structure [1–4]. Because chiral silica is transparent over a wide spectral range from the ultraviolet to the visible region, incorporation of achiral emitters into its helical nanocavities enables CPL emission across various wavelengths.

We encapsulated pyranine in water and methanol solutions within the chiral silica. Figure 1 shows the CPL spectra of chiral silica⊃pyranine in methanol and aqueous solutions, respectively. A Cotton effect was observed at around 520 nm for the aqueous system, whereas a Cotton effect centered at approximately 450 nm was obtained for the methanol system. Moreover, the CPL signals exhibited a mirror-image relationship depending on the handedness of the chiral silica. These results indicate that the achiral emitter molecules are arranged along the helical nanocavities of the chiral silica, leading to CPL generation.

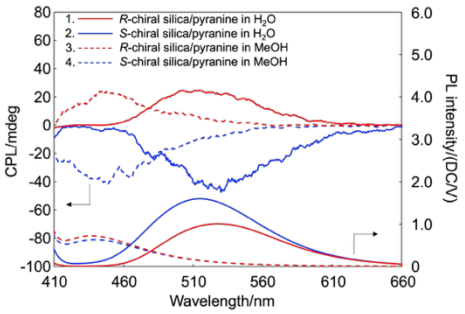

Figure 1. CPL spectra of pyranine solution in chiral silica.

We also attempted to achieve photon upconversion circularly polarized luminescence (UC-CPL) using the chiral silica system. Diphenylanthracene (DPA) and a porphyrin derivative (PtOEP) were incorporated into the chiral silica. Upon excitation with a 532 nm continuous-wave laser, emission at 440 nm was observed, demonstrating upconverted CPL. This result suggests that energy transfer occurs along the helical nanocavities of the chiral silica, leading to UC-CPL emission (Figure 2).

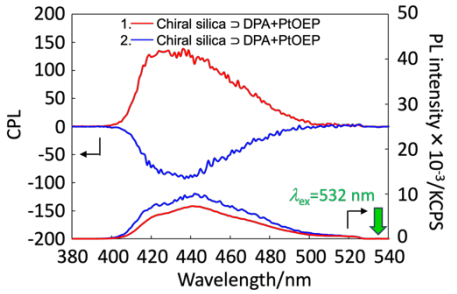

Figure 2. UC-CPL spectra of chiral silica with emitter.

[1] Hirai et al. **2021** *JACS Au*,*1*,375.
[2] Hirai et al. **2023** *JACS Au*, *3*, 2698.
[3] Hirai et al. **2023** *ACS Macro Lett.*, *13*, 537.
[4] Hirai et al. **2025** *Macromolecules*, *58*, 6534.

AIE-active Probes to Investigate Cellular Quality Control and Disorder in Diseases

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Understanding how cells maintain a functional proteome and respond to stress is crucial for deciphering molecular pathogenesis and developing treatments for diseases such as neurodegenerative disorders. Achieving finer quantification of cellular proteostasis efficiency, phase transitions, and local environmental changes remains a key but challenging goal.

Here, we present our recent progress in developing fluorescence-based strategies and methodologies to study proteostasis. To assess proteostasis efficiency, we directly measure the unfolded protein load in cells, as a decline in proteostasis capacity leads to the accumulation of unfolded proteins. To this end, we designed and synthesized a series of cysteine-reactive fluorogenic probes that selectively react with unfolded proteins exposing cysteine residues, producing a fluorescence turn-on response. Remarkably, these probes exhibit strong fluorescence with unfolded proteins, weak fluorescence with folded proteins containing surface cysteines, and no fluorescence with small-molecule biothiols.

We applied this method to monitor proteostasis collapse in cells exposed to pharmacological stressors, expressing mutant proteins in Huntington's disease models, or infected with viruses. When integrated with mass spectrometry-based proteomics, our approach also enables the identification of basal intrinsically disordered proteins and those that become unfolded upon stress. Together, this strategy provides a powerful platform for probing protein unfolding and stress responses and holds promise for biomarker discovery and therapeutic development.

Mechanochromic and Circularly Polarized Luminescence in Solid-State Organic Luminophores

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Concurrent with the development of aggregation-induced emission (AIE) materials, research on solid-state organic luminophores that exhibit mechanochromic luminescence (MCL) have recently expanded significantly.[1] In contrast, circularly polarized luminescence (CPL) in the solid state remains largely unexplored. Reported here is the mechanochromic CPL of a chiral pyrenylprolinamide derivative (Figure 1a).[2] Upon grinding, the blue-emissive crystals changed into a blue-green-emissive amorphous state. Notably, the sign of the CPL remained unchanged during this process, indicating that the clockwise orientation of the stacked pyrene units is retained even in the amorphous state through intermolecular hydrogen bonding. Another example is the CPL of a quasiracemic crystal (Figure 1b) [3]. In this system, an enantiomeric pair consisting of naphthalene-substituted (*S*)-**Naph** and benzothiadiazole-substituted (*R*)-**BTz** was used to construct the quasiracemate. The resulting crystals exhibited CPL, demonstrating that the chirality of the individual enantiomers is not cancelled in the quasiracemic crystal.

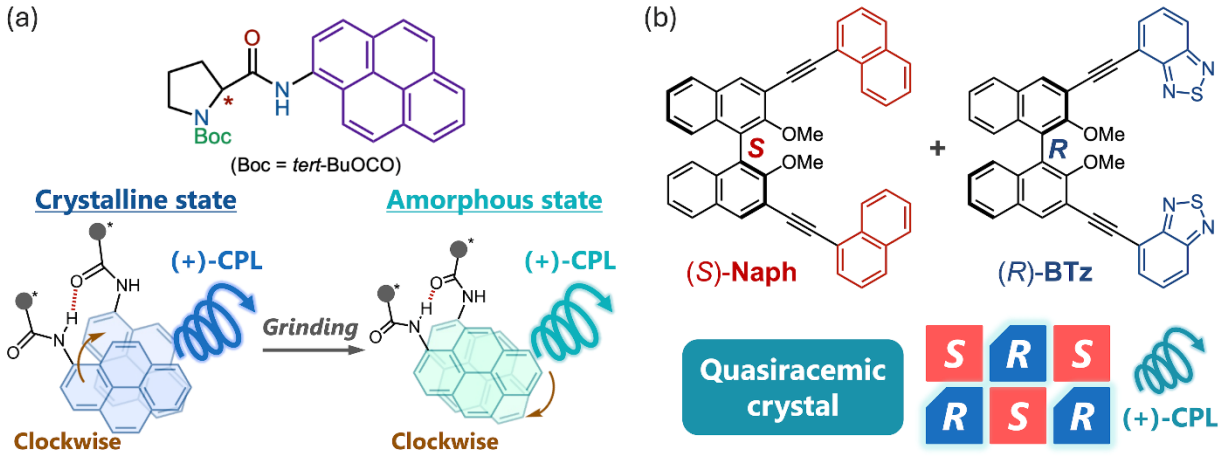

Figure 1. (a) Mechanochromic CPL of a pyrenylprolinamide derivative. (b) CPL from a quasiracemic crystal.

[1] S. Ito **2022** *J. Photochem. Photobiol., C*, *51*, 100481.
[2] S. Ito et al. **2025** *Angew. Chem. Int. Ed.*, *64*, e202422913.
[3] S. Ito et al. **2025** *Chem. Eur. J.*, *31*, e202501677.

Conical Intersection Accessibility in AIE: From Principles to Functional Materials

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Aggregation-induced emission (AIE) is a powerful concept for developing highly emissive materials in the condensed phase; however, its design principles are often described qualitatively in terms of restricted intramolecular motion or molecular rotor models. Here, we present a unified framework that redefines AIE as a problem of controlling nonradiative decay pathways, focusing on the accessibility of conical intersections (CIs) on the excited-state potential energy surface (PES).[1] Using 9,10-bis(N,N-dialkylamino)anthracene (BDAA) as a model system, we demonstrate that fluorescence efficiency is governed by the energetic and structural accessibility of CIs. This concept, termed control of conical intersection accessibility (CCIA), provides a general design principle in which emissive and non-emissive states are distinguished by whether the CI is accessible.[2] We further investigate environmental effects through viscosity-dependent studies of representative AIE luminogens. The results reveal that their fluorescence response cannot be explained by conventional molecular rotor models based on activation barriers. Instead, viscosity-dependent constraints on structural relaxation toward nonradiative decay regions dominate, leading to pronounced sensitivity even in low-viscosity regimes.[3] In a push–pull bridged stilbene system, femtosecond transient absorption spectroscopy and temperature-dependent kinetic analysis show that nonradiative decay is governed not by activation energy (ΔEa) but by the pre-exponential factor in the Arrhenius equation. This finding indicates that internal conversion rates are controlled by the configurational accessibility of molecular geometries that can reach the CI.[4] Finally, introducing conformational flexibility into π-conjugated systems enables near-room-temperature nematic liquid crystals. Increased conformational entropy reduces phase transition temperatures and modulates access to nonradiative decay pathways, leading to electric-field-responsive fluorescence switching.[5]

Overall, this work establishes a unified framework in which AIE is governed by CI accessibility controlled by energetic, dynamic, and configurational factors, providing a mechanistic basis for the rational design of advanced functional materials.

[1] S. Suzuki et al. **2020** *Angew Chem. Int. Ed*. 59, 9856.
[2] S. Sasaki et al. **2016** *JACS*, 138, 8194.
[3] T. Tanaka et al. **2025** *Chin Chem. Lett*., 36, 111495.
[4] T. Tanaka et al. **2026** *Aggregate*, 7, 70295.
[5] R. Iwai et al. **2025** *Aggregate*, 6, e660.

Light-Accelerated Redox Cycling Enables Hypoxia-Resilient Type I Photodynamic Therapy

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Maximizing phototherapeutic efficacy under hypoxic conditions remains a fundamental challenge in photodynamic therapy (PDT). In this study, we describe a redox-active photosensitizer that integrates light-driven acceleration of redox cycling with efficient Type I reactive oxygen species (ROS) generation. Electrochemical analyses conducted under irradiation demonstrate that photoexcitation enables electron transfer to molecular oxygen that is thermodynamically inaccessible in the dark, leading to enhanced superoxide production. Time-dependent density functional theory calculations, together with excited-state kinetic analyses, elucidate the pH-dependent interplay among nonradiative decay, intersystem crossing (ISC), and ROS-generating pathways. Notably, the photosensitizer is responsive to key features of the tumor microenvironment (TME), mildly acidic conditions promote ISC efficiency, while the presence of polysulfide species further amplifies Type I ROS generation through reinforcement of redox cycling. Incorporation into a DSPE-mPEG2000-based nanoformulation improves aqueous dispersibility and biocompatibility, enabling the combined implementation of Type I PDT and photothermal therapy with pronounced light-induced cytotoxicity and negligible dark toxicity.

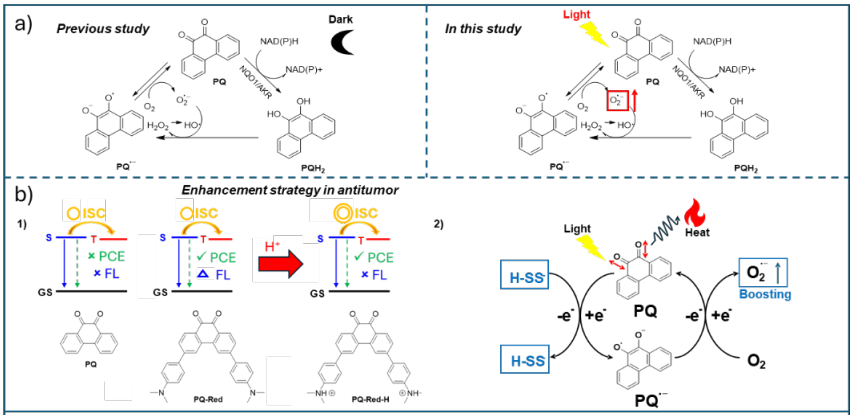

Figure 1. Schematic illustration of the design strategy for PQ-Red: (a) established PQ redox cycling in the dark and the proposed light-accelerated strategy; (b) complementary approaches to improve practical antitumor efficacy.

[1] S. Nandanwar et al. **2026** *Coordin. Chem. Rev., 548*, 217165.
[2] T. C. Pham et al. **2024** *ACS Appl. Mater. Interfaces, 16*, 21699.

Water as source to induce AIE in dansyl emissive chemosensors

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The design of optical sensors based on molecular and nanostructured platforms has become one of the most dynamic and adaptable approaches for innovation in analytical and diagnostic chemistry. This lecture discusses the evolution of sensing systems from traditional organic emissive molecules based on dansyl units toward hybrid architectures and nanomaterial-integrated platforms, where chromogenic and fluorogenic units are combined into polymers or polymeric nanostructures.
Our research was centered on the conception and development of multifunctional sensing materials able to detect and quantify a wide variety of analytes, including toxic metal ions, such as Hg(II), Cu(II), Tl(III), among other substances of interest. By employing luminescent, colorimetric, and ratiometric signaling mechanisms, these systems enable rapid, selective, and reversible measurements in environmental monitoring, biomedical analysis, and forensic applications. To improve aqueous compatibility, the molecular sensors have been systematically investigated in mixed water–organic solvent systems. Under these conditions, notable aggregation-induced emission (AIE) phenomena are observed in the presence of water, providing additional insight into their photophysical behavior and enhancing their performance in sensing applications. [1-3]

This work was supported by FCT – Fundação para a Ciência e a Tecnologia, I.P., Associate Laboratory for Green Chemistry – LAQV REQUIMTE, and the PROTEOMASS Scientific Society (Grants 2025-2026).

[1] F. Duarte et al. **2023** *Dyes and Pigments*, 218, 111428;
[2] G. Pedro et al. **2025** *Inorg. Chem. Comm.*, 181,115290;
[3] I. Pereira Gomes et al. **2026** *Inorg. Chem. Comm.*, 186, 116289.

Multichromophoric *S,N*-Ketene Acetals Operating by Energy Transfer upon Induced Aggregation

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Functional chromophores can be readily assembled by the powerful synthetic tool of skeletogenic and chromogenic approaches giving access to chromophore libraries in a concise, modular fashion, paving the way to rational design by structure-functional property relationships.[1] This conceptual approach is particularly successful in designing fluorophores and AIEgens.[2] Since 2020, aroyl-*S,N*-ketene acetals have literally experienced luminous renaissance as AIEgens.[3] In this presentation, aroyl-*S,N*-ketene acetal-triarylamine bichromophores for modulation of emission by energy transfer upon aggregation,[4] and sequential three-component synthesis of solid-state and aggregation-induced ester-substituted aroyl-*S,N*-ketene acetals will be discussed.[5]

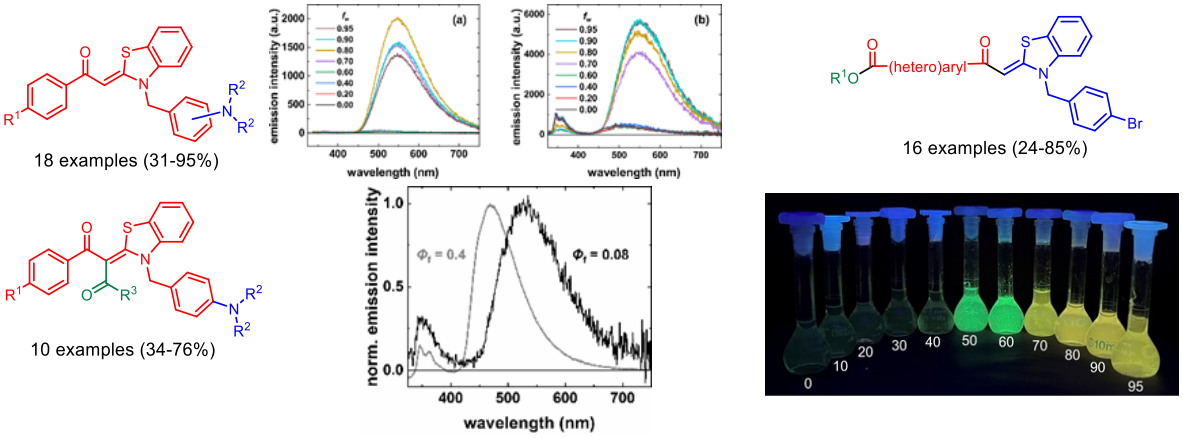

Figure 1. Aroyl-S,N-ketene acetal-triarylamine bichromophores with and without energy transfer in the aggregated state and emission enhancement by encapsulation and ester-substituted aroyl-S,N-ketene acetal AIEgens.

[1] a) L. Levi et al. **2016** *Chem. Soc. Rev.*, *45*, 2825. b) L. Brandner et al. **2023** *Front. Chem.*, *11*, 1124209.
[2] a) T. J. J. Müller **2018** *Drug Discov. Today Technol., 29*, 19. b) F.K. Merkt et al. **2018** *Isr. J. Chem.*, *58*, 889.
[3] L. Biesen et al. **2023** *Chem. Eur. J.*, *29*, e202302067.
[4] A. El Abbassi et al. **2026** *RSC Adv.*, *16*, 10260.
[5] Y. Hartmann et al. **2025** *Chem. Eur. J.*, *30*, e02071.

Organic High-Temperature Photothermal Materials

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Restriction of Intramolecular Motion (RIM) is the working mechanism of organic aggregation-induced emission (AIE) materials. Guided by this principle, a wide range of material systems with AIE features have been designed and prepared, leading to their applications in optoelectronics, biology, sensing, and so on. To further advance the development of novel organic optoelectronic materials, molecular design under the guidance of RIM is crucial.
In this talk, I will report our recently effort on the development of high photothermal materials with a temperature of 450 °C. Moreover, their applications in safe ignition, photo-melting, photo- welding and photothermal coating for high temperature shape-memory as well as solar energy conversion will be discussed.

[1] P.B. Han et al. **2024** *Angew. Chem. Int. Ed.*, e202406381.
[2] H. Xu et al. **2025** *Chem. Asian J.*, 20, e202500034.
[3] H. Xu et al. **2025** *ChemRxiv*, DOI: 10.26434/chemrxiv-2025-818cr.

Modulating Aggregation-Driven Luminescence in Enaminitrile Switches: From Isomerization Control to Polymer-Induced Clusterization

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We report a family of responsive enaminitrile molecular switches where emission intensity is governed by the aggregation state, modulated through distinct chemical and physical stimuli. Our study reveals that the emission is highly tunable via isomerization. Acid/base activation triggers reversible switching between isomers, resulting in a distinct "off-on-off" emission profile in the solid phase. This switching capability enables the development of solid-state chemosensors with high sensitivity, and the aggregation state facilitates synergistic excited-state intramolecular proton transfer, yielding intense fluorescence in films and dispersions.

We further demonstrate that the aggregation environment critically gates metallofluorochromism. The switches thus respond with selective emission enhancement for Cu^{2+} and Zn^{2+}, achieved through chelation-enhanced fluorescence mechanisms that are dependent on the supramolecular assembly. This highlights how the aggregated matrix amplifies specific metal-ligand interactions. Finally, we extend these principles to macromolecular systems, introducing polymer-induced emission. By incorporating enaminitrile units into polymer backbones, we observe that molecular weight and chain conformation drive clusterization-triggered emission. In these systems, the degree of polymerization dictates the aggregation morphology, allowing for precise tuning of emission intensity and spectral properties.

These findings establish a framework where the aggregation state serves as the central platform for modulating optical output. By integrating isomerization dynamics, proton transfer, metal chelation, and polymer-induced clustering, we provide a versatile strategy for designing high-performance solid-state emitters and dynamic optical devices.

Development for Stimuli-Responsive Materials Based on AIE-Active Element-Blocks

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We recently proposed a new idea for material design based on an element-block, which is a minimum functional unit including inorganic element. By the combination, connection and assembly of element-blocks, diverse unique properties originating from each element can be induced and applied for constructing functional materials. In particular, we have discovered several types of luminescent element-blocks and applied them as a building block for obtaining stimuli-responsive luminochromic materials (Figure 1). From the mechanistic studies, we found that larger degree of structural relaxation should occur around the element. In particular, by regulating molecular motions through morphological changes, various types of luminochromic properties in solid were observed. In this presentation, I will explain the recent progress on the development of new stimuli-responsive luminochromic materials based on excitation-driven element-blocks which can show significant structural relaxation in the excited state. From some of boron and hypervalent complexes, typical aggregation-induced emission behaviors, where intense emission appeared only in condensed states, were observed, and stimuli-responsive element-blocks were identified. By using them, solid-state luminescent polymers were fabricated. Moreover, some of their luminescent colors were varied by morphological changes. Subsequently, environment-sensitive luminochromic materials were obtained. The mechanism in these materials will be explained, and development of chemical sensors based on luminochromic properties of excitation-driven element-blocks will be demonstrated in the presentation.

Figure 1. Concept for developing functional luminescent materials from scratch.

[1] H. Ogoshi et al. **2025** *Chem. Commun.*, *61(76)*, 14625–14628.
[2] C. Hotta et al. **2025** *Adv. Opt. Mater.*, *13 (28)*, e01251
[3] K. Yuhara et al. **2025** *Chem. Sci.*, *16 (15)*, 6495–6506
[4] K. Tanimura et al. **2025** *Adv. Funct. Mater.*, *35(24)*, 2418600.

Shrinking luminophores – What is the limit?

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Luminophores typically consist of polyaromatic structures bearing electron-donating and electron-accepting substituents, thereby forming push-pull systems. These constructs can be easily fine-tuned with respect to their photophysical properties, including emission wavelengths, photoluminescence quantum yields, and excited-state lifetimes. The size, polarity, and captured volume are often neglected in materials science, whereas these parameters play a crucial role in biomedical applications. Our research deals with the goal to shrink luminophores in such a way that single benzene-based fluorophores (SBBF)[1] can be used in bioimaging with less interference with the surrounding biological medium compared to classic polyaromatic conjugated compounds. In this talk, the way from emissive heteropentacenes[2] to single benzene luminophores is depicted.

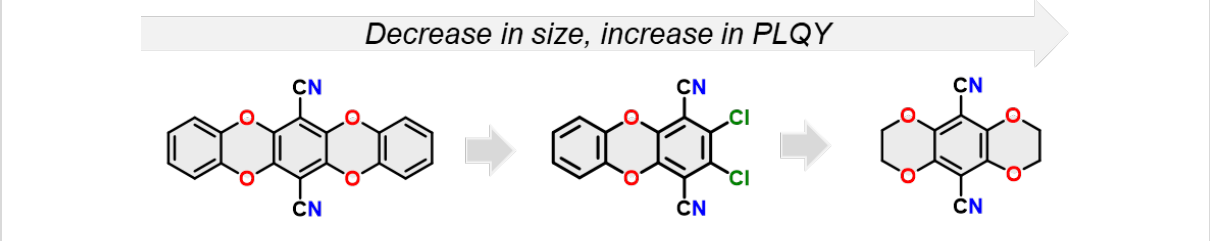

Figure 1: Evolution of luminophores towards single benzene-based fluorophores (SBBF).

[1] A. Huber et al. **2025** *Chem. Eur. J.*, 31, e202404263.
[2] a) A. Huber et al. **2025** *Chem. Sci.*,16, 15723-15733. b) S. Riebe et al., **2021** *Chem. Asian J.*, 16, 2307.

Recent Progress on Phototherapy and Photoimmunotherapy

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Phototherapy, including photodynamic therapy (PDT) and photothermal therapy (PTT), offers high specificity and low invasiveness for cancer treatment.[1] Photoimmunotherapy (PIT), a process using light to kill primary tumors and simultaneously induce an immune response, is an emerging treatment that combines photo-therapy and immunotherapy. PIT can thus convert tumor immunity from the off state to the on state by inducing an immune response. Therefore, the combination of a primary tumor treatment with an im-mune response can ideally suppress the growth of primary tumors, tumor recurrence, and metastasis. These perceived merits promote PIT as an attractive tumor treatment approach. Recent contributions for this topic include; an O_2-independent copper(II) phototherapeutic agent for photo-activating H_2O_2 to enhance antitumor immunotherapy[2], caged ligand-decorated near-infrared photosensitizer with in vivo albumin-hijacking capacity for tumor-targeted hypoxia-tolerant photoimmunotherapy of cancer,[3] photochemical generation of peroxynitrite induced concurrent inhibition of glycolysis and glutamine metabolism for enhanced metabolic therapy,[4] regioisomeric engineering of sterically hindered bright near-infrared paraptosis agents for chemo-photodynamic therapy,[5] and Supramolecular phthalocyanine assemblies-enhanced synergistic photodynamic and photothermal therapy guided by photoacoustic imaging.[6]

[1] H. Bian et al. **2026** *Chem. Soc. Rev.*, 55, 3139.
[2] Y.-Y. Zhao et al. **2025** *J. Am. Chem. Soc.*, 147, 48072.
[3] X. Wu et al. **2026** *J. Am. Chem. Soc.*, 148, 6135.
[4] L. Yuan et al. **2025** *J. Am. Chem. Soc.*, 147, 32610.
[5] X. Wang et al. **2025** *J. Am. Chem. Soc.*, 2025,147, 27068.
[6] Y.-Y. Zhao et al. **2024** *Aggregate*, 5, e514.

Nonconventional Luminophores: Emission Mechanism, Regulation, and Applications

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Intrinsic emission from nonconventional luminophores without classic remarkable conjugation but merely with electron-rich subunits (e.g., NH_2, COOH, CN, C=O, C=C, -O-) has aroused increasing attention due to its significant fundamental importance and promising applications in bioimaging, sensing, information storage, encryption and anticounterfeiting, etc.[1] These nonconventional luminophores generally exhibit common features of concentration enhanced emission, aggregation-induced emission (AIE), excitation-dependent luminescence, and prevailing phosphorescence emission. We proposed the clustering-triggered emission (CTE) mechanism, namely clustering of nonconventional chromophores and subsequent electron cloud overlap that results in extended electron delocalization and conformation rigidification, to rationalize the emission.[1-3] Notably, according to the CTE mechanism, we can rationally discover and design new nonconventional luminophores, testifying the rationality of the mechanism in turn.[4,5] Moreover, we revealed the three key elements of the mechanism, namely electron-rich units, clustering, and the conformational rigidity of the clusters. By adjusting these elements, the luminescent properties of the materials were effectively regulated, leading to successful red and near-infrared light emission,[6] along with the discovery of materials featuring photochromic luminescence.[7] New types of CTE materials have been created, and their applications in bioimaging, multi-dimensional high-performance anti-counterfeiting, and luminescent fibers have been explored.[8,9]

[1] Z. Zhao et al. **2025** *Acc. Chem. Res.*, 85, 612.
[2] Y.Y. Gong et al. **2013** *Sci. China Chem.*, 56, 1178.
[3] Q. Zhou et al. **2016** *Small* 12, 6586.
[4] S. Zheng et al. **2020**, *Angew. Chem. Int. Ed.*, 59, 10018.
[5] S. Tang et al. **2022** *Angew. Chem. Int. Ed.*, 61, e202117368.
[6] T. Zhu et al. **2022** *Nat. Commun.*, 13, 2658.
[7] Z. Zhao et al. **2024**, *Nat. Commun.*, 15, 5054.
[8] Z. Zhao, et al. **2024** *Angew. Chem. Int. Ed.*, 63, e202412967.
[9] Y. S. Cai et al. **202**6 *Adv. Mater.*, 38, e18820.

Aggregation-Enabled Biomaterials for 3D Bioprinting

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Over the last decades, the fabrication of three-dimensional (3D) tissues has become commonplace. However, conventional 3D fabrication techniques are limited in their capacity to produce complex tissue constructs with the required precision and controllability that is needed to replicate biologically relevant tissues. To this end, 3D bioprinting offers great versatility in the fabrication of biomimetic volumetric tissues that are structurally and functionally relevant. It enables precise control of the composition, spatial distribution, and architecture of bioprinted constructs facilitating the recapitulation of the delicate shapes and structures of target organs and tissues. This talk will discuss our recent efforts in developing advanced 3D bioprinting strategies with a correlation to those that are relying on aggregation and self-assembly. These platform technologies will likely provide new opportunities in constructing functional tissues to facilitate regeneration as well as microtissue models for promoting personalized medicine.

ORAL & POSTER

Enhancing Organic Long-Persistent Luminescence via Trace Doping and Triplet-Triplet Energy Transfer

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Organic long-persistent luminescence (OLPL) materials offer unique afterglow properties with promising applications in biomedical imaging and optoelectronics. Here, we report a significant advancement by employing a trace-doping strategy to extend OLPL duration up to 7 hours.[1,2] This enhancement, governed by the "Sergeant-and-Soldier" effect, modulates crystal packing and markedly improves luminescence efficiency. Through spectroscopic investigation, we directly visualize exciton dynamics under different excitation conditions. The results reveal that the enhanced performance originates primarily from efficient triplet–triplet energy transfer (TTET) from the host to the guest, rather than increased intersystem crossing.[3] This mechanistic insight provides a new strategy for regulating triplet exciton utilization in room-temperature phosphorescent (RTP) systems. These findings open new avenues for designing high-performance afterglow materials for advanced optoelectronic and bioimaging applications.

[1] P. Alam et al. **2020** *Adv. Mater.*, 32, 2001026.
[2] P. Alam et al. **2022** *J. Am. Chem. Soc.*, 141, 3050–3062.
[3] P. Alam et al. **2024** *Adv. Mater.*, 36, 2311384.

Electroluminescent Polymers via Controlled Radical Polymerization

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Electroluminescent polymers with thermally activated delayed fluorescence (TADF) have attracted significant attention in optoelectronics, particularly in organic light-emitting diodes (OLEDs), due to their enhanced performance, synthetic versatility, and solution processability. The development of photopatternable electroluminescent polymers that do not rely on sophisticated synthetic methodologies is highly appealing, yet remains challenging.[1] We discovered a versatile approach for the design of well-defined light-emitting polymers with color-tunable solid-state emission enabled by controlled radical polymerization.[2,3] Using a single-acceptor fluorophore as the initiator for atom transfer radical polymerization (ATRP), a series of electron-donor groups containing simple aromatic moieties were introduced through facile polymerization and post-functionalization strategies. The resulting charge transfer-based polymer library exhibits continuously tunable emission across the visible spectrum, achieved through precise modulation of donor–acceptor interactions via controlled polymer synthesis. Importantly, we demonstrate that polymer chemistry plays a critical role in governing the photoluminescence properties of these materials.[4,5] Most recently, we have extended these insights to electroluminescent TADF polymers and their photolithography for high-efficiency OLEDs.[6] The work to be introduced in this presentation may represent a pivotal advancement in the design of light-emitting materials for next-generation optoelectronic devices.

[1] C. Müller et al. **2003** *Nature*, 421, 829–833.
[2] S. Ye et al. **2021** *Sci. Adv.* **2021**, 7, eabd1794.
[3] S. Ye et al. **2023** *Chem*, 9, 924-947.
[4] Y. Bao *Langmuir* **2024**, 40, 3275–3282.
[5] S. Ye et al. **2026** *ACS Polymers Au*, 6, 2, 565–574.
[6] S. -W. Lo et al. **2026** *ChemRxiv*.

Spacer Length as a Key Parameter in Aggregation-Induced Emission Mechanochromic Polymers

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Mechanochromic polymers enable the direct visualization of mechanical stress by converting deformation into optical signals, offering powerful tools for structural health monitoring and failure prediction.[1] In this context, fluorophores such as perylene bisimides (PBIs), well known for their strong tendency to form emissive aggregates in the solid state, are particularly attractive. These aggregates typically exhibit fluorescence at wavelengths distinct from those of the molecularly dissolved (monomeric) species, thus providing an intrinsic chromogenic platform to detect aggregation–disaggregation processes occurring in polymers during mechanical deformation. Despite extensive efforts in mechanophore design, the role of spacer architecture in covalently integrated systems has rarely been addressed systematically. In this study, we developed a polymeric perylene bisimide (PBI) macromechanophore bearing flexible poly(ε-caprolactone) (PCL) spacers and terminal hydroxyl groups (M-PBI), which was covalently incorporated into maleic anhydride–grafted SEBS and LLDPE matrices as crosslinker. Its performance was benchmarked against an analogous short-spacer PBI crosslinker (P-PBI) and a physically blended small-molecule PBI (S-PBI). Upon tensile deformation, films containing M-PBI and P-PBI displayed strain-induced disaggregation, with an increase in fluorescence intensity upon deformation, as commonly observed in other mechanochromic systems based on PBI.[2] The monomer-to-aggregate emission ratio served as a quantitative indicator of strain, showing a clear and reversible response over multiple loading–unloading cycles in elastomeric SEBS, while S-PBI blends remained optically inactive. Covalent incorporation of M-PBI did not significantly affect the mechanical properties of SEBS and LLDPE, indicating its role as a compliant crosslinker. In contrast, the short-chain P-PBI increased rigidity and reduced ductility in semicrystalline LLDPE. Overall, spacer length and flexibility emerge as key parameters governing both mechanochromic response and mechanical performance in polymer matrices.

[1] B. Bertoncini et al. **2026** *Chem. Asian J.*, 21, 1, e01000.
[2] C. Micheletti et al. **2024** *ACS Appl. Polym. Mater.*, 6, 11, 6572–6580.

Fluorescent Supramolecular Assemblies: Understanding the Regulation of Self-Assembly

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Our research work aims at development of donor-acceptor building blocks which undergo self-assembly in aqueous media to generate fluorescent assemblies in aqueous media [1-4]. These assemblies having appropriate binding sites for interactions with specific analytes undergo guest induced morphology transformation and exhibit interesting photophysical properties. Very recently, we have developed supramolecular assemblies having chiral -handle and investigated the achiral/chiral guest induced chirality transformations in aqueous media [4]. Furthermore, we have also developed metal based as well as metal free supramolecular catalytic ensembles for carrying out various organic transformations. In the presentation, different aspects of development of these 'lighted' materials and their molecular recognition and catalytic applications will be discussed.

[1] S. Aditya et al. **2025** *Catal. Sci. Technol,* 15, 4024.
[2] S. Aditya et al. **2024** *ACS Appl. Mater. Interfaces*, 16, 62064.
[3] K. Gaurav et al. **2024** *ACS Appl. Mater. Interfaces*, 16, 62988.
[4] K. Gaurav et al. **2022** *Angew. Chem. Int. Ed.*, 61, e202207416.

Mechanofluorochromism in Folded Thiele Hydrocarbons

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Thiele hydrocarbons and related diradicaloids have recently emerged as a distinctive class of emitters, combining molecular stability with efficient visible-to-near-infrared (NIR) luminescence originating from a zwitterionic excited state.[1] The latter results from the mixing between two closely lying charge-resonance (CR) excited states,[2] leading to symmetry breaking induced by the twisting of exocyclic double bonds. Interestingly, variations in the halogenation pattern represents an effective tool to tailor the optical response of Thiele hydrocarbons. The introduction of multiple halogen substituents synergistically combines steric and electronic effects, modulating excited-state reorganization and molecular geometry. As a result, polyhalogenated Thiele hydrocarbons display giant Stokes shifts exceeding 2 eV, solid-state emission, nearly unitary photoluminescence quantum yields, and a pronounced mechanofluorochromism (Figure 1).[3] The possibility of triggering a charge-separated excited state in centrosymmetric, non-polar derivatives, together with their remarkable mechanofluorochromic behaviour, opens new and exciting opportunities for the use of these systems in photonic, flexible electronics, and optoelectronics, highlighting polyhalogenated Thiele hydrocarbons as promising stimuli-responsive molecular materials.

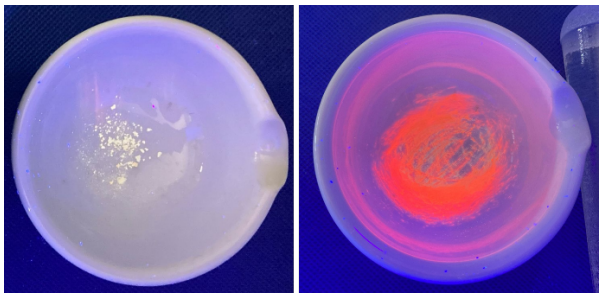

Figure 1. Photograph of a mixed-halide Thiele hydrocarbon as a powder under UV-light (365 nm) before (top) and after (bottom) grinding.[3]

[1] A. Punzi et al. **2023** *J. Am. Chem. Soc.*, 145, 37, 20229–20241
[2] D. Mesto et al. **2025** *Chem. Eur. J.*, 31, e202500749.
[3] A. Punzi et al. **2025** *Angew. Chem. Int. Ed.*, 65, e24043.

Dynamics-structure-properties relations to design functional molecular crystals

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Functional properties of molecular crystals are often governed not only by static structure but also by collective lattice dynamics, including low-frequency vibrations, cooperative molecular motions, and soft phonon modes. Establishing clear dynamics-structure-properties relationships is therefore essential to move beyond empirical crystal engineering toward predictive material design. Recent advances in vibrational spectroscopy, in situ structural characterization, and multiscale molecular design enable direct access to these dynamic degrees of freedom and their rational modulation.[1]

By integrating molecular and supramolecular engineering with external stimuli, such as temperature, pressure, and electric or electromagnetic fields, polymorphic energy landscapes can be reshaped on demand, reversible phase transitions can be programmed (Figure 1), and adaptive functionalities such as flexibility, self-healing, and tunable thermal and optoelectronic properties can be achieved.[2,3] Representative examples illustrate how lattice dynamics can be elevated from a descriptive parameter to an active design variable, enabling the development of dynamic functional molecular crystals.

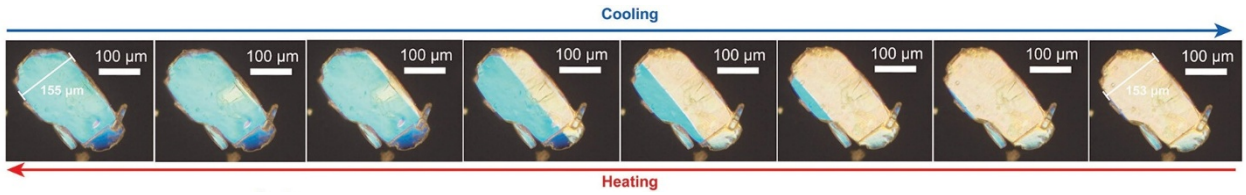

Figure 1. A representative molecular crystal engineered to undergo a temperature-induced cooperative polymorphic transition.

[1] L. Catalano et al. **2024** *J. Am. Chem. Soc.*, 146, 31911.
[2] M.B. Al-Handawi et al. **2022** *Adv. Mater.*, 34, 2109374.
[3] B.M.T.C. Peluzo et al. **2025** *Angew. Chem. Int. Ed.*, 137, e202507566.

Aggregation-Tolerant Fluorophores for Transparent Wood-based Luminescent Solar Concentrators

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Aggregation-induced emission luminogens (AIEgens) are promising fluorophores for solid state photonic and energy harvesting materials, where concentration-dependent quenching and reabsorption often limit performance.[1,2] This is especially relevant for luminescent solar concentrators (LSCs), where high dye loadings result in aggregation-caused quenching (ACQ) and increased reabsorption losses when employing conventional dyes, as exemplified by our recent work on Rhodamine 6G (R6G)-functionalized transparent wood (TW)-LSCs.[3]

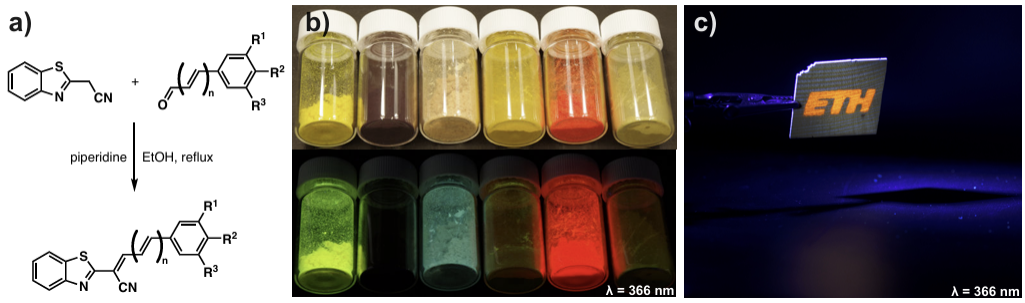

Figure 1. a) BT-CV Synthesis, b) bulk powder of selected dyes under ambient and UV light and c) incorporation into a shine-through luminescent wood membrane.

To address these limitations, we investigated benzothiazole-based cyanovinyl (BT-CV) dyes as AIE-active fluorophores with markedly larger Stokes shifts than R6G and therefore strong potential to reduce reabsorption losses. BT-CV dyes are readily accessible via Knoevenagel condensation (Figure 1a) in reasonable bulk purity, enabling straightforward molecular tailoring and upscaling. Using complementary optical and structural characterization techniques, as well as machine learning, we were able to relate molecular modifications and aggregate formation to emission behavior in suspension and in the solid bulk state (Figure 1b). As a proof-of-concept, selected BT-CV candidates were incorporated into shine-through luminescent wood membranes (Figure 1c), and promising dyes were subsequently introduced into TW as a first step toward AIE-based TW-LSCs.

[1] A. Pucci **2018** *Isr. J. Chem.*, 58, 837–844.
[2] H. Liu et al. **2023** *Nanoscale Horiz.*, 8, 453–459.
[3] D. Vivas et al. *Unpublished Manuscript*.

AIE Probe Platform for Quantitative Imaging of Lipid Droplet Biology

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Lipid droplets (LDs) are highly dynamic organelles that regulate lipid storage, energy supply, and cellular stress responses, and their dysfunction is increasingly implicated in metabolic, cardiovascular, and neurodegenerative diseases. Despite their importance, tools to quantitatively interrogate LD composition, polarity, and fate in living systems have been limited, constraining our understanding of their roles in health and disease.

Here, we present a suite of newly developed fluorescent reporters that enable high-resolution and functional imaging of LDs across multiple biological contexts. These tools provide quantitative readouts of LD polarity, viscosity, and lipophagic flux at the single-organelle level, with excellent specificity, photostability, and applicability in both cell culture and whole organisms. Using these approaches, we reveal how LD polarity and composition dynamically change under lipid overload, endoplasmic reticulum stress, and nutrient deprivation, offering new insight into how cells selectively mobilize LDs for lipolysis or degradation via lipophagy. Applied in animal models, these probes permit robust visualization of hepatic LDs and uncover previously unrecognized lipid pathologies that can be modulated pharmacologically.

We further demonstrate the utility of these tools in patient-derived fibroblasts, where they reveal disease-associated alterations in LD number, morphology, and contacts with mitochondria, pointing to disrupted lipid–energy coupling in cellular pathogenesis. In addition, real-time quantification of lipophagic flux exposes lysosomal dysfunction, enabling discrimination of lysosomal storage disorders at the single-cell level with greater sensitivity than conventional staining methods.

Together, these advances establish a versatile chemical biology platform for dissecting LD heterogeneity, organelle crosstalk, and lipid metabolic remodeling in live systems, and open new opportunities for understanding the contribution of LD dysfunction to human disease.

Aggregated organic dyes for photocatalysis

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In this talk, the critical role of molecular packing and "aggregation-induced photocatalysis" (AIP) in determining reactivity will be discussed. Recently, our group has demonstrated that the photocatalytic activity can be enhanced by aggregation of organic chromophores in water through stabilization of their localized excited states.[2-4] This "rigidification" of organic chromophores within the aggregates can suppresses unproductive non-radiative decay (such as intramolecular motions), thereby increasing the photocatalytic activity of the nanostructures. We will examine how the aggregation enalbes the production of storable fuels like hydrogen and hydrogen peroxide. By correlating nanostructure formation with specific photophysical outputs, this talk underscores how supramolecular engineering can surpass the limitations of isolated molecular dyes, offering a blueprint for the next generation of switchable, high-performance organic photocatalysts (Figure 1).

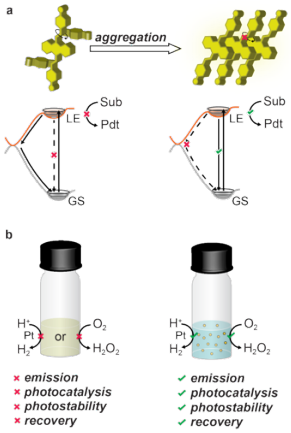

Figure 1. Aggregation-induced photocatalysis with organic dyes. Supramolecular polymerization (a) prevents non-radiative decays and (b) leads to excited states to be used in photocatalysis.

[1] D. Cappelletti, M. Barbieri, A. Aliprandi et al. **2024** *Nanoscale*, *16*, 9153.
[2] L. Đorđević, T.J. Jaynes, H. Sai et al. Stupp, **2025** *Adv. Mater.*, *37*, 2418137.
[3] M. Barbieri, M. Doardo, I. Fortunati et al. **2026** *Adv. Funct. Mater.*, *36*, 2505835.
[4] M. Barbieri, D. Cappelletti, L. Vaccarin et al. **2026** *Nat. Chem.*, *accepted*, doi:10.26434/chemrxiv-2025-g5rql/v2.

Solid-state Photoluminescence Properties of α-Substituted Dibenzoylmethanatoboron Difluoride Complex with Aggregation-Induced Emission Property

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Organic molecules with aggregation-induced emission (AIE) properties have attracted much attention not only for material applications, but also for understanding their photophysical processes and excited-state dynamics. Investigation of the excited-state dynamics of AIE compounds, mainly in solution, have led to the proposal of the restricted access to a conical intersection (RACI) model. We previously investigated the excited-state dynamics of an α-substituted dibenzoylmethanatoboron difluoride complex derivative with AIE property ($2amBF_2$) in solution using time-resolved absorption spectroscopy and quantum chemical calculations.[1] In the excited state, $2amBF_2$ has two stable geometries: planar and bending form, and the bending form leads to rapid non-radiative deactivation to the ground state via a conical intersection (CI). Based on these findings and the RACI model, the restriction of the structural changes of $2amBF_2$ in the excited state is expected to induce solid-state photoluminescence. In this study, we focused on the solid-state photoluminescence properties of $2amBF_2$. In the crystalline state, $2amBF_2$ exhibits cyan and green emission, corresponding to C- and G-crystal, respectively.[2,3] Moreover, $2amBF_2$ dispersed at low concentration in polymer film exhibited blue emission.[2] We investigated the photoluminescence dynamics of $2amBF_2$ in solid states using various spectroscopic measurements. Spectroscopic measurements for $2amBF_2$ in polymer film directly supported the RACI model. In contrast, for both C- and G-crystal, the photoluminescence dynamics involved in monomeric free exciton, monomeric self-trapped exciton, and dimeric excited state of $2amBF_2$. Furthermore, amplified spontaneous emission (ASE) was observed only for C-crystal due to its high photoluminescence quantum efficiency and large oscillator strength originating from its molecular packing. These results suggest that solid-state photoluminescence of $2amBF_2$ is governed not only by the RACI model but also by aggregate structures in the crystalline state.

[1] Y. Fujimoto et al. **2024** *J. Am. Chem. Soc.*, 146, 32529.
[2] F. Ito et al. **2024** *J. Phys. Chem. C*, 128, 1469.
[3] Y. Fujimoto et al. **2025** *Chem. Commun.*, 61, 14430.

Modular π-Scaffold Engineering: From Thiophene Platforms to Functional AIE Fluorophores for LSC applications

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Aggregation-induced emission (AIE) luminogens are promising materials for photonic applications owing to their enhanced solid-state emission and tunable photophysical properties. Among these, luminescent solar concentrators (LSCs) have attracted considerable attention as sustainable technologies for light harvesting and transparent photovoltaic systems. In parallel, π -extended cruciform architectures represent attractive molecular platforms due to their highly tunable conjugation pathways, structural versatility and efficient modulation of optical and electronic properties.[1,2] In this work, we report a modular synthetic platform for the controlled construction of π-extended thiophene-based cruciform architectures with tunable optical and electronic properties. This strategy was further exploited to develop functional AIE-active fluorophores based on π-conjugated tetraphenylethylene (TPE) derived scaffolds for LSC applications (Figure 1A). The developed compounds exhibited pronounced AIE behavior, solvatochromic response, tunable emission characteristics and enhanced solid-state luminescence properties (Figure 1B). The incorporation of rigid aromatic scaffolds and functional substituents enabled fine tuning of the optical behavior and emission profiles, highlighting the versatility of the modular π-scaffold engineering approach. These results demonstrate the potential of the developed fluorophores as efficient functional materials for sustainable photonic and solar energy harvesting technologies.[3]

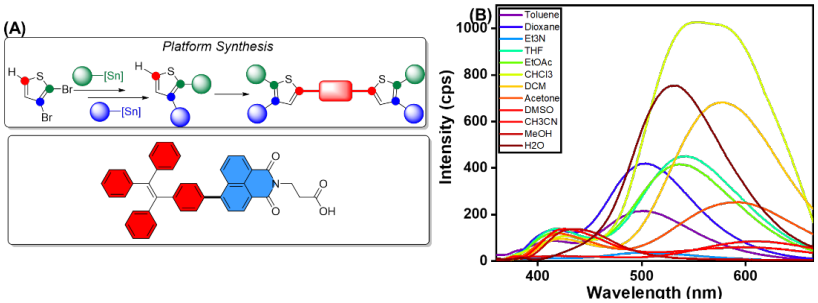

Figure 1. (A) Molecular design of the synthesized fluorophores and (B) Solvatochromic emission behavior of the synthesized luminogen in solvents with different polarities.

[1] K. Itami et al. **2006** *Chem. Eur. J.,* 12, 3966.
[2] P. Gawas et al. **2026** *Org. Lett*. (Submitted)
[3] A. Nitti, et al. **2026** *Chem. Commun*. 62, 4320.

Redox-triggered controlled aggregation of Pt complexes for water-based mechanosensing and self-amplification

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In this contribution we report the design, synthesis, and characterization of a new class of materials based on the covalent functionalization of biopolymers with a redox active and luminescent Pt(II) complex.[1]
Chitosan and pullulan were chemically modified to introduce reactive functional groups along the polymer backbone, enabling the covalent incorporation of the emissive platinum-based moiety. A series of materials with different functionalization degrees were prepared. The resulting materials exhibit tunable photophysical properties in the solid state, which can be modulated by controlling the degree of doping and the synthetic conditions, resulting in finely controlled optical properties. The contrasting solubility of biopolymers and Pt complexes results in materials with peculiar aggregation behavior in water, resulting in AIE properties and in strong affinity towards microplastics. The exotic redox activity and selective photoreduction mechanism of this kind of Pt complex allows to catalytically enhance the emission signal, yielding a novel amplification scheme.[2]
Overall, in this contribution we describe an effective strategy towards biocompatible and stimuli-responsive polymeric materials for the development of highly dynamic – yet tightly controllable – AIE properties.

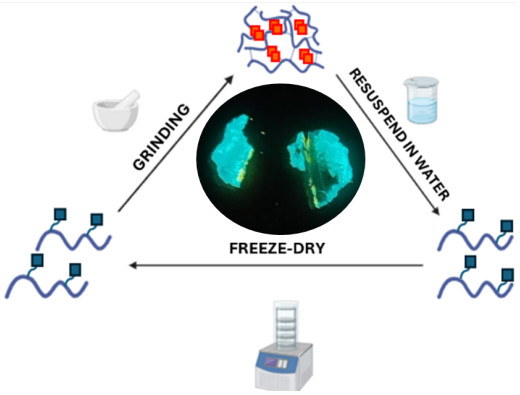

Figure 1. Cycle of activity of mechanochromic pullulan functionalized with Pt(II) complex.

Acknowledgments: MIUR (PRIN) project "Roxanne" (grant agreement no. 2022ETBCER).

[1] A. Aliprandi et al. **2015** *Chem. Lett.*, 44, 9, 1152–1169.
[2] D. Alessi et al. **2025** *Nat. Commun.*, 16, 4316.

Aggregation-Induced Quantum Delocalization Governs Optical Response and Charge Separation

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Light-absorbing and emissive molecular aggregates underpin a wide range of technologies, from organic optoelectronics to photovoltaics and sensing. Their optical response emerges from the interplay of intermolecular electronic couplings, quantum delocalization and electron–vibrational interactions [1-3], yet a predictive, microscopic description of these effects in realistic, disordered materials remains challenging.

Here, we show that first-principles-derived Hamiltonians, explicitly incorporating both localized and charge-transfer excitations and parametrized for structurally and vibrationally disordered systems, quantitatively reproduce aggregation-induced modifications in optical spectra, in excellent agreement with experiment [1,2]. Focusing on perylene diimide (PDI) supramolecular aggregates, and combining these Hamiltonians with quantum dynamical simulations, we resolve the nature and temporal evolution of excitations across the system, revealing how electronic delocalization, vibronic coupling, and environmental disorder jointly govern the resulting dynamics [2] and charge separation process [3,4].

Extending this framework to radical emitters, we uncover a counterintuitive regime in which aggregation and the host environment mitigate non-radiative decay. In a CBP matrix, a TTM-based emitter exhibits reduced non-radiative losses despite red-shifted emission, partially circumventing the energy gap law [5]. We attribute this behaviour to aggregation-induced wavefunction delocalization that partially arrest vibronic coupling in the high-frequency region decreasing non-radiative rates, consistent with experimental observations.

Overall, our results identify a unifying mechanistic picture in which exciton delocalization, vibronic coherence, and environmental fluctuations collectively control excited-state relaxation, establishing design principles for high-efficiency organic optoelectronic materials.

[1] S. Giannini et al. **2024** *Mater. Today*, *80*, 308–326.
[2] S. Giannini et al. **2026** *J. Am. Chem. Soc.*, 148, 3788–3800.
[3] P. Ghosh et al. **2026** *Nat. Commun.*, *17*, 2165.
[4] F. Ivanović et al. **2025** *Nat. Commun.*, 16, 11560.
[5] P. Ghosh et al. **2026** *submitted*.

Luminescence in Materials – from Glowing Liquid Crystals to Smart 3D-Printed Materials

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The combination of luminophores with the unique temperature-controlled molecular order of liquid crystals provides a broad application field, ranging from novel display technology, to sensors and information storage.[1] The talk summarizes the research of the Giese group in the field of luminescent liquid crystalline materials and additive manufacturing. It gives insight in how we employ supramolecular binding motifs (intermolecular interactions) and dynamic covalent chemistry to design materials with responsive and adaptive properties.[2,3]
The materials bear the potential for application in the field of thermo sensing and information storage as well as self-healing systems.

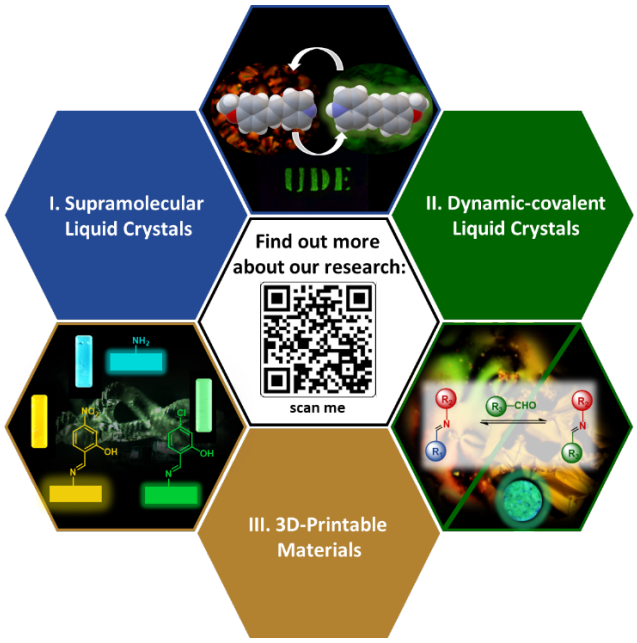

Figure 1. Luminescent materials from the Giese Group ranging from supramolecular liquid crystals to dynamic-covalent systems and to 3D-printed materials.

[1] J. Voskuhl et al. **2022** *Aggregate*, 3, e124.
[2] A. Kappelt et al. **2020** *Chem. Eur. J.*, 26, 13347-13351.
[3] M. Blanke et al. **2022** *ACS Applied Materials & Interfaces*, 14, 55864-55872.

Organic emitters exhibiting aggregation induced emission enhancement for OLED and sensing applications

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Exploitation of organic emitters exhibiting aggregation induced emission enhancement (AIEE), which is also known as soli-state emission enhancement, enables to simplify fabrication of OLEDs. Particularly good results can be achieved when emitters alongside AIEE exhibit some other useful properties such as thermally activated delayed fluorescence (TADF) and/or bipolar charge transport. In this presentation, the properties and applications of organic emitters, exhibiting AIEE and some other useful properties synthesized at the laboratories of the author are reviewed.

Symmetrical donor–acceptor-donor organic emitters containing pyrimidine-5-carbonitrile electron-withdrawing scaffold and carbazole, *tert*-butyl carbazole and methoxy carbazole donor moieties show sky-blue efficient TADF, AIEE with photoluminescence quantum yields in the solid state exceeding 50%, hole and electron transporting properties with charge mobilities exceeding 10^{-4} cm^2/V s.[1] Sky-blue OLEDs with host-free light-emitting layers of the synthesized emitter show maximum external efficiency (EQE) of 12.8%. These emitters are also used as oxygen probes for optical sensors with oxygen sensitivity estimated by the Stern-Volmer constant of 3.24×10^{-5} ppm^{-1}.

Emitters containing quinoxaline fragment as an acceptor and differently substituted carbazole donors with unsymmetrical D-A-D' type structures exhibit TADF, luminescence variation in response to external stresses (from green to orange) and AIEE.[2] Using the synthesized compound as an emitter in OLED, maximum EQE of 10.5% is observed.

Derivatives of phenylethenyl substituted phenoxazine and phenothiazine exhibit AIEE.[3] The emissive aggregates of the compounds exhibit extremely high sensitivity to electrondeficient picric acid via noncovalent interactions. This is attributed to their strong donor−acceptor charge-transfer mechanisms. OLEDs employing these materials as emitters display bluish-cyan electroluminescence, with brightness surpassing 1000 cd/m^2 and EQE of up to 6%.

Derivatives of dicyanoisophorone and different donors, i.e., phenylcarbazole, fluorene, phenanthrene and dimethylfluorene, are characterized by AIEE and nonlinear optical properties.[4] The applicability of the derivative of fluorene and dicyanoisophorone as the emitter for white OLEDs and for the detection of picric acid is demonstrated.

[1] U. Tsiko et al. **2021** *J. Adv. Res.*, 33, 41-51.
[2] R. Pashazadeh et al. **2020** *Chem. Eng. J.*, 401, 125962.
[3] E.U. Rashid et al. **2025** *ACS Appl. Electron. Mater.*, 7,9, 3877.
[4] K. Kaur et al. *J. Matr. Chem. C.* **2026**, early access.

Aggregation-induced emission in luminescent solar concentrators: from molecular to macromolecular systems

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Luminescent solar concentrators (LSCs) are a versatile energy technology with strong potential for use in a wide range of standalone and portable applications. In their simplest form, LSCs consist of a highly transparent waveguide—typically made from glass or polymer materials—incorporating (or coated with) one or more luminescent compounds. These materials absorb incoming light and re-emit it at longer wavelengths *via* photoluminescence. The re-emitted photons are then trapped inside the waveguide by total internal reflection and guided toward the device edges, where they can be captured by small-area photovoltaic cells for light to electricity conversion.

A key challenge for LSCs is represented by the optical losses linked to the luminescent materials. High concentrations, often needed in practice, can cause multiple photon reabsorptions and aggregation-caused luminescence quenching. In addition, compatibility issues between the luminophore and the host matrix may limit usable concentrations and reduce overall performance. These limitations impair the uniform distribution of the luminophore within the host matrix and result in non-ideal optical properties, ultimately hampering device response. Recent progresses in luminophore design have addressed these issues by resorting to the aggregation-induced emission (AIE) concept.

In this contribution, we will present our recent work in the area of LSC devices incorporating AIE luminogens (AIE*gens*) to produce scalable transparent systems with enhanced efficiency and photostability.[1,2]. In particular, we will illustrate different strategies for maximizing the photonic response of LSC devices through the incorporation of AIE*gens* into polymeric matrices, moving from molecular aggregates to controlled macromolecular architectures.[3,4]

By discussing the current strengths and limitations of AIE luminophores for application in LSCs, we will present our vision on the potential pathways for their future implementation in visibly-transparent spectral conversion systems.

[1] F. Corsini et al. **2021** *Adv. Optical Mater.*, 9, 2100182.
[2] E. Tatsi et al. **2024** *Nanoscale*, 16, 15502.
[3] E. Tatsi *et al.* **2025** *Commun. Chem.*, 8, 312.
[4] A. Nitti et al. **2026** *Chem. Commun.*, 62, 4320.

Self-reporting polymers based on luminescent probes

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The combination of luminescent molecules with polymeric materials is an effective strategy for monitoring chemical and physical processes occurring in polymers, from synthesis to application. Aggregation-induced emission (AIE) luminogens, for example, have been proposed as probes to determine polymer glass transition temperature (T_g) and vitrimeric temperature. In this contribution, recent results obtained using different AIEgens in polymer matrices of industrial relevance are presented, highlighting their ability to detect physical ageing, mechanical deformation, and glass transition.

Tetraphenylethylene (TPE), a well-known AIE, was dispersed in glassy polymer matrices with different T_g to monitor temperature variations and mechanical stress through optical signals. Changes in emission intensity enabled the identification of polymer T_g and physical ageing of the glassy phase, although no variation in TPE lifetime was observed. A marked fluorescence increase was also detected when the polymer was stretched beyond 150% strain. These effects were attributed to changes in film transparency and the formation of microcracks, which enhance light scattering within the samples[1]. As a further step, a new TPE derivative bearing two dimethylamino groups and a 3-methyl-rhodanine moiety (TPE-MRh) was incorporated into several amorphous polymers with different T_g. In this case, a clear correlation between fluorescence lifetime and polymer T_g was observed, attributable to variations in polymer chain mobility[2]. The phosphorescent probe hexakis(4-methyl-1-phenylthio)benzene (A6Me) was also investigated by monitoring its lifetime after accelerated physical ageing and during in-situ mechanical stretching. This dye proved highly sensitive to small reductions in free volume: its lifetime increased with ageing time, following the same trend as enthalpy relaxation. Moreover, tensile stress–strain tests showed a clear decrease in A6Me lifetime during the elastic deformation regime[3].

Overall, these results demonstrate that luminescent probes are powerful tools for monitoring polymer dynamics and structural changes. However, different luminogens may selectively respond to distinct polymer phenomena, such as free-volume variations, chain mobility, or morphological changes, making the choice of the probe crucial for targeting specific processes.

[1] V. A. Dini et al. **2023** *Aggregate*, 4, e373.
[2] E. Contini et al. **2026** *Aggregate* 2026, 7, e70314.
[3] V. A. Dini et al. **2023**, *Chem. Comm.*, 59, 1465.

Macroscopic Chiral Ordering of Platinum Platelet Nanostructures Directed by Vortex Flow

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Vortex flows break the mirror symmetry of fluid motion and can induce macroscopic chirality. However, Brownian motion commonly suppresses the transfer of this macroscopic chirality to the molecular level. Nevertheless, Aida and Meijer independently reported that stirring supramolecular polymer solutions generates nonequilibrium circular dichroism (CD),[1,2] attributed to flow-induced alignment of supramolecular polymers, giving rise to macroscopic orientational order, with linear dichroism (LD) and linear birefringence (LB) contributing to the observed CD signals. Because previous studies have relied mainly on bulk spectroscopy, the real-space orientation and spatial arrangement of supramolecular polymers within flow remain unresolved. Direct visualization of such macroscopic orientational order is therefore essential for elucidating the vortex-induced CD effects. Here, we investigate the flow-driven alignment of platelet-like nanostructures formed by a Pt(II) complex 1 functionalized with bis(phenylisoxazolyl)benzene moieties. By means of confocal laser scanning microscopy (CLSM), the alignment of platelet-like nanostructures was visualized under flow conditions. The platelet-like nanostructures adopt a helical arrangement under vortex flow. This nonequilibrium hierarchical organization acts as a helically displaced polarizing medium along the optical axis, due to macroscopic orientational order and anisotropic optical response. These findings offer direct structural insight into vortex-flow-induced chiroptical responses in supramolecular solutions.

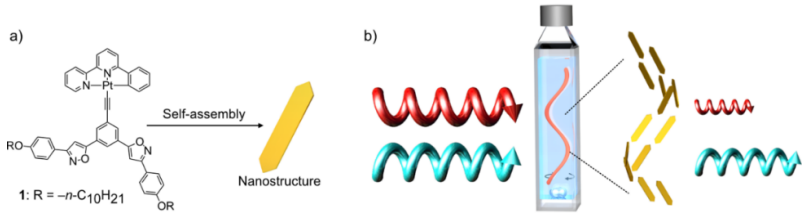

Figure 1. (a) Formation of nanostructure via self-assembly of ***1****.* (b) Schematic representation of the vortex-directed helical ordering of nanostructures. Adapted from ref. 4 under CC BY 4.0.

[1] A. Tsuda et al. **2007** *Angew. Chem. Int. Ed.*, *46*, 8198-8202.
[2] M. Wolffs et al. **2007** *Angew. Chem. Int. Ed.*, *46*, 8203-8205.
[3] T. Ikeda et al. **2015** *Dalton Trans.*, *44*, 13156-13162.
[4] M. Yoshida et al., **2025** *J. Am. Chem. Soc.*, *147*, 30674-30683.

Development of a Hinge-like Mechanophore That Changes Orange Fluorescence Intensity

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Mechanochromic mechanophores are molecular structures that exhibit changes in absorption and/or fluorescence properties in response to mechanical stimuli.[1] Our group has developed hinge-like supramolecular mechanophores, in which the same fluorophores are introduced into each benzene ring of [2.2]paracyclophane.[2] The hinge-like mechanophores show hypsochromic shifts of the fluorescence bands. In this study, we developed a new hinge-like mechanophore with two 5,12-bis(phenylethynyl)tetracenes that change orange fluorescence intensity. Force-induced separation of the tetracene moieties results in changes in orange fluorescence intensity (Figure 1a). A polyurethane film into which the hinge-like mechanophore was covalently introduced showed a gradual increase in orange fluorescence intensity with increment of strain (Figure 1b). Upon unloading, the fluorescence intensity decreased, and the initial spectrum recovered in the force-free state.

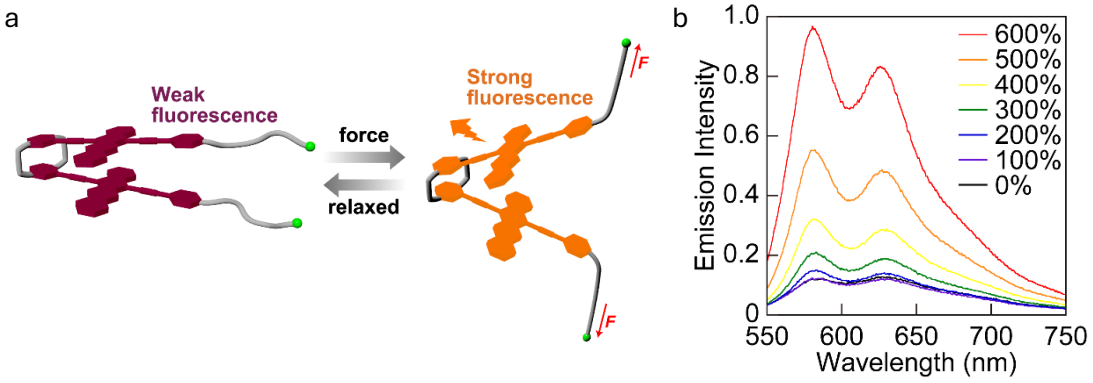

Figure 1. (a) Operating mechanism of a hinge-like mechanophore. (b) Emission spectra of the polyurethane films in which the mechanophore was covalently embedded upon stretching.

[1] Y. Chen et al. **2021** *Chem. Soc. Rev.*, *50*, 4100.
[2] S. Shimizu et al. **2025** *Angew. Chem. Int. Ed.*, *64*, e202510114.

Flexible FRET-assisted Organic Crystal Waveguides Based on Solid-state Emissive Molecules

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This study reports the development of flexible optical waveguides based on anthracene-derived elastic mixed molecular crystals (EMMCs) with improved photon transport efficiency. Optical waveguides from molecular crystals often suffer from low emission efficiency and significant optical loss due to fluorescence reabsorption. To overcome these limitations, Förster resonance energy transfer (FRET) was introduced by doping a highly emissive acceptor, 9,10-dicyanoanthracene (DCA), into elastic host crystals of 9,10-dibromoanthracene (DBA).

EMMCs with 1–5% DCA were prepared via solution crystallization and retained excellent elastic flexibility, showing reversible bending without fracture. Structural analysis confirmed that low-level doping preserved the crystal framework while modifying intermolecular interactions. Optical measurements revealed efficient energy transfer from DBA to DCA, resulting in red-shifted emission and reduced spectral overlap between absorption and emission. Therefore, the optical loss coefficient was significantly reduced from 1258 to 92 dB cm^{-1} at 1% doping, indicating suppressed reabsorption. The photoluminescence quantum yields also improved to 0.016, representing a fourfold enhancement over previous systems. These results demonstrate that low-level acceptor doping is an effective strategy for simultaneously improving emission and waveguiding performance in elastic molecular crystals, providing a practical route toward flexible photonics.

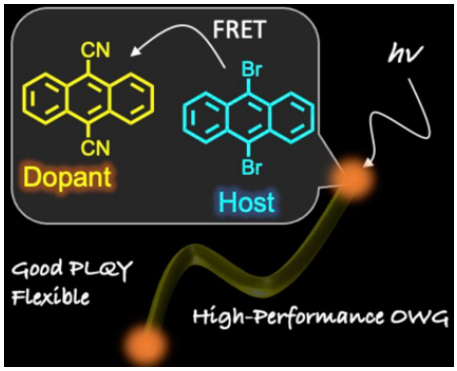

Figure 1. Illustration of flexible organic crystals for FRET-assisted optical waveguide

[1] S. Hayashi et al. **2023** *Aggregate*, e378
[2] S. Hayashi et al. **2024** *Bull. Chem. Soc. Jpn.*, 97, uoae115

Precise Synthesis and Hierarchical Structural Regulation of Oligomeric Optoelectronic Materials

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Solar cell technology is a key approach to addressing the global energy and environmental crisis. In recent years, OSCs have advanced rapidly, with power conversion efficiencies now exceeding 20%, approaching the threshold for commercial application. However, large-scale industrialization still faces major challenges, particularly in device stability, mechanical robustness, and fabrication reproducibility. These limitations largely arise from an insufficient understanding of the complex internal operating mechanisms of OSC devices and the critical roles of their constituent materials. To fundamentally address these challenges, we focus on precise molecular design and synthesis of π-conjugated materials to establish clear structure/property relationships and guide the development of high-performance organic photovoltaic materials. First, structurally well-defined and monodisperse oligomer model compounds will be designed and synthesized to elucidate the balance between molecular packing order (crystallinity) and thermodynamic miscibility (compatibility). This will clarify how these factors regulate the formation dynamics and stability of active-layer microstructures, providing theoretical insight for simultaneously improving efficiency and long-term stability. Second, guided by oligomer-model studies, controllable polymerization methods will be developed to precisely regulate polymerization degree and polydispersity index (PDI), enabling the preparation of high-performance polymer materials with improved reproducibility. Third, based on the resulting high-performance materials, stable quasiplanar heterojunction (Q-PHJ) device architectures, especially bilayer-based structures, will be developed to improve device stability and advance large-area applications.

[1] H.J. Lai et al. **2020** *Joule*, 4, 688-700.
[2] H. Chen et al. **2021** *Adv. Mater.*, 2102778.
[3] Y.W. Lang et al. **2025** *Adv. Mater.*, 2413270.
[4] Y.F. https://europepmc.org/article/med/37949738Ding et al. **2025** *Adv. Mater.*, 2501671.
[5] Y.F. https://europepmc.org/article/med/37949738Ding et al. **2025** *Angew. Chem. Int. Ed.*, 64, e202421430.

Fluorescent Functional Supramolecular Hosts as Platforms for the Detection and Removal of Per- and Polyfluoroalkyl Substances

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The persistent accumulation of perfluoroalkyl and polyfluoroalkyl substances (PFAS) presents a significant threat to global water resources and human health. Despite international efforts, traditional adsorbents like activated carbon and ion exchange resins struggle with low selectivity, slow adsorption rates, and limited adsorption capacity. To address these limitations, functional supramolecular host (FSH) materials have emerged as a promising alternative for water remediation. FSHs leverage their rich host-guest molecular recognition capabilities, structural design flexibility, and excellent environmental adaptability to deliver superior performance in PFAS detection and adsorption. This report primarily focuses on the structural innovations of novel supramolecular hosts and their environmental adsorption and detection research. Specific aspects include the design and construction of functional structures of supramolecular hosts, the investigation of adsorption mechanisms, and the study of detection platforms. By leveraging the advantages of supramolecular host-guest systems and constructing responsive sites, the integrated adsorption and detection of PFAS have been successfully achieved. This provides theoretical foundations and technical pathways for designing new-generation PFAS remediation materials with high selectivity, high efficiency, and environmental adaptability, as well as for the functionalization of supramolecular topological structures.

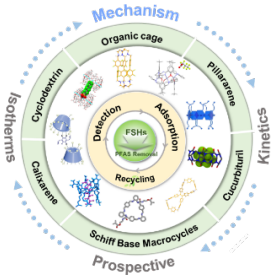

Figure 1. Schematic illustration of supramolecular host-based strategies for the detection and removal of PFAS.

[1] H. Yanlei et al. **2025** *Matter*, 8, 9.

Stimuli-Responsive Hybrid Polymers by Boron–Pnictogen Doping of Poly(arylene vinylenes)

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Isoelectronic and isosteric substitution of selected CC units in π-conjugated organic materials by the main-group element couple BN has led to various novel hybrid materials with intriguing properties and functions.[1] Some time ago, we reported the first poly(*p*-phenylene iminoborane), which is derived from poly(*p*-phenylene vinylene) (PPV) by replacement of its vinylene with B=N moieties, i.e., **BBNN-PPV** (Figure 1).[2] Recently, we targeted a BN/CC isostere of poly(thiophene vinylene) (PTV), namely, poly(thiophene iminoborane) (**BBNN-PTV**),[3] as well as mixed copolymers combining both PPV and PTV building blocks (i.e., **BN-PAVs**), showing aggregation-induced emission (AIE) and pronounced solid-state fluorescence.[4,5] We recently also accomplished the synthesis of a strictly alternating **BN-PPV**, which shows dual emission and stimuli-responsive properties.[6] In addition, we achieved the incorporation of valence isoelectronic B=P moieties into the PPV framework, thus leading to the first poly(*p*-phenylene phosphaborene) (**BBPP-PPV**) as well as related oligomers, which exhibit a highly planar backbone with effective conjugation across the B=P units and further redshifted absorption and emission properties.[7] In addition, novel pyrrylboranes that show AIEE will be presented.[8]

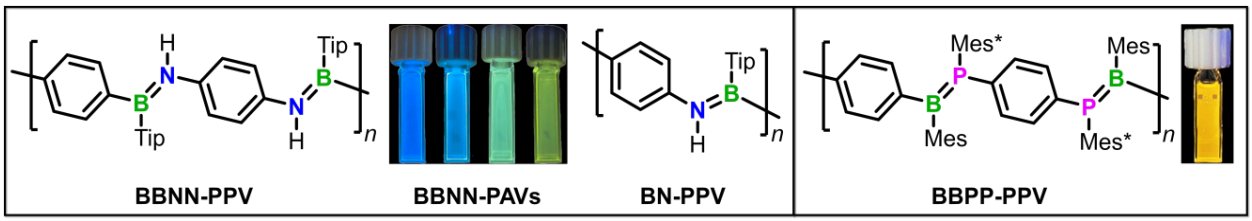

Figure 1. Poly(p-phenylene iminoboranes), poly(p-phenylene phosphaborene), and thin films thereof.

[1] H. Helten **2016** *Chem. Eur. J.*, 22, 12972.
[2] T. Lorenz et al **2017** *Angew. Chem. Int. Ed.*, 56, 2780.
[3] J. Chorbacher et al. **2023** *Macromol. Rapid Commun.*, 44, 2300278.
[4] M. Maier et al. **2023** *Chem. Eur. J.*, 29, e202302767.
[5] J. Chorbacher et al. **2025** *Chem. Commun.*, 61, 17149.
[6] J. Chorbacher et al. **2025** *Angew. Chem. Int. Ed.*, 64, e202416088.
[7] J. Glock et al. **2025** *Angew. Chem. Int. Ed.*, 64, e202510272.
[8] D. Göbel et al. **2026** *Angew. Chem. Int. Ed.*, 65, e16982.

Synthesis, Optical Properties, and Photochemistry of Pressure-Responsive Soft Materials

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Recent advances in mechanobiology have highlighted the importance of mechanical stimuli, such as hydrostatic pressure, in biological systems. Motivated by this growing interest, we have been developing pressure-responsive soft materials based on conformational changes and variations in intermolecular chromophore interactions under hydrostatic pressure[1]. In this study, we designed new pressure-responsive photosensitizers based on tetracene-modified polylysine for pressure-controllable singlet fission (Figure 1).
Tetracene was employed as a chromophore because of its efficient triplet generation through singlet fission, while polylysine was introduced as a flexible polymer backbone responsive to hydrostatic pressure. Pressure-induced conformational changes of the polylysine backbone are expected to alter the intermolecular distance and orientation of tetracene units, thereby changing singlet fission behavior and subsequent singlet oxygen generation.
Such pressure-dependent control of photophysical properties may provide a new strategy for stimuli-responsive photodynamic therapy systems with reduced side effects. In this presentation, the synthesis and optical properties of the newly synthesized materials under hydrostatic pressure will be discussed.

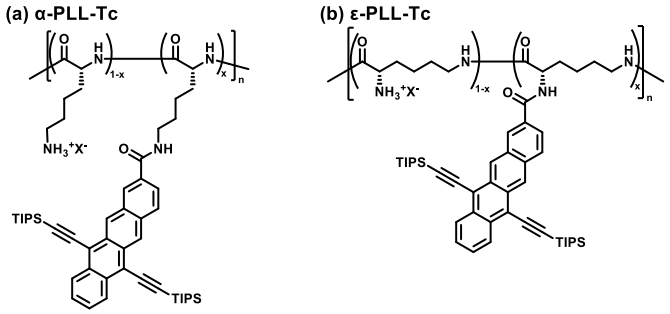

*Figure 1. Chemical structures of (a) α-polylysine-tetracene (**α-PLL-Tc**) and (b) ε-polylysine-tetracene (**ε-PLL-Tc**) conjugates, respectively.*

[1] H. Mizuno et al. **2022** *Acc. Chem. Res.*, 55, 1748.

Polymorphism-Induced Luminescence Modulation in Anthracene Molecular Crystals

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Polymorphism in organic molecular crystals arises when the same molecule forms two or more distinct crystal structures through non-covalent interactions. Molecular packing strongly influences luminescence in the aggregated state, and polymorphic systems therefore provide an important platform for understanding structure–property relationships in solid-state fluorophores.[1] The role of molecular motion in generating multiple emissive polymorphs remains poorly understood. In our previous work, we developed a strategy to control dimeric packing in anthracene derivatives.[2] In this study, we show that a thienyl-substituted anthracene, **BTAN**, forms five polymorphs, depending on the rotational conformation of the thienyl group during crystallization (Figure 1). X-ray crystallographic analysis revealed that each polymorph adopts a distinct packing arrangement and exhibits different luminescence properties. These results clarify how conformational flexibility and molecular packing are coupled during aggregation and provide insight into the design of luminescent molecular crystals with tunable solid-state emission.

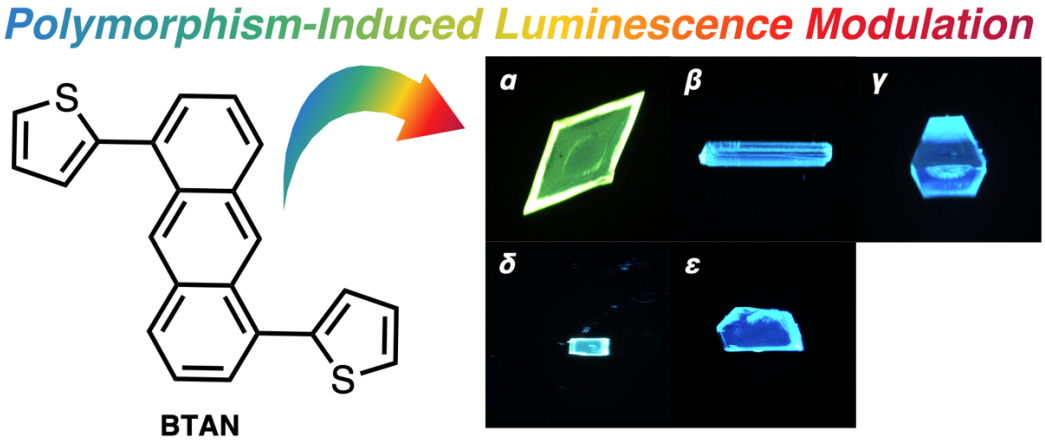

Figure 1. Molecular structure of BTAN and photographs of its polymorphic crystals under UV irradiation.

[1] N. Y. B. Tang et al. **2026** *Acc. Chem. Res.,* 59, 7, 1297–1312.
[2] Y. Hino et al. **2025** *Nat. Commun*, 16, 10191.

Thermodynamics of the AIE mechanism of berberine and palmatine in aqueous solution

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Berberine and palmatine are isoquinoline alkaloids (Figure 1), which demonstrate anticancer and antioxidant activities. Their singlet excited states are formed by the excitation of the isoquinoline moieties and rapidly quenched through intramolecular electron transfer from the alkoxy-benzene moieties.[1] However, berberine and its derivatives exhibit photocytotoxicity and DNA-photodamaging activities. Electrostatic interactions between the cationic isoquinoline moieties and anionic DNA strands decrease their electron-accepting ability, resulting in the inhibition of intramolecular electron transfer and the restoration of their photosensitizer activities. Furthermore, it has been reported that berberine and its derivatives display AIE under various conditions. In this study, the photophysical properties of berberine and palmatine were examined in aqueous solution.[2] Their fluorescence decay profiles at relatively high concentrations in aqueous solution were analyzed using a biexponential function, whereas those in dilute solutions were fitted with a single-exponential function. The observed shorter fluorescence lifetimes (60-80 ps) were almost identical to those of the monomeric species. The longer lifetime components were assigned to the AIE. The enthalpy and entropy changes of this aggregation were obtained from the temperature dependence of the association constants. These thermodynamic parameters were explained by an aggregation model of berberine or palmatine molecules mediated by counter chloride ions.

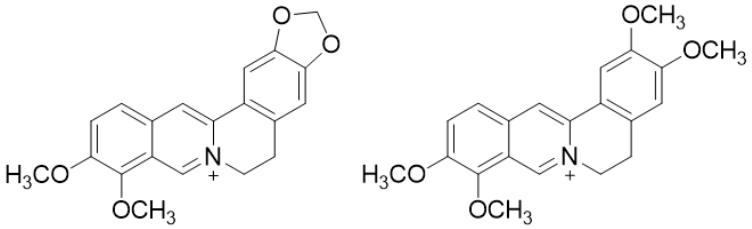

Figure 1. Structures of berberine (left) and palmatine (right) cations.

[1] K. Hirakawa et al. **2012** *J. Phys. Chem. B*, 116, 3037.
[2] K. Hirakawa et al. **2025** *Photochem. Photobiol. Sci.*, 24, 79.

Organic Phosphorescent Host-Guest Nanocrystals Enabling Rapid Oxygen Concentration Mapping

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Long-lived phosphorescence lifetime of host-guest crystals exhibiting organic phosphorescence remains largely unchanged by oxygen concentration in the bulk crystalline condition. However, there are certain crystals where the first-order exponential decay of the long-lived phosphorescence varies significantly with oxygen concentration only when formed into nanocrystals.[1] Here we report the mechanism behind this oxygen-dependent change in organic phosphorescence decay, a phenomenon that emerges selectively upon nano-crystallization. In host-guest crystals exhibiting bright green organic phosphorescence, the decay of phosphorescence from a single nanoparticle is observed to decrease significantly as oxygen concentration increases (Fig. 1a). This behavior depends strongly on the crystal structure of the host; specifically, ultra-slow oxygen diffusion through tiny space between host molecules triggers the oxygen responsiveness. By utilizing this material technology, high-precision and rapid oxygen concentration mapping within cells will be achieved by measuring the first-order exponential decay of phosphorescence using a charge coupled device (Fig. 1a, right). Our group is also developing efficient red organic phosphorescent guest molecules with novel structural features (Fig. 1b, left).[2,3] We present oxygen concentration measurements using host-guest nanocrystals incorporating the red organic phosphorescence molecule as guests for deep-tissue oxygen imaging (Fig. 1b, right).

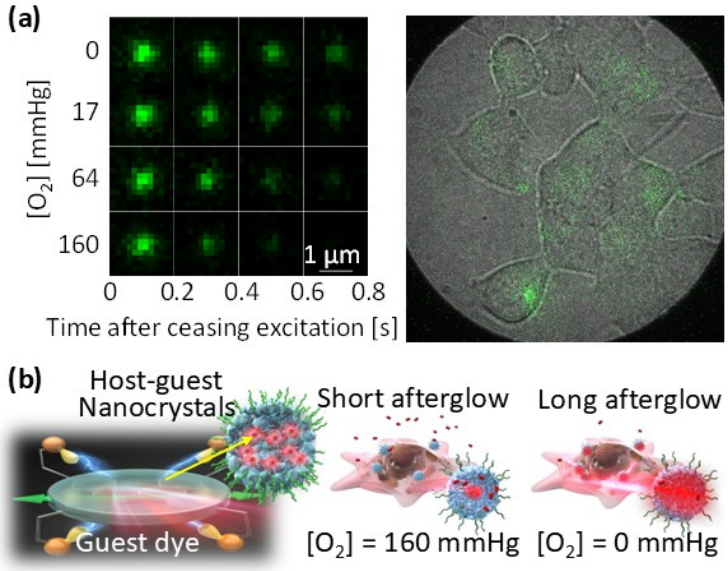

Figure 1. (a) Changes in the green organic phosphorescence decay of a single nanocrystal in response to oxygen concentration for intracellular oxygen concentration [O_2] imaging. (b) Development of efficient red organic phosphorescent molecules for deep-tissue oxygen imaging.

[1] R. Shimura et al. **2025** *ACS Materials Lett.*, 7, 2049.
[2] R. K. Mulimani et al. **2025** *Adv. Mater.*, 37, 2502611.
[3] K. Hayashi et al. **2026** *Nat. Commun.*, 17, 4098.

Mechanochromic Fluorescent Supramolecular Nanorings Consisting of Hetero-dumbbell-shaped Molecules

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[4] Research Center for Autonomous Systems Materialogy (ASMat), Institute of Integrated Research, Institute of Science Tokyo, 4259 Nagatsuta-cho, Midori-ku, Yokohama, Kanagawa 226-8501, Japan
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Mechanochromic luminescence materials, which change the photoluminescence properties in response to mechanical stimuli, have been investigated because such mechano-sensing materials visualize the damaged part of the materials.[1,2] When used as practical mechanosensors, low-dimensional molecular assemblies are preferable. Based on this consideration, Mechanochromic fluorescence micelles and supramolecular fibers were developed.[3,4] However, the supramolecular fibers tend to bundle because they contain a large number of constituent molecules, making them unsuitable for quantitatively evaluating the force threshold at which the fluorescent color changes. We hypothesized that introducing curvature into the fiber and forming ring structures could limit the number of constituent molecules and thereby prevent undesirable bundling. In this study, we developed supramolecular nanorings consisting of hetero-dumbbell-shaped molecules and investigated the molecular assembly and mechanochromic fluorescence. Morphological observations using atomic force microscopy and transmission electron microscopy as well as small-angle X-ray scattering revealed that the molecules form supramolecular nanorings in methylcyclohexane. Furthermore, a thin film obtained by drying a solution containing the nanorings exhibited mechanochromic fluorescence. Upon grinding with a spatula, fluorescence color changed from green to yellow.

[1] Y. Sagara, T. Kato, *Nat. Chem.* **2009**, *1*, 605.
[2] Y. Sagara et al. *Adv. Mater.* **2016**, *28*, 1073.
[3] Y. Sagara et al. *J. Am. Chem. Soc.* **2014**, *136*, 4273.
[4] Q. Liu et al. *Small* **2024**, 2400063.

Solid-State-Luminescent Arsine-Ligated Complexes

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Solid-state luminescent complexes represent an important class of functional materials with broad potential in sensing, switching, and photonic applications. To achieve precise control over their emission properties, a wide variety of ligands have been explored. Among them, arsenic-based ligands are particularly attractive because their flexible coordination directionality and heavy-atom effect are expected to open up coordination chemistry that is distinct from that of conventional phosphorus congeners. Nevertheless, the development of arsenic-ligand-based luminescent complexes has been severely limited by the poor commercial availability and difficult accessibility of organoarsenic compounds. To address this issue, we have developed practical synthetic methods for a wide range of organoarsenic compounds and have thereby established a versatile library of arsenic ligands. Using this platform, we have reported a series of solid-state luminescent complexes based on arsines and arsine oxides, which exhibit unique structural transformations and attractive photophysical properties.[1,2]

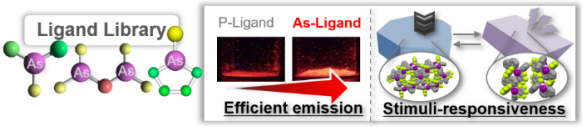

Figure 1. Concept of studies on arsine-ligated complexes.

For example, platinum complexes bearing arsa-fluorene ligands show intense room-temperature phosphorescence and further enable unusual functions such as shape-selective recognition of solvent vapors and solvent-vapor-driven switching between porous and nonporous solid states. In another system, copper(I) iodide complexes coordinated by triphenylarsine undergo remarkable structural transformations upon exposure to vapors of bidentate nitrogen ligands, demonstrating the high structural flexibility of arsenic-ligated Cu(I) assemblies. Furthermore, europium complexes containing arsine oxide ligands exhibit substantially improved ligand-to-metal energy transfer efficiency compared with their phosphine oxide analogues. In coordination polymers, the use of arsine oxide ligands also leads to a marked enhancement of thermal stability, and luminescence is retained even at 550 K. These results demonstrate that arsenic ligands provide a powerful molecular toolkit for creating solid-state luminescent complexes with unprecedented structural responsiveness, efficient energy transfer, and high thermal robustness.

[1] H. Imoto et al. **2025** *Inorg. Chem. Front.*, 7931
[2] H. Imoto et al. **2019** *Chem. Eur. J.*, 1883.

Orthogonal Cyclization Strategy for AIE/ACQ Switching in Cationic Azatriphenylenes

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The bottom-up synthesis of heteroatom-doped polycyclic aromatic hydrocarbons (PAHs) has attracted considerable attention in the development of models of doped graphene. Among PAHs, nitrogen-cation (N^+)-doped PAHs are known to exhibit superior optoelectronic functionalities; however, practical methods for their synthesis remain limited and challenging [1]. In this context, we have developed a facile and selective synthetic method for N^+-doped PAHs by anodic intramolecular cyclization without a transition-metal catalyst or chemical oxidant [2]. Intramolecular anodic pyridination of electron-rich arenes afforded a variety of cationic azatriphenylene derivatives with high selectivity.

In this study, the combination of anodic pyridination of electron-rich arenes and nucleophilic aromatic substitution (S_NAr) reaction of perfluoroarenes was investigated. The phenylpyridine bearing methoxyphenyl and pentafluorophenyl groups exhibited orthogonal reactivity toward thermal and electrochemical stimuli for cyclization at electron-deficient and electron-rich aromatic moieties, respectively (Figure 1) [3]. Interestingly, the resulting products displayed distinct fluorescence behaviors, namely, aggregation-induced emission (AIE) and aggregation-caused quenching (ACQ), despite sharing common molecular skeletons. Theoretical calculations and single-crystal X-ray diffraction analysis revealed the origin of this pronounced difference in optical properties.

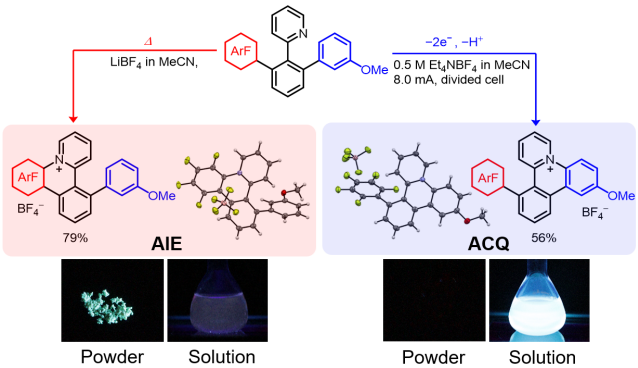

Figure 1. Orthogonal synthesis of cationic azatriphenylene derivatives exhibiting AIE or ACQ properties.

[1] A. Borissov et al. **2022** *Chem. Rev.*, *122*, 565.
[2] Y. Ohno et al. **2023** *Org. Lett.*, *25*, 3951.
[3] Y. Ohno et al. **2025** *Org. Lett.*, *27*, 4964.

Probing Molecular Motion during Polymorph Emergence in Evaporative Crystallization via Aggregation-Induced Emission

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[1] *Department of Chemistry, Institute of Education, Shinshu Univ., Nagano 380-8544, Japan*
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Crystallization of organic compounds from solution is essential for the preparation of functional materials and pharmaceuticals, and understanding the crystallization process is crucial for controlling polymorphism. Aggregation-induced emission (AIE) molecules, which exhibit fluorescence enhancement due to restriction of intramolecular motion, can serve as probes for molecular mobility during crystallization. In this study, we investigated molecular motion and polymorph emergence during solvent-evaporative crystallization using an AIE-active dibenzoylmethanatoboron difluoride complex (2amBF$_2$; Figure 1).[1,2] Real-time fluorescence measurements revealed a transition from non-emissive monomers to emissive liquid-like clusters (LLCs), followed by crystallization, consistent with the two-step nucleation mechanism. Fluorescence analysis showed polymorph-dependent behavior: in the green-emissive G-crystal, emission is enhanced at the LLC stage due to strong intermolecular overlap, whereas in the cyan-emissive C-crystal, it gradually increases during the transition to a rigid structure. These results demonstrate that AIE molecules enable visualization of molecular motion during crystallization and provide insights into polymorph emergence.

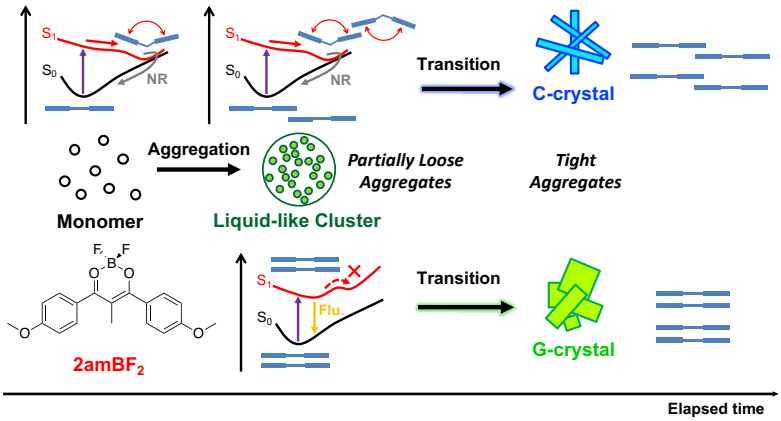

Figure 1. Schematic representation of the evaporative crystallization process probed by AIE.

[1] Y. Fujimoto et al. **2024** *J. Am. Chem. Soc.*, 146, 32529.
[2] Y. Fujimoto et al. **2025** *Chem. Commun.*, 61, 14430.

Estimating Fluorescence Quantum Yields with Theoretical Tools: Still a Dream ?

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Fluorescence is a radiative de-excitation process that competes with many other non-radiative pathways. Understanding how the environment and/or chemical substitutions do impact the fluorescence efficiency, that is, the quantum yield (ϕ_{fl}), remains a major challenge. In this context, obtaining accurate theoretical estimates of ϕ_{fl} would be welcome. To this end, one typically characterizes both key points of the Jablonski diagram and couplings between states (Figure 1), so as to estimates the rates of the radiative and non-radiative phenomena.[1] In this context, I will discuss some benchmarks in the field,[2,3] and next illustrate, for several practical examples performed in close collaboration with experimental groups successes and failures. The key role of twisted intramolecular charge transfer (TICT) and the case of excited-state intramolecular proton transfer (ESIPT) will highlighted since their presence is closely related to the changes of ϕ_{fl} induced by packing.[4,5]

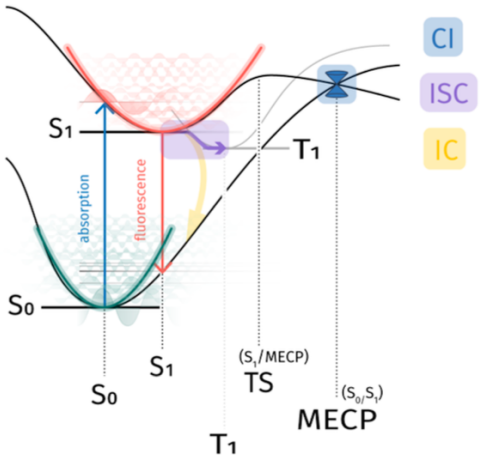

Figure 1. Key phenomena to be modelled to estimate fluorescence quantum yields.

[1] M. T. do Casal et al. **2023** *J. Phys. Chem. A*, 127, 10033.
[2] M. H. E. Bousquet et al. **2023** *J. Chem. Theory Comput.*, 19, 5525.
[3] K. Veys et al. **2023** *J. Chem. Theory Comput.*, 19, 9344.
[4] A. F. Henwood et al. **2024** *Chem*, 10, 578.
[5] T. Stoerkler et al. **2025** *J. Org. Chem.*, 16, 8338.

Persistent and Stimulated Luminescence from Trapped Charge Carriers in Organic Solids

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Long-persistent luminescent (LPL) materials store absorbed energy as charge carriers and gradually release it, thereby producing emissions that can last for hours. Such behavior has been reported mainly in inorganic materials, whereas long-lived emission in organic materials has traditionally relied on phosphorescence from triplet excitons because long term charge storage is generally difficult. By stabilizing organic charge carriers, we have developed organic systems that exhibit persistent and stimulated luminescence.[1-5] The mechanism of these systems can be divided into three processes: charge generation, charge retention, and recombination emission (Fig. 1). In organic materials, charge generation at donor–acceptor interfaces is well established in organic photovoltaics, and radiative charge recombination is the basis of organic light-emitting diodes.[6] This means that trapped-charge-carrier-based luminescence can be realized by introducing a charge accumulation process between charge separation and charge recombination. Charge traps can arise from shallow intrinsic traps as well as from extrinsic traps introduced through molecular additives. In this talk, I will discuss the key factors governing charge generation, retention, and recombination in these systems.

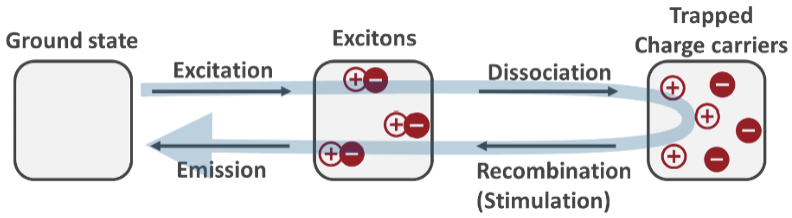

Figure 1. Emission mechanisms of persistent and stimulated luminescence.

[1] R. Kabe et al. **2017** *Nature*, 550, 384.
[2] K. Jinnai et al. **2021** *Nanoscale*, 13, 8412.
[3] M. Sakurai et al. **2021** *Commun. Mater.*, 2, 74.
[4] K. Jinnai et al. **2022** *Nat. Mater.* 2022, 21, 338.
[5] Z. Lin et al. **2025** *Nat. Commun.*, 16, 2686.
[6] S. R. Forrest, *Organic Electronics: Foundations to Applications*. Oxford University Press, **2020**.

Engineering Magnetic AIE-MOF Nanoplatforms for SN-38-Based Cancer Theranostics

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Cancer theranostics requires nanocarriers that integrate drug delivery and imaging in one platform. Aggregation-induced emission, AIE, is valuable for such systems because emission is retained or enhanced in the aggregated and framework-confined state, unlike many conventional fluorophores that undergo aggregation-caused quenching. AIE-active metal-organic frameworks, AIE-MOFs, are therefore attractive because they combine porous drug-loading capability with intrinsic solid-state fluorescence. Here, we report a zirconium-based magnetic AIE-MOF nanoplatform for SN-38-based cancer theranostics (Figure 1). The system was constructed by integrating a Zr-based AIE-MOF, derived from a mechanofluorochromic tetracarboxylate ligand, with citrate-modified silica-coated Fe_3O_4 nanoparticles to obtain a fluorescent and magnetically responsive nanocarrier. FTIR, XRD, FESEM, Raman, XPS and UV-Vis analyses confirmed framework formation and composite integration. The composite retained the fluorescence characteristics of the AIE framework after incorporation of the magnetic core. Gas sorption analysis showed high porosity for the bare MOF and a marked decrease in apparent surface area after magnetic core integration and SN-38 loading, consistent with composite formation and drug incorporation. The drug-loaded magnetic AIE-MOF showed high loading efficiency. Cytotoxicity studies showed that the unloaded bare MOF and magnetic MOF carriers were non-toxic. The developed system is directed toward cellular uptake, magnetic-guided delivery, fluorescence imaging, and cancer theranostic applications in colorectal cancer cells.
This work establishes a multifunctional magnetic AIE-MOF nanoplatform combining porous drug encapsulation, intrinsic AIE fluorescence, and magnetic responsiveness within a single system.

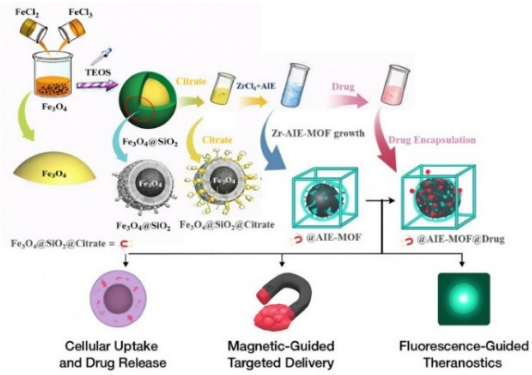

Figure 1. schematic illustration of magnetic AIE-MOF synthesis, SN-38 encapsulation, cellular uptake, magnetic-guided delivery, and fluorescence-guided cancer Theranostics.

[1] J. Luo et al. **2001** *Chem. Commun.*, 1740-1741.
[2] Q. Qi et al. **2024** *Int. J. Nanomedicine*, 19, 945-964.

Arranging Photo-Responsive Modules Circularly around Chiral Three-Dimensional Units

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Circular dichroism (CD) and circularly polarized luminescence (CPL) attract much attention in terms of three-dimensional (3D) display, security ink, imaging, and other advanced technologies. Chirality requires 3D structures without any mirror planes, while most organic photo-responsive modules use strong π–π* transitions from planar π-conjugated systems. Therefore, combination of the two features is the key to attractive chiroptical systems.
Along this line, we have investigated chiral molecular scaffolds with well-defined 3D shapes, such as pillar[5]arene, for visible photophysical properties. Due to sp^3-carbon-containing macrocycle, pillar[5]arenes prefer to take symmetric cylinder conformations (Figure 1a). When we introduced five pyrene modules to a rim-differentiated pillar[5]arene using relatively short linkages (Figure 1b), the circularly arranged pyrene cluster exhibited CD and CPL in visible region due to efficient transfer of chiral information from the pillar[5]arene subunit.[1] We also tested supramolecular combination with rod-shaped π-conjugated molecules so that the highest occupied molecular orbital (HOMO) of pillar[5]arene could participate in a luminescent electronic transition.[2] In poorly solubilizing media, resulting co-aggregates gave high-dissymmetry CPL (up to $g_{lum} = 2.9\times10^{-2}$ and $B_{CPL} \sim 3.0\times10^{2}$).

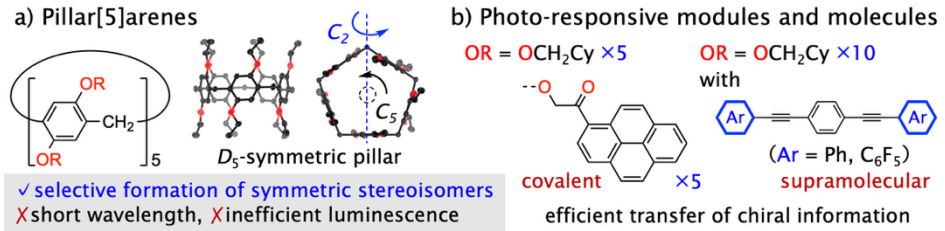

Figure 1. a) Chemical and single-crystal structures of pillar[5]arenes displayed with solution-state symmetry elements. b) Chemical structures of photo-responsive modules and molecules.

[1] K. Kato et al. **2022** *Chem. Sci.*, 13, 13147.
[2] K. Kato et al. **2024** *Aggregate*, 5, e482.

Aggregation induced spin-correlated photoluminescence by organic radicals

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Radicals can exhibit photofunctions unique to their open-shell electronic states, such as spin-allowed doublet-singlet and doublet-triplet energy transfer processes. Such characteristics distinguish radicals from conventional closed-shell molecules, making them a new class of molecular emitters.[1] We have shown that novel spin-correlated optical properties such as magnetic-field-controlled luminescence (i.e., magnetoluminescence) emerge when radicals are aggregated to interact with each other. This talk highlights the spin-correlated photoluminescence from radical-aggregated molecular systems such as radical-doped molecular crystals and diradicals (Figure 1), where the spin degree of freedom arising from interacting spins and spin state-dependent dynamics play key roles.[2-4] Our studies provide a novel spin manipulation method distinctly different from the previous ones that manipulate spin dynamics in the transient excited states, potentially advancing spin-related technology for future optoelectronic and energy-harvesting devices.

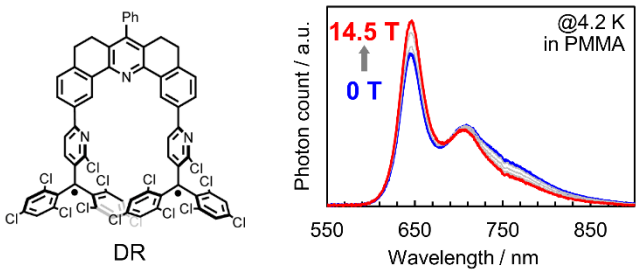

Figure 1. Chemical structure of diradical DR (left) and emission spectra of DR dispersed in PMMA under magnetic fields at 4.2 K (right).

[1] A. Mizuno et al. **2024** *Chem. Rev.*, *124*, 1034.
[2] R. Matsuoka et al. **2023** *J. Am. Chem. Soc.*, *145*, 13615.
[3] A. Mizuno et al. **2024** *J. Am. Chem. Soc.*, *146*, 18470.
[4] S. Kimura et al. **2021** *Chem. Sci.*, *12*, 2025.

Beyond Classical ROS Generation: Unconventional Mechanisms and Biological Outcomes

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Reactive oxygen species (ROS, $^1O_2$, O_2^-, OH·, and H_2O_2) are widely recognized for their dual roles in biological systems, contributing to both cellular signaling and oxidative stress-induced damage. While conventional ROS generation pathways have been extensively explored, emerging evidence highlights unconventional mechanism of ROS generation and their non-canonical biological consequences.

In this presentation, I will deliver three studies that unveil novel aspects of photoinduced ROS generation and their biological outcomes. First, rational design strategy for ROS generation under hypoxic condition will be discussed, achieved via water photooxidation.[1] This oxidative photocatalysis at cellular membranes can initiate non-canonical pyroptosis, a unique form of inflammatory cell death distinct from classical pathway. Notably, in-vivo mouse models confirmed the introduction of immunogenic cell death. In the next study, a spin-flip based electron transfer mechanism is uncovered, enabling efficient singlet oxygen generation from polyaminoglycerol, bypassing the traditional Type II energy transfer mechanism, and leading to potent antibacterial effect.[2] This finding paves the way for the design of biocompatible aliphatic organic photosensitizers. Finally, this unconventional singlet oxygen generation also contributes to revealing a hidden route of protein damage through oxygen-confined photooxidation within microenvironment, emphasizing how spatially restrict ROS can induce site-selective biomolecular damage.[3] Such photooxidative mechanism may represent a latent oxidation pathway in human tissues directly exposed to visible light, such as skin and eyes.

Together, these works highlight the importance of revisiting ROS generation beyond classical paradigms and understanding their spatial, mechanistic, and biological specificity. This presentation will provide an integrative view of these unconventional ROS pathways and discuss their implications in cell death, immunogenicity, therapeutic applications, and protein damages under visible light.

[1] T.-H. Kwon et al. **2024** *Nat. Commun*. 15,4025.
[2] T.-H. Kwon et al. **2023** *JACS Au*. 2, 933-942.
[3] T.-H. Kwon, D. Min et al. **2024** *Nat. Commun*. 15,10873.

Subcellular Visualization: Organelle Targeting and Interaction Monitoring

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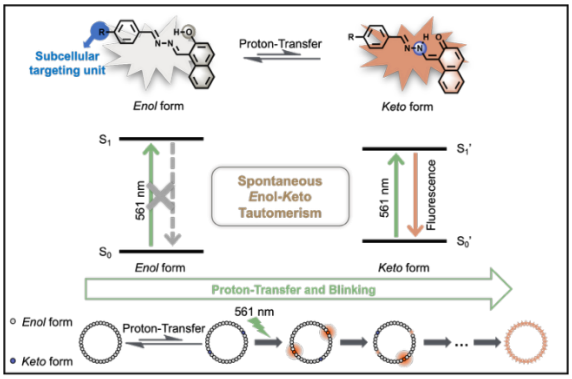
Fluorescence probe is essential for subcellular visualization of organelle targeting and interaction monitoring because it enables real-time, high-spatiotemporal-resolution tracking of dynamic organelle behaviors and their transient contacts in living cells, revealing regulatory mechanisms that static structures cannot capture. Specifically, high-resolution fluorescence imaging with advanced probes is highly desirable for visualizing subcellular targets. For modern super-resolution microscopy techniques, fluorophores with controlled on-off switching properties and subcellular targeting abilities are essential. However, the effective design strategies of blinking fluorophores are still limited with scarce building blocks, and sophisticated functionalization is always required for organelle recognition. This talk will introduce the application of a type of live-cell permeable fluorophores with simple structure in the imaging of lipid droplets and lysosomes using single-molecule localization microscopy. The fluorophores show signature enol-keto tautomerism by spontaneous proton transfer at the ground state without additional photoactivation, which ensures blinking performance by exciting the minor portion of molecules in keto form. In live-cell imaging, we observed lysosomes with a photon number of 1909 and localization precision of 15.6 nm. Given that the proton transfer at the ground state is a low barrier process, this methodology is certainly valuable for exploring environment-sensitive fluorophores in single-molecule super-resolution imaging of various physiological and pathological processes. In addition, our lab's recent progress in tracking dynamic interactions of subcellular organelles, such as mitochondria-lipid droplet contacts, will be discussed.



[1] J. Gao et al. **2024** *CCS Chem.*, 6, 2770.
[2] Z. Tian et al. **2026** *Cell Rep.*, doi: 10.1016/j.celrep.2026.117112.

AIE polymer micelles and vesicles as photocatalysts

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Biocatalytic transformations are increasingly important for green synthesis, but their integration with photocatalysis is limited by enzyme degradation from reactive oxygen species (ROS). We developed core–shell polymer micelles and vesicles with embedded organic luminophores that act as visible-light photocatalysts.[1] These colloids efficiently regenerate NAD+ from NADH while protecting enzymes from ROS, enabling stable, recyclable photobiocatalysis under aerobic conditions with potential for industrial application.

Beyond synthesis, NADH/NAD+ cofactors are central to cellular metabolism, and their disruption can impair cancer cell viability. Remarkably, our AIE polymer colloids catalyze NADH/NAD+ interconversion even under oxygen-deficient conditions, bypassing common electron acceptors. In vitro and in vivo studies show that under hypoxia, these colloids induce severe NAD+/NADH imbalance, suppressing oxidative phosphorylation and glycolysis, and triggering energy crisis in 4T1 cancer cells and tumors.[2] These findings highlight their promise for hypoxia-targeted cancer phototherapy.

[1] N. Zhang et al. **2023** *J. Am. Chem. Soc.*, *145*, 288.
[2] Y. Ma et al. **2025** *J. Am. Chem. Soc.*, *147*, 26557.

Mitochondria-Targeted AIEgen Amplifies Mitochondrial Stress and Immunogenic Signaling for Potent Antitumor Photoimmunotherapy

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Tumor immunotherapy is often limited by weak tumor immunogenicity and an immunosuppressive tumor microenvironment. As a central hub of cellular bioenergetics, redox regulation, and stress signaling, mitochondria represent an attractive target for therapeutic intervention. Directing photoactive aggregation-induced emission luminogen (AIEgen) to mitochondria may localize photochemical stress, enhance tumor cell killing, and promote immunogenic danger signaling. In this work, we designed and synthesized a mitochondria-targeted AIEgen, Mito 1, for image-guided photoactivated tumor therapy and modulation of the tumor immune microenvironment. Mito 1 preferentially accumulated in mitochondria and exhibited potent tumor-killing activity under light irradiation, while showing negligible cytotoxicity and favorable biosafety in the absence of irradiation. Mechanistically, Mito 1-mediated photodynamic therapy induced severe mitochondrial dysfunction, as evidenced by the collapse of mitochondrial membrane potential and disruption of intracellular Ca^{2+} homeostasis, accompanied by significantly increased calreticulin expression, collectively indicating the activation of immunogenic cell death-associated stress signaling. In a 4T1 tumor-bearing mouse model, Mito 1-mediated phototherapy markedly inhibited tumor growth, reduced tumor burden, and caused extensive histopathological damage in tumor tissues. Importantly, the treatment also reshaped the tumor immune microenvironment toward an antitumor state. Taken together, Mito 1 represents a promising mitochondria-targeted AIEgen that integrates precise subcellular imaging, efficient tumor ablation, mitochondria-amplified phototherapy, and immune microenvironment reprogramming, thereby providing a feasible strategy for next-generation AIEgen-based cancer photoimmunotherapy.

[1] K. Wang et al. **2023** *Nat. Commun.,* 14, 2950.
[2] Q. Xu et al. **2025** *Adv. Mater.,* 37, 35, 2502898.
[3] L. Zhu et al. **2025** *Nat. Commun.,* 16, 2578.

A microenvironment-responsive AIEgen orchestrating antibacterial activity and macrophage reprogramming for combating drug-resistant infected wound healing

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Antibiotic resistance has emerged as a severe global public health challenge.[1] The bacterial microenvironment is a key driver of drug resistance development.[2] However, current mainstream antibacterial strategies generally lack microenvironment specificity, often resulting in off-target tissue damage and immune disorders.[3] In this work, we designed a bacterial infection microenvironment-responsive aggregation-induced emission (AIE) molecule (TPVS), which exhibits excellent antibacterial and anti-biofilm activities *in vitro*. TPVS delays bacterial drug resistance by inhibiting the electron transport chain and modulating the bacterial metabolic microenvironment. Moreover, it responds to inflammatory macrophages in the infection microenvironment, promoting their polarization to the anti-inflammatory M2 phenotype, and accelerating infected wound healing through immune microenvironment modulation. This study provides a novel strategy for co-regulating bacterial metabolic and host immune microenvironments to combat multidrug-resistant infections, laying a foundation for developing intelligent microenvironment-responsive antibacterial systems.

[1] Y Y. Gong et al. **2026** *Adv. Mater.*, 38, e11037.
[2] S. E. Caño Muñiz et al. **2025** *Nat Microbiol.*, 10, 3202.
[3] Z. Wang et al. **2025** *Sci. China Mater.*, 68, 2962.

Polydiacetylene-based Highly Efficient CT-Raman Cross-scale Imaging

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X-ray computed tomography (CT) has an important role in precision medicine. However, CT contrast agents with high efficiency and the ability to translate diagnostic accuracy into therapeutic intervention are scarce. Here, poly(diiododiacetylene) (PIDA), a conjugated polymer composed of only carbon and iodine atoms, is reported as an efficient CT contrast agent to bridge CT diagnostic imaging with therapeutic intervention. PIDA has a high iodine payload (>84 wt%), and the aggregation of nanofibrous PIDA can further amplify CT intensity and has improved geometrical and positional stability in vivo. Moreover, with a conjugated backbone, PIDA has an ultrastrong Raman scattering intensity, making it dually visible by both CT imaging and Raman imaging. The performance of PIDA in CT-guided preoperative planning and visualization-guided surgery is validated using orthotopic xenograft rat models. In addition, IDA excels clinical fiducial markers of imaging-guided radiotherapy in efficiency and biocompatibility, and exhibits successful guidance of robotic radiotherapy on Beagles, demonstrating clinical potential to translate CT diagnosis accuracy into therapeutic intervention for precision medicine.

[1] M. Yin et al. **2022** *Nat. Commun.*, 13, 2625.
[2] M. Yin et al. **2023** *ACS Nano*, 17, 3873.

Synthesis and optoelectronic properties of two-dimensional transition metal dichalcogenides Title

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The unique electronic and optoelectronic properties of two-dimensional (2D) transition metal dichalcogenides (TMDs) materials have garnered significant attention. Among the various methods used for their synthesis and growth, chemical vapor deposition (CVD) stands out as a widely employed technique. Recently, we have explored different strategies to synthesize 2D materials and heterostructures through CVD method, with the aim of enhancing their functionality for advanced photodetection applications. These synthesis approaches of 2D TMDs encompass the epitaxial substitution of metal iodides for low-temperature growth and thermally-assisted tellurization method for wafer-scale synthesis. Additionally, we have fabricated van der Waals (vdWs) integrated image sensors based on the pristine 2H-MoTe2 homojunctions array with asymmetric thickness. And we have constructed image sensors with vertical 1T'/2H-MoTe2 homojunctions array to form crossbar architecture for ultralow-power imaging. These endeavors have shed light on the mechanisms underlying CVD synthesis of 2D TMDs and their applications in advanced optoelectronics. Consequently, they have significantly contributed to our understanding of optoelectronics and the integration of 2D materials into advanced image sensing technologies.

Highly Amplified Enantioselective Recognition using Diastereomeric Fluorophore – Nanocellulose Adsorption Complexes

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Diaminodicyanoquinodimethanes exhibit enhanced solid state fluorescence that is highly sensitive to various factors such as the extent of crystallinity of the solid[1] and the dielectric environment of the fluorophore.[2] We have synthesized enantiomers of a new chiral derivative, 7,7-*bis*(2-hydroxyphenyl)ethylenediamino-8,8-dicyanoquinodinomethane, ((*RR*)BHPEDQ and (*SS*)BHPEDQ); they show fluorescence based enantioselective recognition of mandelic acid (MA); enantioselectivity factor (***ef***) of ~ 3 is obtained with nmols of the analyte (Figure 1). Relative stability of the complexes with (*D*)MA and (*L*)MA is explored by spectroscopic studies and *ab initio* computations. A prominent amplification of the ***ef*** is realized using the diastereomeric adsorption complexes of (*RR*)BHPEDQ and (*SS*)BHPEDQ with nanocellulose (NC), exploiting the enhanced fluorescence of the immobilized fluorophore and the chirality of cellulose. The high ***ef*** values of 15 – 47 achieved at µM concentrations of the analyte (~ 2 – 4 nmols) with µMs of the sensor is unprecedented. An important observation is that the weaker diastereomeric complex provides the higher ***ef*** values, amplified by more than an order of magnitude. Generality of the new paradigm for ***ef*** amplification is demonstrated using several analyte enantiomers. The approach is also used to estimate enantiomeric excess in mixtures.

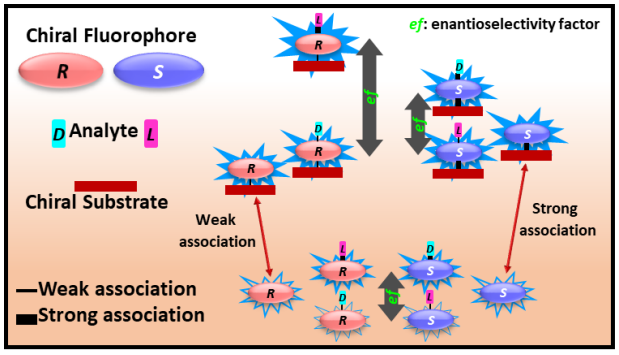

Figure 1. Schematic representation of the enantioselective recognition and the amplification by adsorption on NC; relative strength of the intermolecular associations is represented by the thickness of the arrows.

[1] R. S. Maurya et al. **2022** *Chem. Mater.*, 34, 244-253.
[2] N. Mahajan et al. **2024** *J Mater. Chem. C*, 12, 13430-13438.
[3] N. Mahajan et al. *Highly Amplified Enantioselective Recognition using Diastereomeric Fluorophore-Nanocellulose Adsorption Complexes*. (manuscript submitted).

Exploring the Supramolecular Interactions-Photoluminescence Relationship of Novel Cyclic Triimidazole Derivatives

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[2] Institute of Chemical Sciences and Technologies "Giulio Natta" (SCITEC) of CNR, via Golgi 19, 20133 Milano (Italy).
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Cyclic triimidazole (**TT**, Fig. 1 left) is a small, rigid, planar, N-rich organic molecule characterized by peculiar emissive features in the aggregated phases associated with π–π stacking interactions. In particular, it displays crystallization induced emissive behaviour achieving a photoluminescent quantum yield of 30% due to concomitant fluorescence and ultralong phosphorescence with lifetimes up to 1 second.[1, 2]

Several mono-, di- and tri-substituted **TT**-derivatives have been prepared and characterized often disclosing excitation-dependent photoluminescence comprising both short- and long-lived components of molecular and supramolecular origins, the latter associated with the presence of dimeric or columnar π–π aggregates and/or hydrogen bonded patterns in their crystal structure. Additional multi-stimuli induced responses have been highlighted.[2-4]

Recently, the family of **TT**-based emitters has been extended to the hexa-substituted derivatives (**TT6R**, Fig. 1 right) characterized by additional aggregation induced features associated with their even more pronounced tendency to form π–π stacked dimers. The present contribution will highlight the results obtained so far in this multifaced family underlying the central role of supramolecular interactions in the compounds' photoluminescent behavior.

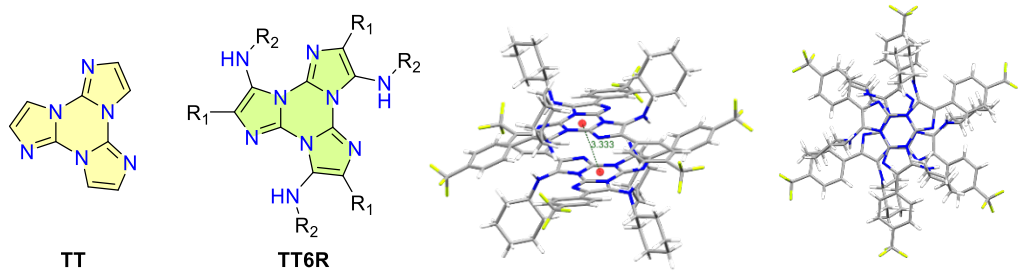

*Figure 1. From left: chemical structure of **TT** and **TT6R**, lateral and top views of **TT6CF$_3$** crystal structure*

[1] E. Lucenti et. al. **2017** *J. Phys. Chem. Lett.*, *8* (8), 1894–1898.
[2] A. Forni et. al. **2025** *J. Mater. Chem. C.*, *13* (8), 3721–3758.
[3] D. Malpicci et. al. **2023** *Dyes Pigm*, *215*, 111274
[4] D. Malpicci et. al. **2023** *Chem. Eur. J.*, *29* (38), e202300930

Experiencing Chemistry Education Across Cultures: A Semester at The Chinese University of Hong Kong, Shenzhen

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The poster illustrates the academic and personal journey of an undergraduate student enrolled in the Bachelor's Degree in Industrial Chemistry at the University of Pisa who spent one semester at The Chinese University of Hong Kong, Shenzhen (CUHK-Shenzhen) within the framework of the bilateral exchange agreement between the two institutions.

Special attention is devoted to comparing the educational approaches adopted in Italy and China, focusing on the organization of lectures, practical laboratory sessions, student–teacher interaction, assessment methods, and campus life. While differences in teaching styles and academic organization emerge, several common features—including the emphasis on experimental training, scientific rigor, and internationalization—demonstrate the shared commitment of both institutions to high-quality chemical education.

The exchange also strengthened the student's awareness of the global nature of chemistry and the importance of international cooperation in addressing scientific and technological challenges.

The primary objective of this contribution is to encourage undergraduate students to participate in international mobility programs by providing a first-hand account of the educational, professional, and personal benefits gained during a semester abroad. At the same time, the poster aims to further promote the successful collaboration between the University of Pisa and CUHK-Shenzhen, demonstrating how student exchanges contribute to building lasting academic partnerships and preparing the next generation of globally minded chemists.

Targeted Raman Visualization and Mitigation of α-Synuclein Amyloidogenesis in Living Zebrafish by a Nanobody-Decorated Polydiacetylene

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α-Synuclein (α-Syn) amyloidogenesis is considered a promising diagnostic marker and therapeutic target for Parkinson's disease (PD). Simultaneously visualizing and mitigating α-Syn amyloidogenesis are essential for future PD theranostics, yet they continue to pose an insurmountable challenge. This study have herein developed a nanobody-decorated polydiacetylene to approach a straightforward solution. Grafting α-Syn61-95 segment into the third complementary determining region of a parent nanobody generates an engineered nanobody X30 that can bind with α-Syn and prevent its amyloidogenesis through homotypic interaction. It next use X30 to decorate poly(deca-4,6-diynedioic acid) (PDDA), a polydiacetylene with an ultrastrong alkyne Raman signal (2120 cm^{-1}) in the cellular silent region, to create an α-Syn targeting Raman probe PX30. The binding affinity between X30 and α-Syn can be further boosted for over 150 times attributed to the rigidity of PDDA backbone and the multivalent effect. Therefore, PX30 not only enables real-time Raman visualization of α-Syn amyloidogenesis with a high signal-to-noise ratio in living zebrafish (Figure 1), but also alleviates amyloidogenesis-mediated damage to zebrafish embryos by effectively inhibiting α-Syn amyloidogenesis at low stoichiometric concentrations and scavenging pathologic reactive oxygen species.

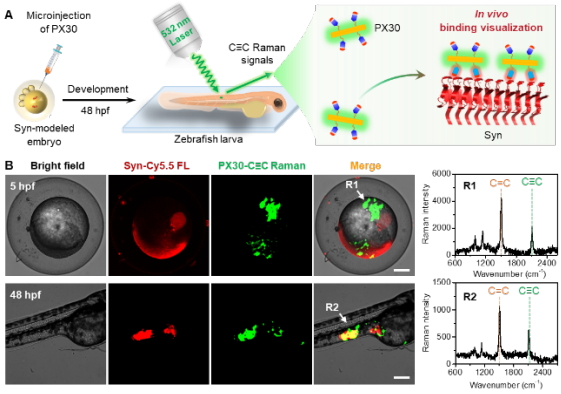

Figure 1. Targeted Raman visualization of α-syn amyloidogenesis in living zebrafish.

[1] L. Zhao et al. **2023** *Adv. Mater.* 35, 2210879.
[2] L. Zhao et al. **2025** *Small*, 21, 2411419.

Fluorescent Arylvinyl-Based Dyes: Functional Modulation and Imaging Applications

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Arylvinyl-based fluorescent dyes have attracted considerable attention owing to their tunable photophysical properties, structural versatility, and broad applications in chemical sensing and bioimaging. With extended π-conjugated frameworks and donor–acceptor architectures, these dyes display distinctive fluorescence behaviors, including high sensitivity to polarity, viscosity, pH, and specific analytes. Through rational molecular design, we regulated the functions of arylvinyl-based dyes by modulating electron-donating and electron-withdrawing groups, adjusting conjugation length, restricting intramolecular rotation, and incorporating targeting or responsive moieties. As a result, these functional arylvinyl-based dyes have been widely applied in biosensing, super-resolution imaging, and chemotherapy.[1-4]

[1] T. Zang et al. **2020** *Angew. Chem. Int. Ed.*, 59, 10003.
[2] S. Cao et al. **2023** *Chem. Mater.*, 35, 2472.
[3] L. Zhang et al. **2024** *Nano Lett.*, 24, 15396.
[4] J. Wang et al. **2024** *J. Am. Chem. Soc.*, 146, 28783.

Force-induced Control of Circularly Polarized Luminescence with Rotaxane Architecture

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Mechanochromic mechanophores are molecular structures that change absorption and/or fluorescence properties in response to mechanical stimuli. We have developed rotaxane-based supramolecular mechanophores that exhibit instantaneous and reversible changes in fluorescence intensity.[1] These mechanophores have great potential as versatile molecular tools for controlling not only fluorescence but also various photofunctions at the single-molecule level by force.[2] In this study, we developed rotaxane-based supramolecular mechanophores each featuring a helicene group as the fluorophore and demonstrated that circularly polarized luminescence (CPL) can be controlled upon mechanical activation of the rotaxane-based supramolecular mechanophores.

The mechanophores were introduced into the first network of double-network (DN) gels as cross-linkers to investigate the mechanoresponsive behavior and enable reliable evaluation of CPL through isotropic swelling. Swelling experiments revealed that the DN gels showed different volume swelling ratios depending on the solvent. When swollen in methanol, the gels exhibited a volume swelling ratio of 1.9, with the first network remaining in a relaxed state, leading to weak fluorescence and negligible CPL emission. In contrast, swelling in chloroform resulted in a volume swelling ratio of 4.5, inducing mechanical stress within the first network polymer chains. The stress transduced through the polymer chains activated the mechanophores, leading to an increase in fluorescence intensity and the turn-on of CPL. Furthermore, the CPL properties exhibited reversible switching upon sequential solvent exchanges between methanol and chloroform.

[1] Y. Sagara et al. **2018** *J. Am. Chem. Soc.*, *140*, 1584.
[2] T. Muramatsu et al. **2023** *ACS Appl. Mater. Interfaces*, *15*, 8502.

Remarkable Piezofluorochromism of [2.2]Paracyclophane-Containing Organoboron Complexes

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Piezofluorochromic (PFC) materials, which reversibly modulate their fluorescence color in response to pressure, have attracted growing interest as stimuli-responsive smart materials. However, the rational design of PFC materials remains challenging because their responses are highly sensitive to molecular packing in the aggregated states. In this work, crystalline organoboron complexes incorporating a [2.2]paracyclophane moiety (**1BF$_2$-R**, Figure 1a) are presented as a new class of PFC materials. The crystals exhibit distinct PFC responses depending on the substituent R (Figure 1b).[1,2] X-ray crystallography under ambient and high pressure reveals that these differences originate from variations in inter- and intramolecular π–π interactions. Furthermore, optically resolved chiral crystals of **(S_p)-1BF$_2$-H** display characteristic "T-shaped" excimer fluorescence arising from *edge-to-face* π–π interactions between [2.2]paracyclophane moieties (Figure 1c).[3] These results demonstrate that the [2.2]paracyclophane moiety acts as a pressure-sensitive unit in PFC materials.

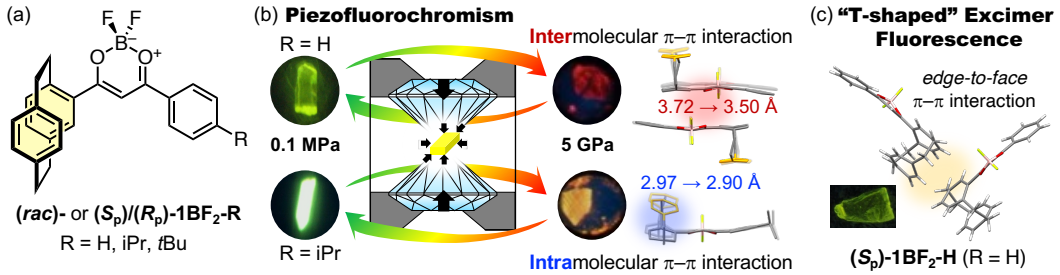

Figure 1. (a) Molecular structures of 1BF$_2$-R. (b) Distinct PFC behavior of crystals of 1BF$_2$-H and 1BF$_2$-iPr depending on the packing structures. (c) "T-shaped" excimer fluorescence from chiral crystals of (S_p)-1BF$_2$-H.

[1] S. Irii et al. **2022** *Tetrahedron Lett.*, *101*, 153913.
[2] S. Irii et al. **2026** *J. Mater. Chem. C*, *14*, 232–242.
[3] S. Irii et al. **2026** *Chem. Asian J.*, *21*, e70693.

Design of Photofunctional Materials Based on Multicomponent Host–Guest Systems

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Recent advances in the development of photofunctional materials based on supramolecular assembly and host–guest chemistry are presented. Emphasis is placed on multicomponent systems, where higher-order intermolecular interactions and self-assembly are utilized to achieve complex and tunable functions beyond conventional 1:1 host–guest interactions.[1]
Multicomponent host–guest crystals composed of three to six molecular components have been designed and constructed. Through their self-assembly behavior, solid-state luminescent materials with diverse photophysical properties have been realized (Figure 1). These include crystalline materials exhibiting multicolor or white luminescence, room-temperature phosphorescent (RTP) crystals with potential applications as oxygen sensors, as well as vapochromic and piezochromic materials responsive to external stimuli.
These results demonstrate that multicomponent supramolecular design enables precise control of photofunctions, providing a promising strategy for the development of advanced functional materials.

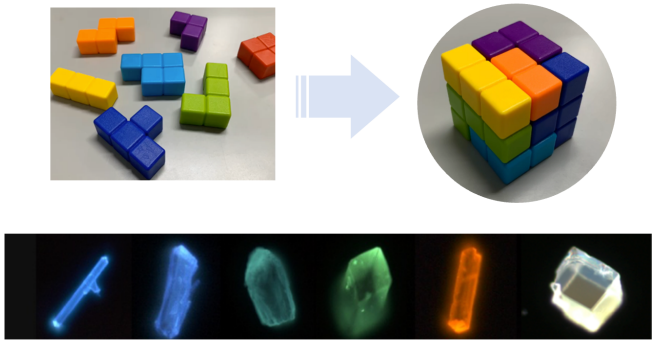

Figure 1. Schematic illustration of multicomponent assembly and the resulting luminescent crystals with diverse emission properties.

[1] T. Ono **2025** *J. Incl. Phenom. Macrocycl. Chem.*, 105, 261-280.

Through-space interactions and aggregation leading to non-conventional luminescence in organic light emitters

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Non-Conventional Organic Light Emitters (NCOLEs) represent an emerging class of luminescent materials that exhibit fluorescence, a.k.a. unusual photophysical behavior, in the near-UV and visible range despite lacking extended π-conjugation, challenging traditional theories of organic photophysics. This research aims to establish a theoretical framework to determine the mechanism of luminescence of compound 1,1,2,2-tetraphenylethane (sTPE),[1] a prototypical propeller-shaped aggregation-induced emission (AIE) luminogen, in both aggregate and crystalline phases by examining the roles of Through-space Interactions (TSI) and Conical Intersections (CI). sTPE exhibits weak UV emission in solution but in contrast, it displays strong visible fluorescence (~460 nm) in the crystalline phase.[1] It has been proposed that this bathochromic shift arises from restriction of intramolecular motion (RIM) in the solid phase,[1] which serves as a mechanism of aggregation-induced emission (AIE), and through-space π–π interactions (TSI-(π–π*)).[2] However, the precise mechanisms governing these interactions remain unclear and require further elucidation. A combination of time-dependent density functional theory (TD-DFT) using long-range corrected functionals, multistate CASPT2 validation, and QM/MM ONIOM methods is employed to study both isolated and aggregated systems. The results provide a theoretical framework for understanding the optical properties of non-conjugated aromatic systems. They highlight the critical role of TSI between the phenyl rings in modulating the energy and intensity of the emission, and show how structural restrictions in the aggregate phase modulate the degree of interaction and favour the red-shifted emission.

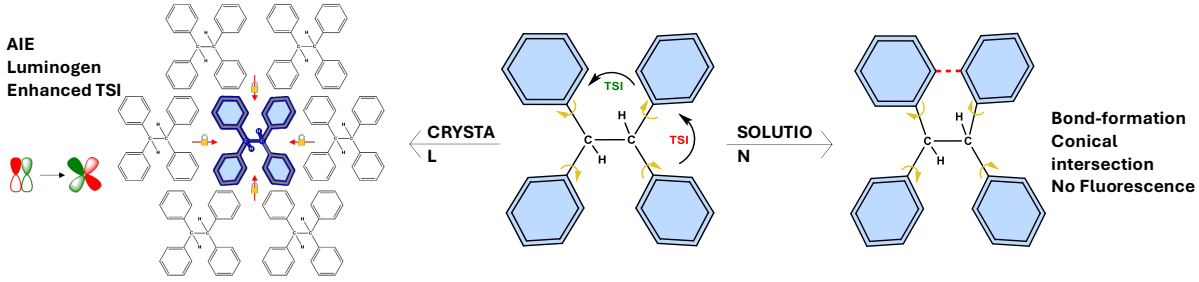

Figure 1. Aggregation-Induced Emission (AIE) of 1,1,2,2-Tetraphenylethane (sTPE)

[1] H. Zhang et al. **2017** *J. Am. Chem. Soc.*, 139, 45, 16264–16272.
[2] H. Zhang et al. **2021** *JACS Au*, 1, 11, 1805–1814.

Circularly Polarized Luminescence and Through-Space Interaction in Non-planar Luminogens

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After centuries of development, organic molecules with different sizes and edge structures have been synthesized and applied in optoelectronics and other research fields. However, traditional organic materials with large π planar structures usually suffer from poor solubility and fluorescence quenching caused by molecular aggregation. Novel organic functional materials with exciting properties such as aggregation-induced luminescence, circularly polarized luminescence, and through-space interaction can be designed and synthesized by introducing a three-dimensional structure. In this talk, I will introduce the design principle and intriguing properties of several nonplanar molecular systems. These kinds of novel functional materials are potential candidates in optoelectronics, information encryption, and storage, as well as bioimaging and biosensing.

New classes of phosphorus heterocycle derivatives as fluorophore for luminescent solar concentrators

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Today, in a world where energy consumption, especially electricity, is constantly increasing, the transition from fossil fuels to renewable energy sources has become a central issue. Within this context, research and development of new sustainable technologies for energy production based on the use of luminescent solar concentrators (LSCs) are of growing importance. LSC devices,[1] thanks to the presence of photoactive materials that absorb light and re-emit it at longer wavelengths, are capable to concentrate solar radiation along the edges of polymer slabs, where a photovoltaic cell is placed to convert the radiation into electricity. Among the most promising candidates for this application are organic dyes. One of the most effective strategies for developing organic fluorophores emitting in the near-infrared (NIR) region, and therefore compatible with silicon photovoltaic cells, involves the use of π-conjugated donor–acceptor architectures, such as D–A–D and D–A–A' systems.[2] The work focused on the synthesis of new symmetric D-A-D and asymmetric D-A-A' classes of dyes featuring two different central acceptor cores dithieno[*3,2-b:2',3'-d*]phosphole[3] and dithieno[*b,f*]phosphepines[4] (Figure 1), functionalized with various electron-donating and electron-accepting substituents. These types of molecules often exhibit AIE properties, allowing the preservation of high fluorescence quantum yields in the solid state or at high concentrations, which are typical of LSC devices. Structural modifications were employed to investigate their influence on intramolecular charge transfer and photophysical behavior. After synthesis, the final compounds were fully characterized and tested in LSC devices.

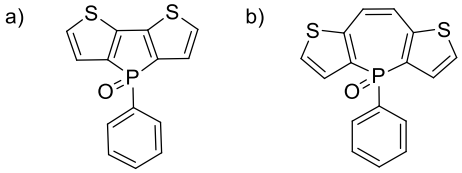

Figure 1. Structures of the central acceptor cores: a) dithieno[3,2-b:2',3'-d]phosphole, b) dithieno[b,f]phosphepines

[1] S. Castelletto et al. **2023** *Nano Energy*, *109*, 10826.
[2] R. Kundu et al. **2015** *RSC Adv.*, *5*, 77460–77468.
[3] C. Romero-Nieto et al. **2013** *Synlett*, *24*, 920-937.
[4] T. Delouche et al. **2019** *Organic Letters, 21*, 3, 802-806.

Mechanochromic Luminescence Using Supramolecular Mechanophores: Design and Mechanism

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Mechanochromic mechanophores are reporter molecules that reveal mechanical events by exhibiting changes in their photophysical properties. Working mechanism of supramolecular mechanochromic mechanophores relies on force-induced changes in the arrangement of luminophores and/or quenchers without covalent bond scission. Various supramolecular mechanophores, including rotaxanes,[1-4] catenanes, cyclophanes,[5,6] loop-forming structures,[7] and hinge-like structures,[8] have been developed to exhibit diverse activation behaviors (Figure 1). As a representative example, our prototype rotaxane mechanophore comprises a ring bearing a luminophore and an axle containing an electronically matched quencher and two stoppers. In the absence of an external force, the ring resides over the quencher, leading to fluorescence quenching through photoinduced electron transfer (PET).[4] Upon application of mechanical force, spatial separation of the luminophore and quencher suppresses PET, resulting in intense fluorescence. When such supramolecular mechanophores are covalently incorporated into polyurethane elastomers and the resulting films are subjected to cycle stretching, the fluorescence properties change instantaneously and reversibly. The functions controllable by supramolecular mechanophores are not limited to fluorescence; they also extend to fluorescence resonance energy transfer (FRET),[9] phosphorescence, and circularly polarized luminescence (CPL).

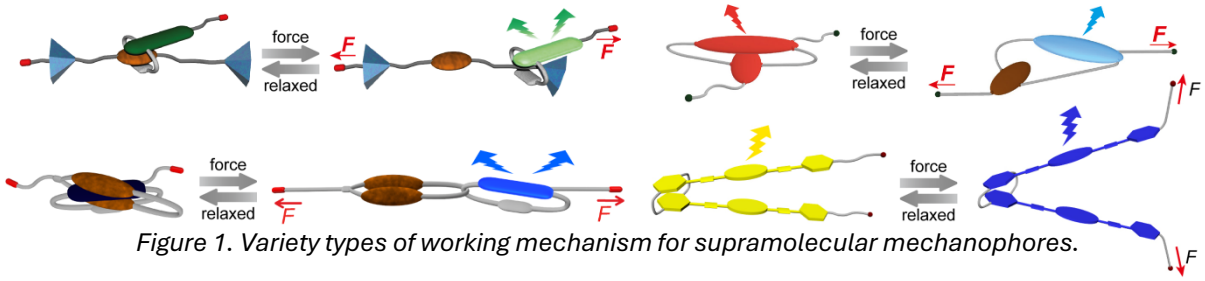

Figure 1. Variety types of working mechanism for supramolecular mechanophores.

[1] Y. Sagara et al. **2018** *J. Am. Chem. Soc.*, *140*, 1584. [2] Y. Sagara et al. **2019** *ACS Cent. Sci.*, *5*, 874. [3] T. Muramatsu et al. **2021** *J. Am. Chem. Soc.*, *143*, 9884. [4] K. Nonaka et al. **2025** *Chem. Sci.*, *16*, 21534. [5] Y. Sagara et al. **2021** *J. Am. Chem. Soc.*, *143*, 5519. [6] S. Thazhathethil et al. **2022** *Angew. Chem. Int. Ed.*, *61*, e202209225. [7] H. Traeger et al. **2021** *Angew. Chem. Int. Ed.*, *60*, 16191. [8] S. Shimizu et al. **2025** *Angew. Chem. Int. Ed.*, e202510114. [9] T. Muramatsu et al. **2023** *ACS Appl. Mater. Interfaces*, *15*, 8502.

Rational Design of Organic Fluorophores Highly Emissive in Both Molecularly Dispersed and Aggregated States

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High luminescence of organic fluorophores in both molecularly dispersed and Aggregated states—often referred to as dual-state emission—overcomes the longstanding trade-off between efficient emission in dilute solution and aggregation-induced quenching in the solid state. This unique property significantly expands their applicability in optoelectronic devices, sensing, and bioimaging by allowing reliable performance irrespective of molecular aggregation or processing conditions. Here, we present a rational design of dual-state emissive organic fluorophores based on excited-state intramolecular proton transfer (ESIPT)-type molecules. ESIPT molecules bearing a proton-donating hydroxy group isomerize from the *enol* form to the *keto* form upon photoexcitation, thereby allowing a four-level photophysical cycle—*enol*, *enol**, *keto**, and *keto* states. The fluorescence from the *keto** form has advantages of the large Stokes shift and thus minimal self-absorption, contributing to the efficient photoluminescence in the aggregated state. However, ESIPT fluorophores generally suffer from low fluorescence quantum yields (Φ) in fluid media such as organic solvents and liquid crystals (LCs). For example, 2-(2-hydroxyphenyl)benzothiazole (HBT), a representative ESIPT fluorophore, exhibits a low Φ (~0.01) in solution due to nonradiative decay associated with twisting of the central C–C bond in the excited state. In this study, we demonstrate that a substitution of HBT with conjugated and/or electron-deficient groups such as phenylene, ethynylene, and cyano ones remarkably increases Φ in solutions and LCs.[1–7] These derivatives are highly miscible in LCs[1–6] and amorphous polymer[7,8] over 10 wt%, which enables the polarized luminescence,[1–6] amplified spontaneous emission,[5,6] and microcavity laser.[7]

[1] T. Sakurai et al. **2019** *Adv. Opt. Mater., 7*, 1801349.
[2] T. Sakurai et al. **2019** *Langmuir*, *35*, 14031.
[3] T. Sakurai et al. **2020** *Phys. Chem. Chem. Phys.*, *22*, 28393.
[4] T. Sakurai et al. **2021** *Crystals*, *11*, 1105.
[5] Y. Tsutsui et al. **2020** *Adv. Opt. Mater.*, *8*, 1902158.
[6] Y. Tsutsui et al. **2024** *Faraday Discuss.*, 250, 271.
[7] T. Sakurai et al. **2025** *Chem. Commun.*, *61*, 5589.
[8] T. Sakurai et al. **2026** *Chem. Lett.*, *55*, upag031.

Aggregation-Induced Charge Separation Drives Sustained Radical Photochemistry for Hypoxia-Tolerant Photodynamic Therapy

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Photodynamic therapy (PDT) is a minimally invasive treatment that uses light-activated photosensitizers to generate cytotoxic reactive oxygen species for tumor ablation. However, conventional PDT mainly relies on singlet oxygen generation through the Type II mechanism, which requires molecular oxygen and therefore shows reduced efficacy in hypoxic tumors. Here we report a supramolecular photosensitizer based on the redox active carbenium dye dimethoxyquinacridinium (**DMQA$^+$**) that enables sustained radical photochemistry *via* aggregation-induced symmetry-breaking charge separation (Figure 1).[1] Amphiphilic **DMQA$^+$-C18** derivatives self-assemble in water to form aggregates that promote intermolecular charge separation upon photoexcitation, generating long-lived radical species with high oxidative potential. The assembled system undergoes repetitive photoredox cycles driven by light and endogenous reductants, enabling continuous radical generation and prolonged intracellular redox perturbation. As a result, the supramolecular photosensitizer exhibits strong photodynamic therapeutic effect even under hypoxic conditions. This work highlights aggregation-induced charge separation (AICS) as a promising strategy for hypoxia-tolerant photodynamic therapy.

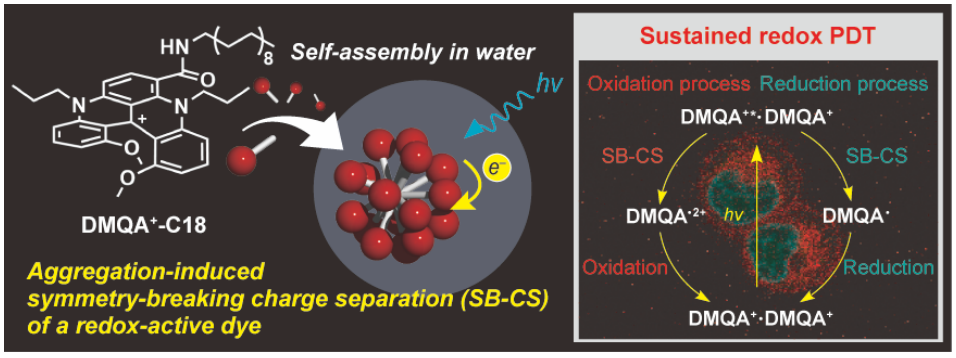

*Figure 1. Schematic representation of this work: aggregation-induced charge separation (AICS) of **DMQA$^+$** assembly for hypoxia-tolerant PDT.*

[1] Y. Imuro et al. **2026** *ChemRxiv*.

Amorphization-induced Enhanced Ultraviolet Emission of Silicon-substituted 2′,5′-Dioxy-*p*-terphenyls

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The advancement of organic light-emitting diodes technology has increased the demand for luminescent materials with high emission efficiency in the solid state and stable amorphous properties. This requirement is particularly critical for ultraviolet (UV)-emitting materials, for which doping strategies are generally ineffective. We have previously demonstrated that 2′,5′-dioxy-*p*-terphenyls efficiently emit UV light in the solid state.[1] However, their crystalline nature, originating from simple *p*-terphenyl skeletons, results in either the absence of a glass transition temperature (T_g) or a T_g as low as 47 °C, which significantly limits their practical applications. We present the molecular design, synthesis, and thermal and photophysical properties of triorganosilyl-substituted 2′,5′-dioxy-*p*-terphenyls.[2] These terphenyl derivatives also exhibit efficient UV fluorescence in the solid state as the parent terphenyls. The introduction of silyl groups at 3 and 3′′ or 4 and 4′′-positions of the terminal phenyl rings effectively suppresses crystallization and enhances amorphous stability. Density functional theory calculations indicate that the incorporation of silyl groups has minimal influence on the electronic structure, thereby preserving UV emission characteristics. Differential scanning calorimetry analysis reveals that terphenyls bearing triphenylsilyl groups exhibit the highest glass transition temperature and superior amorphous stability. Photophysical measurements demonstrate that these materials exhibit amorphization-induced enhanced emission, a rare phenomenon in which fluorescence efficiency in the amorphous state exceeds that in the crystalline state. These findings highlight the effectiveness of silicon-based molecular modifications in stabilizing the amorphous nature of UV-emitting materials.

[1] M. Shimizu et al. **2024** *ChemPhotoChem*, *8*, e202300287.
[2] M. Shimizu et al. **2025** *Mater. Chem. Front.*, *9*, 3006–3015.

Development of a Hinge-like Mechanophore Controlling Excimer and Monomer Emission

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Mechanochromic mechanophores, which are useful for evaluating and visualizing damage applied to polymer materials, are widely investigated.[1] Our group has developed supramolecular mechanophores that utilize the rearrangement of fluorophores and/or quenchers.[2,3] Because the working mechanisms do not involve scission of covalent bonds, the mechanochromic response is instantaneous and reversible. Here, we demonstrate a hinge-like supramolecular mechanophore utilizing the rigidity of [2.2]paracyclophane structure (Figure 1a).[3] The mechanophore consists of two 1,6-bis(phenylethynyl)pyrenes as excimer-forming fluorophores that share each one phenyl group with [2.2]paracyclophane. Polyurethane films covalently incorporating the mechanophore display an excimer-dominant spectrum because the rigid and strained [2.2]paracyclophane forces the fluorophores into proximity. The polyurethane films exhibit distinct ratiometric change in the photoluminescence properties from excimer emission to monomer-dominant emission upon deformation due to the separation of the proximate fluorophores (Figure 1b). After releasing force, the initial emission spectrum recovers.

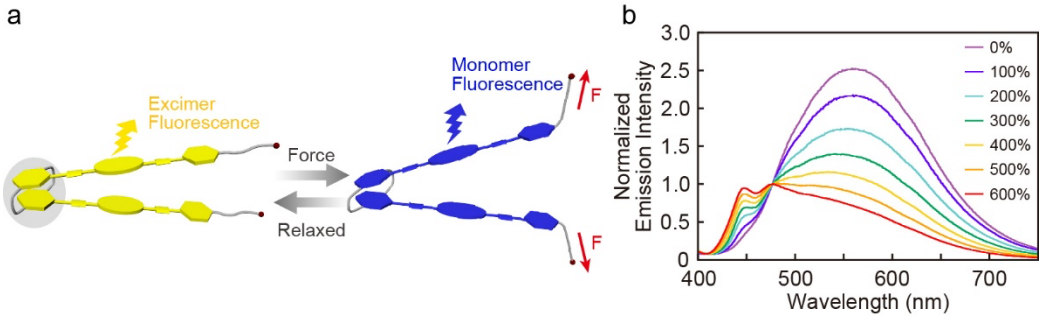

Figure 1. (a) Operating mechanism of a hinge-like mechanophore. (b) Emission spectra of the polyurethane films in which the mechanophore was covalently embedded upon stretching.

[1] D. Xu, H. Qian et al., *Chem. Rev.* **2026**, *126*, 3125.
[2] Y. Sagara et al., *J. Am. Chem. Soc.* **2018**, *140*, 1584.
[3] S. Shimizu, Y. Sagara et al., *Angew. Chem. Int. Ed.* **2025**, *64*, e202510114.

Mechanochromic Polyolefin Elastomers

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Mechanical robustness is a critical requirement for polymeric materials used in demanding applications such as aerospace components and flexible electronics.[1] However, the accumulation of mechanical stress at the molecular level—often preceding macroscopic failure—remains difficult to detect in real time. In this context, force-responsive optical systems have emerged as powerful tools for probing stress evolution, with mechanochromic polymers offering the distinct advantage of visualizing deformation through changes in color or fluorescence. In this work, we present a simple and efficient strategy to introduce mechanochromic functionality into a commercial polyolefin elastomer (POE).[2] The approach relies on a one-step modification of anhydride-functionalized POE using small amounts (<0.8 wt%) of mechanochromic cross-linkers (Loop and sPDI) incorporating perylene diimide (PDI) chromophores. The Loop system allows intramolecular interactions, while sPDI promotes intermolecular ones. Upon mechanical deformation, both materials show a clear mechanochromic response due to the disruption of dye aggregates and an increase in the monomer-to-excimer emission ratio. Spectroscopic analysis indicates that intermolecular PDI interactions largely govern the optical behavior. These results demonstrate that minimal incorporation of tailored chromophores enables sensitive and reversible stress sensing in polymer matrices.

[1] Y. Huang et al. **2023** *ChemPlusChem*, 88, e202300213.
[2] C. Micheletti et al. **2024** *ACS Appl. Polym. Mater.*, 6, 6572−6580.

Induction, Amplification and Regulation of Circularly Polarized Luminescence through Chiral Intermolecular Interactions

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Circularly polarized light (CPL) is a special type of polarized light whose electric field vector rotates at a fixed angular velocity in the plane perpendicular to the propagation direction. CPL materials hold great promise for advanced photonic applications, yet achieving dynamic control over both the luminescent dissymmetry factor (g_{lum}) and photoluminescence quantum yields remains a substantial challenge. Conventional approaches to CPL inversion often require the intricate synthesis of enantiomers or depend on specific crystal orientation effects. A new strategy for regulating the sign of CPL signals by controlling weak interactions in aggregate states to modulate the molecular conformation and excited-state transition dipole moments of aggregated molecules.[1-3] This work provides a robust strategy for designing multifunctional chiroptical materials with controllable CPL signs through chiral intermolecular interactions for applications in photonics and sensing.

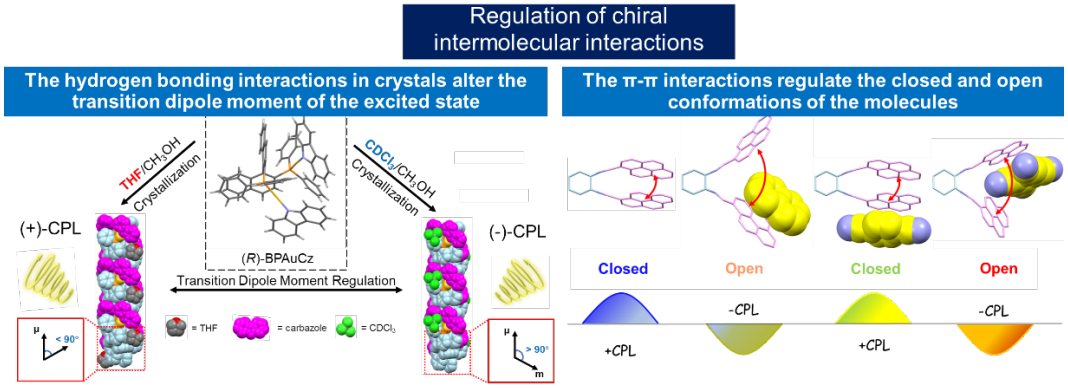

Figure 1. CPL regulation through chiral intermolecular interactions

[1] F. Lin et al. **2026** *Angew. Chem. Int. Ed.*, 65, e15768.
[2] K. Wang et al. **2026** *Angew. Chem. Int. Ed.*, 65, e20826.
[3] X. Niu et al. **2025** *Aggregate*, 6, e70003.

AIE Photosensitizer-mediated Photodegradation of Carbonic Anhydrase IX Triggers Ferroptosis

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To address hypoxia-driven therapeutic resistance exacerbated by photodynamic therapy (PDT), targeted photodegradation of hypoxia-inducible carbonic anhydrase IX (CAIX), an enzyme overexpressed on the tumor cell membrane, offers a direct countermeasure.[1,2] Toward this goal, **TBC** was designed and synthesized as an aggregation-induced emission photosensitizer (AIE PS) featuring a benzenesulfonamide tail for specifical CAIX targeting. Compared with the aniline-modified **TBN**, the substitution with benzenesulfonamide endowed **TBC** with enhanced charge-transfer characteristics, a more pronounced AIE effect, red-shifted emission, and superior Type I/II PDT efficacy.[3] **TBC** acted through selective CAIX binding and inhibition, an effect markedly amplified by its subsequent photodegradation, thereby promoting tumor-specific accumulation while simultaneously alleviating hypoxia. Mechanistically, CAIX photodegradation synergistically mitigated hypoxia and induced intracellular acidosis, leading to elevated reactive oxygen species levels and lipid peroxidation that drove robust ferroptosis. Furthermore, **TBC** induced a spatiotemporal targeting cascade from the cell membrane to the Golgi apparatus and endoplasmic reticulum. The light-induced stress at these sites potentiated ferroptosis and stimulated antitumor immunity.[4] To our knowledge, this is the first AIE PS enabling in situ CAIX photodegradation to trigger ferroptosis via dual hypoxia alleviation and intracellular acidosis, offering a novel strategy against PDT resistance.

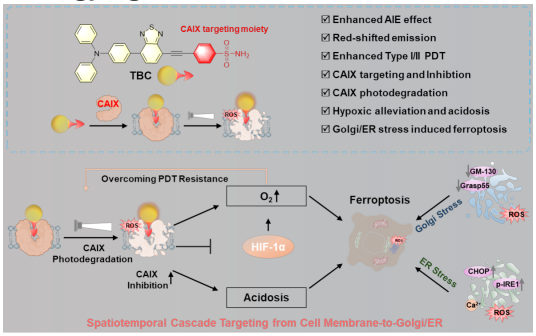

*Figure 1. Mechanism of action of the AIE PS **TBC**: in situ photodegradation of CAIX triggers ferroptosis by alleviating hypoxia and inducing intracellular acidosis.*

[1] C. T. Supuran et al. **2008** *Nat. Rev. Drug Discov.*, 7, 168-181.
[2] X. Su et al. **2022** *Angew. Chem. Int. Ed.*, 61, e202115800.
[3] J. Mei et al. **2015** *Chem. Rev.*, 115, 11718-11940.
[4] X. Su et al. **2023** *Angew. Chem. Int. Ed.*, 62, e202216917.

Aggregation-Induced Energy Transfer in a Thermally Activated Delayed Fluorescence Organic Emitters

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Thermally activated delayed fluorescence (TADF) is a photophysical phenomenon that enables harvesting of triplet excitons. Owing to its long-lived emission via reverse intersystem crossing (rISC), TADF compounds have attracted considerable attention for organic light-emitting diodes (OLEDs) and biological applications. To design TADF emitters that function effectively in biological environments, understanding the effects of aggregation on the photophysical properties of organic TADF emitters is essential. In this work, we developed a molecular system that readily forms aggregates in aqueous environments by introducing hydrophobic self-assembling chains at the periphery of a dibenzophenazine-cored donor–acceptor–donor (D–A–D) TADF emitter.[1] The D–A–D compound bearing the self-assembly chains (**1**, Figure 1a) exhibited a distinct change in photoluminescence (PL) color as a function of the water fraction (f_w) under UV irradiation (Figure 1b). This aggregation-induced PL color change was found to originate from a ratiometric change in dual emission intensity (Figure 1c). In this presentation, we discuss the effect of aggregation on the photophysical properties of TADF-active emitters.

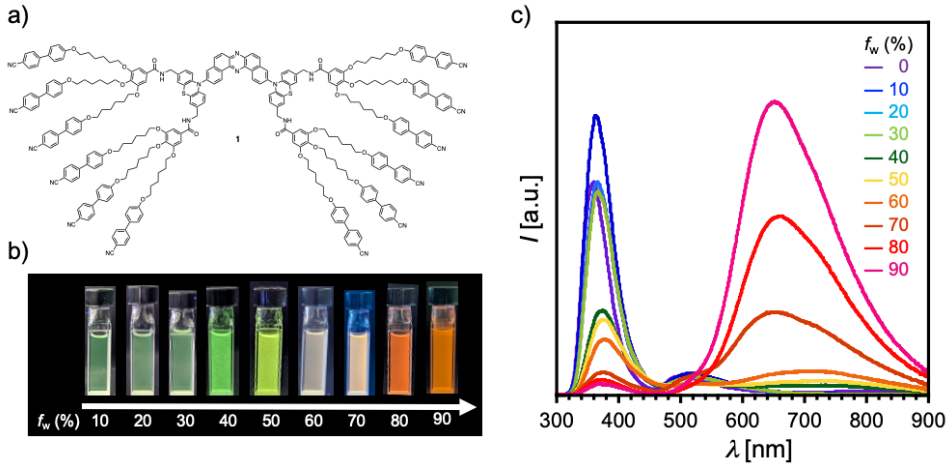

*Figure 1. a) Chemical structure of compound **1**. b) Photographs of **1** taken under UV lamp irradiation (λ=365 nm) and c) PL spectra of **1** in water/THF mixtures with varied water fraction.*

[1] Y. Takeda et al. **2017** *Chem. Sci.*, 8, 2677.
[2] Y. Takeda et al. **2026** *Chem. Asian J.*, 21, e70426.

POSA: Fast Amplified and Multiplexing Protein Imaging

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Fluorescent π-conjugated polymers (FCPs) are known for their superior brightness but are still unavailable for highly multiplexed molecular imaging in single cells, as they are hydrophobic and lack targeting capability toward biomolecules. Herein, we develop a π-conjugated polymer-based amplification (POSA) method to achieve highly multiplexed signal amplification. Direct optical amplification by virtue of the high brightness of FCPs makes POSA the simplest and quickest signal amplification technique that can spatially resolve the distribution of multiplexed proteins in single cells, with a 28- to 126-fold signal amplification effect. By this POSA method, for the first time, we demonstrate that the high brightness of FCPs can be used to strengthen the images of subcellular biomolecules and showcase the phenomenon of optical amplification of FCPs at the cellular level. Additionally, with its sensitivity, ease of use, and quick imaging features, the POSA technique proves to be a valuable tool for advanced biological research.

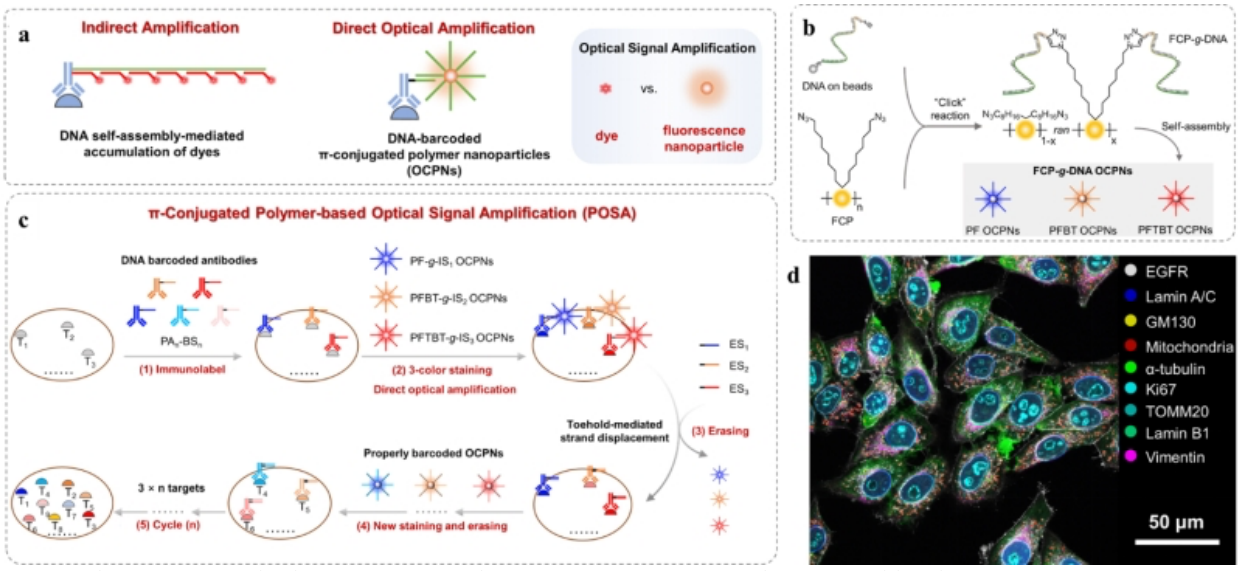

Figure 1. The principle of the π-conjugated polymer-based signal amplification (POSA) method.

[1] W. Zhang et al. **2025** *Nat. Commun.* 16, 2300.

Self-assembled Circularly Polarized Luminescent Aggregates

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Forming long-range ordered micro-/nanostructures through self-assembly is a widely used strategy to achieve chirality amplification in circularly polarized luminescence (CPL) materials. Meanwhile, aggregation-induced emission (AIE) molecules provide a new approach to overcome the low fluorescence quantum efficiency commonly observed in aggregated states. However, due to their intrinsically twisted molecular conformations, most AIE molecules do not easily form π–π stacking structures, and the regulation of their properties as well as the investigation of the underlying mechanisms remain challenging. Based on our previous work, [1-3] we selected the 9,10-distyrylanthracene (DSA) structural unit for molecular modification. Under aqueous solvent assembly conditions, equivalent hydrophilic–hydrophobic interactions were introduced on both sides of the molecule, and a DSA-centered CPL system was successfully constructed through a “clamping-embedding” strategy. The system not only exhibits relatively excellent chiral and luminescent properties, but is also strongly influenced by the solvent environment. By varying the water fraction, significant CPL amplification as well as multiple signal inversions can be observed. Morphological characterization and single-crystal structure analysis indicate that such variability most likely originates from differences in the assembled structures under different environments, namely variations in intermolecular interactions. In addition, in a water-free tetrahydrofuran/methanol system, the molecule can also form assemblies with diverse morphologies by tuning the solvent ratio, leading to distinct CPL emissions. This work provides valuable insights for expanding the AIE molecular platform for CPL materials, constructing new intelligent chiral luminescent systems, and understanding the mechanism of chirality generation and amplification in aggregated states.[4]

[1] Feng. J, Gu. Z et al. **2021** *J. Phys. Chem. C*, 125, 21270.
[2] Gu. Z, Ma. W et al. **2023** *Macromol. Rapid Commun.*, 44, 2300428.
[3] Gu. Z, Ma. W et al. **2023** *J. Phys. Chem. Lett.*, 14, 6437.
[4] Wang. M, Song. Y et al. **2026** *Chem. Commun.*, 62, 3334.

Directed Growth of Functional Helical Aggregates in Chiral-Nematic Liquid Crystal Polymer Films by Photo-Gradient Polymerization

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Aggregation and self-organization of molecules in the condensed phase often generate emergent functions that are inaccessible at the single-molecule level. Chiral-nematic liquid crystals (N* LCs) are a representative soft condensed-matter system, in which molecular aggregation and cooperative alignment spontaneously produce helical superstructures with periodic refractive-index modulation. These functional aggregates exhibit unique photonic properties, including selective reflection, diffraction, and polarization conversion. However, precise control of helical-axis orientation in polymeric N* LC aggregates, especially uniaxial in-plane alignment, has remained a significant challenge. Here we report a simple strategy for creating functional photonic aggregates in N* LC polymer films by photo-gradient polymerization. An N* LC monomer mixture was polymerized in a homeotropic alignment cell under a spatial light-intensity gradient. This process generated a spatial gradient in polymer concentration and, consequently, a chemical potential gradient across the film, which induced a directional isotropic-to-N* LC phase transition during slow cooling. As a result, the helical aggregates grew in a directed manner and formed ordered uniaxial in-plane helical-axis alignment over a wide area.[1]

A notable feature of this method is that the spatial organization of the aggregate structure can be programmed by the light-gradient profile. This enables two-dimensional control of helical-axis alignment without electric or magnetic fields, surface patterning, or post-alignment treatments. Thus, photo-gradient polymerization provides a versatile route to controlling not only polymerization but also the growth direction and mesoscale order of functional soft aggregates. Furthermore, these aligned N* LC aggregates can be extended to freestanding elastomer films that exhibit anisotropic mechano-optical responses. Upon tensile deformation, the diffraction angle changes systematically in response to deformation of the helical superstructure, while polarization-related optical functions are retained.[2] Our results show that molecular aggregation in chiral liquid-crystalline polymers can be directed into highly ordered helical superstructures with emergent photonic and mechano-optical functions. This study highlights a new aspect of aggregate science, in which controlling the formation, directed growth, and mesoscale ordering of soft molecular aggregates leads directly to advanced functional materials.

[1] Y. Shikata et al. **2025** *Small Structures*, 6, 2400458.
[2] Y. Shikata et al. **2025** *Small Structures*, e202500553.

Carbohydrate-Functionalized Nanoclusters: Synthesis, Ligand-Induced Chirality, and Antimicrobial Activity

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Atomically precise nanoclusters exhibit molecule-like electronic structures and tunable photophysical properties, making them attractive for AIE and biomedical applications. We are interested in carbohydrate-capped nanoclusters for biomedical applications due to the many attractive features of carbohydrates as capping ligands. Here, we report a one-step synthesis of a trehalose-capped nanocluster, $Au_{25}Tre_{18}$, under mild conditions. The nanocluster was characterized by mass spectrometry, optical spectroscopy, and NMR including DOSY. $Au_{25}Tre_{18}$ displays distinct chiroptical activity, suggesting ligand-induced asymmetry. Upon activation with thiourea (TU), otherwise inactive glyco-nanoclusters become potent antimicrobials, and the antimicrobial activity is ligand dependent. $Au_{25}Tre_{18}$/TU shows enhanced activity against *Mycobacterium smegmatis*, achieving complete bacterial eradication at 1×MIC, whereas bacteria treated with $Au_{25}SG_{18}$/TU at the same concentration continued to grow. TU activation of maltose-capped nanoclusters led to broad-spectrum antimicrobial activity, including multidrug-resistant *Pseudomonas aeruginosa* (MIC = 1 μg/mL). Mechanistic studies indicate that TU promotes gold uptake and stabilizes Au(I), leading to multiple antibacterial pathways, including thioredoxin reductase inhibition, disruption of metal homeostasis, and ATP depletion. Furthermore, the activity is unaffected by membrane barriers or efflux pumps.

[1] W. Ndugire et al. **2023** *Angew. Chem. Int. Ed.*, *62*, e202214086.
[2] M. P. Bodiuzzaman et al. *Manuscript under review.*

Cyclic trimidazole pyridine derivatives: a new platform for the preparation of Cu(I) luminescent derivatives

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Triimidazo[1,2-*a*:1',2'-*c*:1",2"-e][1,3,5]-triazine (**TT**) is a nitrogen rich molecule characterized by an intriguing aggregation induced photophysical behavior comprising intense fluorescence and ultralong room temperature phosphorescence (RTUP) in the crystalline state.[1] Due to the C_{3h} symmetry associated with the triazinic central ring and three annelated imidazoles with three nitrogen atoms available for coordination, **TT** behaves as versatile ligand for coordination towards different metal ions. Different studies[2-4] revealed the ability of **TT** to coordinate as mono-, bi- and tri-dentate, leading to luminescent metal complexes and coordination polymers (CPs). The coordination properties of **TT** are enhanced in **TT2Py** where the insertion of a pyridinic moiety allows both terminal and chelating coordination modes[5] (Figure 1).

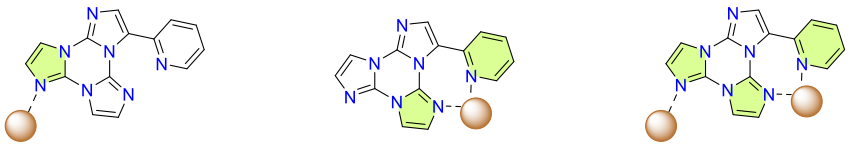

*Figure 1. **TT2Py** monodentate (left), bidentate chelate (center) and tridentate chelate (right) coordination modes.*

The multidentate nature of **TT2Py** is here exploited to isolate, by reaction with CuI in slightly different reaction conditions, three strongly luminescent Cu(I) compounds of formula $[Cu_2I_2(\mathbf{TT2Py})]_n$, $[Cu_2I_2(\mathbf{TT2Py})]_2$ and $[CuI(\mathbf{TT2Py})]_n$. More specifically, an orange emitting one-dimensional coordination network,[6] a green emitting dimeric complex and a yellow emitting two-dimensional coordination network have been obtained. The excitation-dependent photoluminescent behaviour of the three derivatives is interpreted through structural, optical and computational investigations.

[1] E. Lucenti et al. **2017** *J. Phys. Chem. Lett., 8*, 1894 -1898.
[2] E. Lucenti et al. **2019** *Cryst. Growth Des.*, *19*, 1567-1575.
[3] D. Malpicci et al. **2021** *Inorg. Chem. Front., 8*, 1312 -1323.
[4] E. Cariati et al. **2019** *Chem. Asian J., 14*, 853 - 858.
[5] D. Malpicci et al. **2023** *New J. Chem., 47*, 21463 - 21474.
[6] D. Malpicci et al. **2023** *Crystals*, *13*, 149-149.

Polar Aggregation of Subphthalocyanines for Ultrafast Photothermal Conversion

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Macroscopic polar materials refer to noncentrosymmetric molecules that spontaneously or under external forces (such as electric or magnetic fields) assemble into polar aggregates. In recent years, organic small-molecule materials with macroscopic polarity have garnered increasing attention and achieved significant progress. This study focuses on bowl-shaped subphthalocyanines, organic conjugated semiconductors characterized by substantial dipole moments and strong visible light absorption, offering promising potential for expanding the application domains of organic macroscopic polar materials.

Through precise modulation of intermolecular non-covalent interactions, we have successfully overcome the general tendency of organic polar conjugated materials to form non-polar assemblies through dipole cancellation. We have developed a series of macroscopic polar aggregrates, including single crystals, co-crystals, and liquid crystals, based on bowl-shaped subphthalocyanine (Figure 1). Furthermore, we have explored their potential applications in photovoltaic conversion and photothermal conversion.

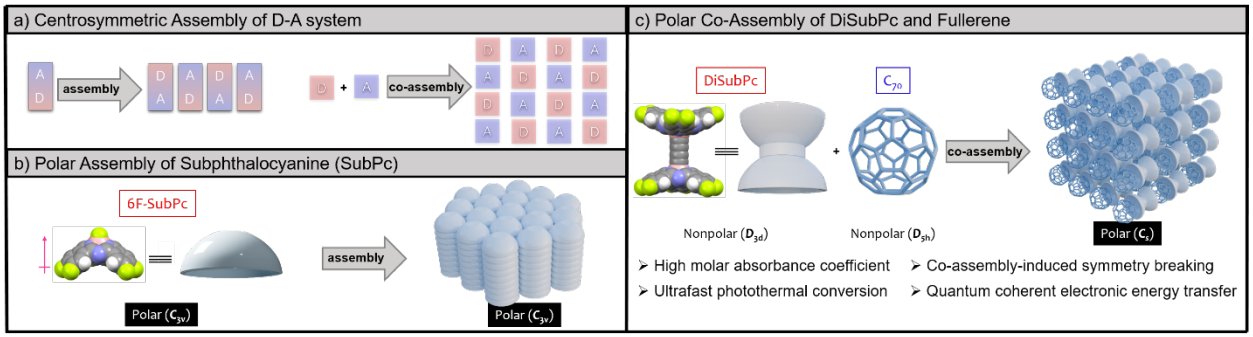

Figure 1. Polar assembly of bowl-shaped subphthalocyanines.

[1] C. Zhang et al. **2026** *Nat. Photon.* Accepted.
[2] C. Zhang et al. **2020** *J. Am. Chem. Soc.* 142, 3326.
[3] C. Zhang et al. **2021** *Angew. Chem. Int. Ed.* 60, 3261.

Organic Luminophores Based on Through-Space Conjugation

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Traditional organic luminescent materials typically rely on through-bond conjugation (TBC) within rigid structures to promote π-electron delocalization, thereby achieving high fluorescence quantum yields and tunable emission wavelengths. However, in recent years, anomalous visible-light emission has been observed in non-TBC systems lacking π-electrons, such as polyethylene glycol and polyethylenimine, overturning the conventional understanding of organic luminescence mechanisms. To address this scientific challenge, our team has designed and synthesized a new class of multiarylalkane systems, systematically exploring a novel luminescence mechanism driven by through-space conjugation (TSC). In this talk, the underlying mechanism and structure–property relationships of TSC will be elaborated, followed by demonstrations of how this principle enables the construction of new organic luminophores, including the development of the smallest known near-infrared organic emitter to date.

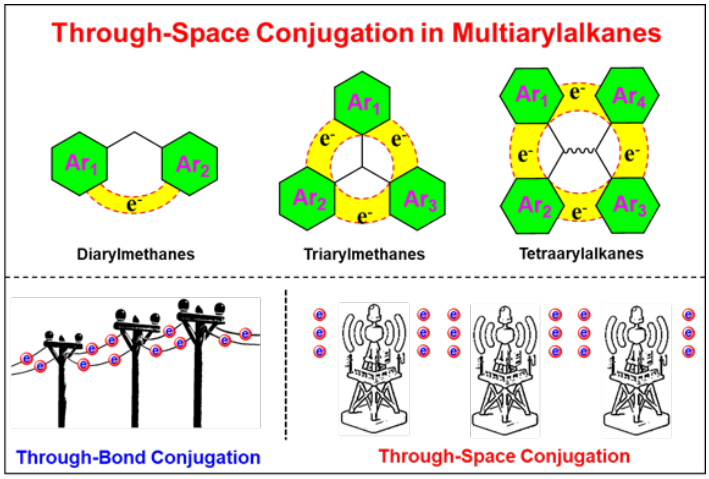

Figure 1. Illustration of the through-space conjugation in multiarylalkanes

[1] Q. Xu, J. Zhang, J.Z. Sun et al. **2024** *Nat. Photon.*, 18, 1185.
[2] Z. Xiong, X. Liu, Z. Zhang et al. **2026** *Chem*, 12, 102858.
[3] Z. Xiong, J. Zhang, L. Wang et al. **2025** *Chem*, 11, 102299.
[4] Y. Wang, J. Zhang, Q. Xu, et al. **2024** *Nat. Commun.*, 15, 6426.
[5] Z. Xiong, J. Zhang, J.Z. Sun et al. **2023** *J. Am. Chem. Soc.*, 145, 21104.

Synthesis and Application Exploration of NIR-II Aggregate Materials

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Developing photofunctional materials in the second near-infrared window (NIR-II) has become a key strategy for advancing biomedical imaging and precision therapy. Leveraging the unique advantages of the NIR-II optical window, including deep tissue penetration, low background autofluorescence, and high spatial resolution, we conducted systematic molecular engineering to create a series of high-performance NIR-II theranostic agents, enabling broad use across biomedical applications.[1–6] In tumor theranostics, these NIR-II agents support high-accuracy deep-tissue fluorescence imaging and can work synergistically with photothermal therapy (PTT) and photodynamic therapy (PDT) for efficient tumor identification and precise ablation. We further integrated NIR-II materials into surgical sutures to enable postoperative antibacterial treatment and noninvasive, real-time monitoring of deep-tissue repair via their fluorescence signals, improving postoperative management and safety. In addition, by combining near-infrared materials with complementary absorption/emission spectra, we achieved dual-color fluorescence imaging across multiple organs, providing new tools for monitoring complex physiological processes and guiding surgery. Overall, the structural tunability, functional versatility, and broad applicability of these NIR-II photofunctional materials highlight their promise for integrated imaging and therapy, functional biomaterials, and intelligent theranostic systems.

[1] H. Xie et al. **2026** *J. Am. Chem. Soc.*, *148*, 1, 1072–1085.
[2] S. He et al. **2026** *J. Am. Chem. Soc.*, *148*, 1, 1513–1523.
[3] H. Xie et al. **2024** *J. Am. Chem. Soc.*, *146*, 18350–18359.
[4] W. Liu et al. **2025** *Adv. Funct. Mater.*, 2501668.
[5] H. Xie et al. **2025** *ACS Nano*, *19*, 43, 37511–37524.
[6] P. Xin et al. **2025** *ACS Nano*, *19*, 31, 28813–28826.

Molecular Knotting as a Platform for Topologically Chiral Lanthanide Photophysics

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Lanthanide complexes exhibit unique photophysical properties, including sharp emission bands, long excited-state lifetimes, and high color purity, making them attractive for applications in sensing, imaging, and optoelectronic materials. Introducing well-defined chiral environments around lanthanide centers is particularly appealing for generating circularly polarized luminescence (CPL), yet controlling the spatial organization of multiple lanthanide ions within a rigid and chiral ligand framework remains challenging.[1] Molecular knots[2] offer a distinctive strategy for organizing metal ions within topologically constrained architectures while simultaneously imposing global chirality.[3] In this talk, we will show a knotted ligand scaffold capable of incorporating a series of lanthanide ions directly into the backbone of a trefoil knot. Each metal center adopts a six-coordinate environment while retaining an accessible coordination site. The inherent topological chirality of the trefoil knot induces pronounced CPL activity in the resulting lanthanide complexes. Importantly, the remaining open coordination site enables selective binding of chiral amino acids, which modulates the local coordination environment and allows tuning of the luminescence properties.[4]

[1] E.G. Moore et al. **2009** *Acc. Chem. Res.*, *42*, 542–552.
[2] S. D. P. Fielden et al. **2017** *Angew. Chem. Int. Ed.*, *56*, 11166–11194.
[3] J. -F. Ayme et al. **2012** *Nat. Chem.*, *4*, 15–20.
[4] G. Zhang et al. **2015** *J. Am. Chem. Soc.*, *137*, 10437–10442.

Strategies for Enhancing Cancer Immunotherapy by Phototheranostics Aggregate

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Cancer immunotherapy has revolutionized clinical tumor treatment, yet its efficacy is severely limited by low response rates, immune-suppressive tumor microenvironments, and systemic immune-related adverse events. Phototherapy, including photodynamic and photothermal therapy, has emerged as a promising strategy to elicit antitumor immune responses via localized photonic intervention. However, conventional phototheranostic agents often suffer from poor photoconversion efficiency, aggregation-caused quenching, and limited immunogenicity, restricting their clinical translation. AIE-active materials offer unique advantages to overcome these challenges by exhibiting strong fluorescence and efficient ROS/heat generation in the aggregated state. This presentation focuses on the application mechanisms of AIE-based phototheranostic aggregates in cancer immunotherapy. We highlight how phototherapy activates innate and adaptive antitumor immunity, synergizes with immune agonists to amplify therapeutic outcomes, and induces regulated cell death to boost tumor immunogenicity.

[1] T. Zhang et al. **2023** *Angew. Chemie Int. Ed.*, *62*, e202211550.
[2] T. Zhang et al. **2025** *Adv. Mater.*, 2502898.
[3] T. Zhang et al. **2025** *J. Am. Chem. Soc.*, *147*, 7433.
[4] T. Zhang et al. **2023** *Adv. Sci.*, 2304042.
[5] T. Zhang et al. **2023** *Adv. Mater.*, 2303186.
[6] S. Ning et al. **2023** *ACS Nano*, *17*, 10206.

Understanding Biomolecular Condensates through Their Physical Microenvironments

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Biomolecular condensates formed by liquid-liquid phase separation are membraneless organelles that play important roles in many cellular processes and diseases. Proteins and RNAs, the main components of these condensates, each harbor unique physicochemical microenvironments—such as micropolarity and microviscosity—which help regulate condensate functions. However, how these physical properties shape condensate behavior and the underlying molecular mechanisms remains poorly understood. To address this, we developed a set of quantitative imaging methods to measure the microenvironments of proteins and RNAs within condensates. Using these tools, we systematically studied how ions and small molecules affect these properties. We found that these microenvironmental features are key factors in governing condensate structural organization, selective drug enrichment, and biomolecular activity. Together, this work provides new insights into the functional principles of membraneless organelles.

[1] Y. Pan et al. **2025** *J. Am. Chem. Soc.*, 147, 26, 22686.
[2] J. Ouyang et al. **2026** *Nat. Chem. Biol.*, 22, 593-603.
[3] L. Zhu et al. **2024** *J. Am. Chem. Soc.*, 146, 20, 14307–14317.
[4] S. Ye et al. **2024** *Nat. Chem. Biol.*, 20, 443–451.

Ultrastrong Through-Space Conjugation Enabled by Chiral Transfer-Driven Helical Structure

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A deep understanding and precise control of electronic structures with through-space conjugation (TSC) is crucial for both theoretical research and practical applications. While the working mechanism of TSC has been established in simple systems, the impact of secondary structures in more complex systems remains unclear. Here, two groups of chiral phenolic-resin derivatives with varying connecting sites of axial chiral spirocyclic phenolic monomer were synthesized, and their photophysical properties were systematically investigated (Figure 1). The transition from folded to helical molecular conformation was identified as having a critical role in increasing TSC strength. Specifically, helical **P2** exhibits efficient long-wavelength clusteroluminescence (CL) extending up to 600 nm, along with a high absolute quantum yield of 62%. Experimental and theoretical results revealed that the helical conformation within the prepolymer chains is fundamental in forming ultrastrong TSC, as it is more effective in reducing the interfragment distance compared to the folded conformation. This work uncovers secondary structure factors for controlling TSC, offering a novel and reliable strategy for designing nonconjugated luminogens with efficient CL in complex systems.

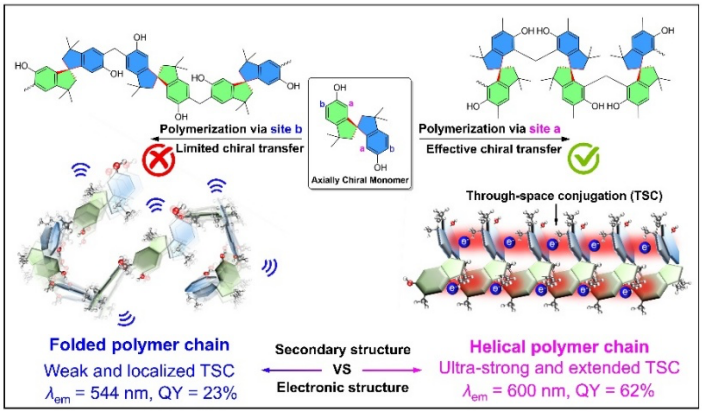

Figure 1. Summary of Chemical Structures and Photophysical Behaviors.

[1] Z. Zi Teng et al. **2026** *CCS Chemistry.,* 1-9.
[2] Z. Zi Teng et al. **2023** *Angew. Chem. Int. Ed., 62, e202306762.*

AIE Probes Based on Through-Space Interactions

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Molecular imaging technology based on organic optoelectronic functional materials can provide critical information for disease diagnosis, treatment, understanding disease mechanisms, and evaluating drug efficacy. However, in the complex aqueous environment of living organisms, organic optoelectronic molecules tend to spontaneously aggregate, forming assemblies with conformations and microenvironments distinct from their single-molecule forms. This aggregation often leads to changes in their properties, limiting their applications in revealing pathological mechanisms and enabling disease diagnosis and treatment at the cellular and in vivo levels.

In this presentation, we will focus on the mechanisms underlying the structural and property differences of biomedical optoelectronic molecules before and after aggregation, as well as their applications in precise diagnosis, treatment, and efficacy evaluation of major diseases. By elucidating the relationship between material properties at the microscopic and aggregate levels, and integrating stimulus-responsive design principles tailored to the complex physiological microenvironments at the cellular and in vivo levels, we have achieved controllable aggregation and activation of biomedical optoelectronic molecules at disease sites. This has enabled the construction of diagnostic, tracing, and therapeutic devices with excellent targeting capabilities, high biosafety, and significant therapeutic efficacy. Furthermore, we have advanced their applications in elucidating cellular physiological processes, disease diagnosis, and treatment.[1-4]

[1] W. Wang et al. **2024** *Nat Commun*, 15, 9999.
[2] K. Zhou et al. **2023** *Matter*, 6, 3449-3462.
[3] C. Xu et al. **2022** *Angew. Chem. Int. Ed.*, 21, e202204604.
[4] R. Dong et al. **2022** *Small Methods*, 6, 2101247.

pH-Triggered AIE-NIR Gold Nanoclusters for Targeted Two-Photon Phototherapy and Tumor Remodeling

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Traditional photodynamic therapy (PDT) is limited by oxygen dependence and poor efficacy in hypoxic tumors.[1] Herein, we report a biomimetic nanoplatform (AuNCs@DA/CM) that leverages lysosome-confined aggregation-induced emission (AIE) to regulate excited-state processes and amplify reactive species via a catalytic oxidative-to-nitrosative cascade (Figure 1). Upon lysosomal accumulation, pH-triggered aggregation of Au nanoclusters restricts intramolecular motion (RIM), activating AIE and enhancing two-photon-excited Type I photoreactivity for efficient superoxide (O_2•$^-$) generation under hypoxia.[2] Meanwhile, the AuNCs catalyze arginine conversion to nitric oxide (NO), which reacts with O_2•$^-$ to form highly cytotoxic peroxynitrite ($ONOO^-$), establishing a localized ROS-to-RNS amplification pathway that bypasses oxygen dependence. This lysosome-confined reactive burst induces membrane permeabilization and apoptosis, while promoting macrophage polarization toward an antitumor phenotype. Overall, this work demonstrates that aggregation-induced motion restriction can modulate excited-state dynamics and amplify photochemical reactivity, providing a general strategy for integrating AIE photophysics with catalytic nanomedicine for hypoxia-resistant cancer therapy.

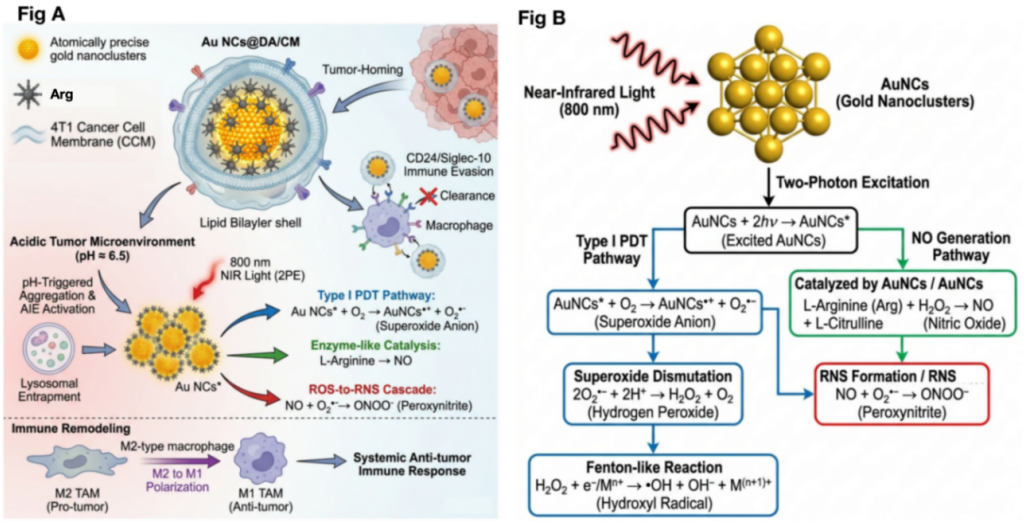

Figure 1. (A) The Design of Au NCs@DA/CM for tumor-targeted two-photon oxidative-to-nitrosative therapy. (B) Mechanistic illustration of ROS and RNS generation under two-photon excitation.

[1] J. An et al., **2022** *Nature Commun.*, 13, 2225.
[2] V. Juvekar et al., **2024** *Coord. Chem. Rev.*, 506, 215711.

Multifunctional AIE Hydrogel for Reconstructing Pro-Healing Microenvironment in Diabetic Wounds

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Currently, neither glucose-lowering nor antimicrobial monotherapy alone suffices to address the complex pathophysiology of diabetic wounds. Persistent hyperglycemia perpetuates local and systemic inflammation, compromises immune regulation, and promotes biofilm formation. These intertwined pathologies exacerbate persistent drug-resistant infections, leading to poor clinical outcomes and significant economic costs, thereby highlighting the urgent need for multidimensional therapeutic strategies that extend beyond glycemic control.[1, 2] In this work, we developed a multifunctional AIE-based hydrogel (AIEgel) with both glucose-responsive and light-responsive properties. In a hyperglycemic environment, the AIEgel released encapsulated AIE probes and glucose-lowering agents in a sustained manner. (1) The glucose-lowering components, together with the glucose-adsorbing matrix, helped alleviate local hyperglycemia. (2) Upon light irradiation, AIE probes generate reactive oxygen species (ROS), which not only inflict direct oxidative damage for efficient bacterial killing but also interfere with bacterial energy metabolism and downregulate quorum sensing-related gene expression. This suppresses intercellular communication and biofilm maturation, ultimately eradicating existing biofilms and preventing recolonization. (3) The AIE-mediated bactericidal activity and metabolic modulation of bacteria promoted macrophage M2 polarization, collectively re-establishing a pro-healing inflammatory microenvironment. Overall, this multifunctional AIEgel integrates glucose-responsive, metabolic and immunomodulatory microenvironment regulation capabilities, offering a promising therapeutic strategy for effective repair of diabetic wounds.

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[2] S. Khattak et al. **2025** *Aggregate*, 6, e688.