# **Denis FRATH**

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## • CURRENT POSITION

10/18 – present CNRS Associate Researcher (CRCN), French National Centre for Scientific Research, C Chemistry Laboratory (UMR 5182), ENS de Lyon, France

#### • **PREVIOUS POSITIONS**

02/18 - 09/18	Postdoctoral research associate, CNRS, IRCELYON (UMR 5256), France
	"Binuclear complexes for challenging catalytic reactions"
01/16 - 12/17	Postdoctoral research associate, Université Paris Diderot, ITODYS (UMR 7086), France
	"Redox-active molecular layers for electronic devices"
09/13 - 12/15	Postdoctoral research fellow, Physical Organic Chemistry Laboratory, Kyoto Univ. Japan
	"Photoresponsive supramolecular self-assembly studied by STM"

## • EDUCATION

- 2024 HDR in chemistry, ENS de Lyon, CNRS (UMR5182), France "Photoredox control of molecular metamorphism for the development of responsive supramolecular materials"
- 2013 PhD in chemistry, Université de Strasbourg, CNRS (UMR7515), France, <u>G. Ulrich</u> and <u>R. Ziessel</u> *"New fluorescent borate complexes: syntheses, properties, applications"*
- 2009 MSc in organic chemistry, Université de Rouen INSA Rouen, France
- 2009 Engineer's degree in fine chemistry, INSA Rouen, France

## • FELLOWSHIPS AND AWARDS

- 2024 Young researcher prize, photochemistry subdivision of the Société Chimique de France
- 2023 Laureate of the *EMERGENCE*@International Program of the CNRS Chemistry Institute
- 2018 Admission as CNRS researcher, section 12, ranked n°1, 5 positions/ca. 80 applicants
- 2015 CSJ presentation award, 95th Annual Meeting of the Chemical Society of Japan
- 2014 Japan Society for the Promotion of Science post-doctoral fellowship, 120 awardees/1285 applicants
- 2013 Attendee at the 63<sup>rd</sup> Lindau Nobel Laureate Meeting (Chemistry), 625 attendees/22000 applicants
- 2009 MENRT PhD fellowship (French government)

## • SUPERVISION OF STUDENTS

2018 - 2024	6 PhD, 9 MSc2, 2 MSc1 and 2 BSc3 Students, ENS de Lyon
2016 - 2017	1 PhD, 1 MSc2 and 1 MSc1 Students, Université Paris Diderot
2011 - 2012	1 MSc2 Student, Université de Strasbourg

## • TEACHING ACTIVITIES

2021–2023 General Chemistry Practical Classes, BSc 3 (24 h), ENS de Lyon
2016 Organic Chemistry Lessons, BSc 1 (30 h), Université Paris Diderot, France

## • INSTITUTIONAL RESPONSIBILITIES

2024 - present	Leader of the Supramolecular Chemistry and Chemical Biology Group
2024 - present	Member of the Board of Direction, Chemistry Laboratory, ENS de Lyon, France
2022 - present	Member of the Board of the GDR New Molecular Electronics (NEMO)
2021 - 2024	Self-assembly theme animator, Chemistry Laboratory, ENS de Lyon, France
2021 - 2024	Safety assistant, Chemistry Laboratory, ENS de Lyon, France
2020 - 2024	Member of the Premises Board, Chemistry Laboratory, ENS de Lyon, France
2019 - 2024	Member of the Laboratory Council, Chemistry Laboratory, ENS de Lyon, France

## • COMMISSIONS OF TRUST

Recruitment	Member of assistant professor recruitment commission, Université Paris Cité, 2024
	Member of ATER recruitment commission, ENS de Lyon, 2019
Grant evaluation	ANR AAP 2023 and 2024: 4 PRC (1 CE07, 2 CE29, 1 CE50)
	Labex CHARM <sub>3</sub> AT AAP 2022: 1 (Axe D)
Peer review	Reviewer for Chem. Eur. J. (1), Nanomaterials (2), ChemPhysChem (1) and
	Luminescence (1)

## • ORGANISATION OF SCIENTIFIC MEETINGS

- 3<sup>rd</sup> NEMO Annual Meetings « New molecular electronics », 14 – 16 Oct. 2024, INIST-CNRS Nancy
- 2<sup>nd</sup> NEMO Annual Meetings « New molecular electronics », 16 – 18 Sept. 2023, IEMN Lille
- 1<sup>st</sup> NEMO Annual Meetings « New molecular electronics », 26 – 27 Sept. 2022, Université Paris Cité
- 10<sup>th</sup> International Conference on Molecular Electronics (ElecMol), 29 Nov. – 2 Dec. 2021, ENS de Lyon
- 3<sup>rd</sup> MAPYRO Symposium « porphyrins and beyond », 14 Nov. 2019, ENS de Lyon, France

## • SCIENTIFIC ACTIVITIES

My research activities at the Chemistry Laboratory of ENS Lyon focus on the synthesis and study of  $\pi$ conjugated molecules with optical and electrochemical properties. I am also interested in their property of supramolecular self-assembly and their use for the development of functional materials with switchable properties. My skills and areas of expertise cover organic synthesis, supramolecular chemistry, physical chemistry techniques (spectroscopy, photochemistry, electrochemistry), soft materials (gels, liquid crystals) and surface science (scanning tunneling microscopy, self-assembly in monolayers, electrochemical grafting). While in Japan, I have coordinated a JSPS grant dealing with supramolecular self-assemblies at the liquid/solid interfaces (ca. 20 k€ in 2014-15). Since I started my independent career, I have also managed funding from CNRS and Idexlyon to work on photo-responsive gels in collaboration with the Physics Laboratory of ENS Lyon (ca. 9 k€ in 2019). I am currently involved as member of several projects consortium for which I am in charge of the characterization of photo-induced processes and photochemical reactions involved in supramolecular materials sol-gel transition (ANR PRC 376 k€, Labex iMUST 90 k€ and CNRS MITI, 35 k€) or in nano-rings supramolecular architectures (ANR PRC 370 k€). I also participate to electrochemical and spectroscopic characterization of metal complexes and Metal-Organic Framework for application in the electrochemical reduction of CO<sub>2</sub> (Pack Ambition International AuRA, 60 k€). I recently obtained an ANR JCJC grant during the AAPG 2022 (204 k€) and a FdR ENSL (60 k€) in order to initiate a new research activity at the Chemistry Laboratory of ENS Lyon from January 2023 on chiroptical switches for the modulation of on-surface circularly polarized luminescence. I have also initiated several international collaborations with Japan in the frame of the Pack Ambition International funding from the Auvergne-Rhône-Alpes region that I coordinate (40 k€, collaboration Kyoto Univ., NAIST Nara, ILM Lyon) and the International Research Project POEMES (CNRS Physics, Coord. G. Rapenne, Collab. Kyoto Univ., NAIST Nara, NIMS Tsukuba, CEMES Toulouse, IPCM Paris).

#### • **BIBLIOMETRIC INDICATORS**

#### - h-index: 18, i10-index: 23

- 1 book chapter and 33 articles in peer-reviewed journals: J. Am. Chem. Soc. (4), Angew. Chem. Int. Éd, Nano Lett., Nanoscale, J. Mater. Chem. C (2), Chem. Commun. (2), Org. Lett. (3), Chem. Eur. J. (3), Electrochim. Acta, Inorg. Chem., J. Org. Chem., ChemPhotoChem, ChemPhysChem, ChemElectroChem (2), J. Photochem. Photobiol. C, J. Phys. Chem. B, J. Phys. Chem. C (2), Eur. J. Org. Chem., Org. Biomol. Chem., J. Porphyrins Phthalocyanines, ECS Adv., ECS J. Solid State Sci. Technol.

- Most papers are High Profile (3 covers or front pages; average IF = 5.78 and 50 citations)

- Total number of citations: 1700 (OpenAlex, September 2024)

- **32 talks** including 14 invited seminars at research institutes, 4 invited lectures, 10 communications and 4 posters at conferences

## • MAJOR COLLABORATIONS

France - T. Gibaud, S. Maneville, Laboratoire de Physique de l'ENS de Lyon Electron-Responsive Supramolecular Soft-materials - S. Guy, B. Baguenard, A. Bensalah-Ledoux, ILM, Université Lyon 1 Boron-based Fluorophores with Circularly Polarized Luminescence Properties - D. Bardelang, A. Kermagoret, D. Siri, ICR, Aix Marseille Université Synthesis of e<sup>-</sup>-Deficient Conjugated Nanorings by Host-guest Templates - N. Mezailles, M. Boutignon, LHFA, Université Toulouse III; S. Bellemin-Laponaz, A. Maisse-François T. Achard, IPCMS, Université de Strasbourg, N<sub>2</sub> Functionalization using a family of (XCX)M complexes - E. Saint-Aman, DCM, Université Grenoble Alpes  $\pi$ -conjugated radicals for the construction and redox control of organized molecular assemblies - J.-C. Lacroix, X. Sun, P. Martin, F. Lafolet, ITODYS, Université Paris Cité; I. Hnid, S. Lenfant, IEMN, Université de Lille ; Stimuli-responsive Molecules for Surface Functionalization and Molecular Electronics Brésil - J.-F. G. Demets, A.P. Ramos, E. Triboni, Universidade de São Paulo Photophysical and electrochemical study of organic semiconductor gels - M. Murugesu, University of Ottawa; S. Chardon, Université Grenoble Alpes Canada Porous Coordination Polymers for the Electrochemical Reduction of CO<sub>2</sub> Japon - K. Matsuda, D. Shimizu, Kyoto University, Graduate School of Engineering Self-Assembled Monolayers on Surface Based on Chiroptical Building Blocks - T. Hirose, Kyoto University, Institute for Chemical Research Helicene based CPL Emitters for On-surface Applications - H. Yamada, Y. Mitsuaki, Kyoto University, Institute for Chemical Research Electrochemical Properties of Pentacene Photosynthesized on Electrodes - T. Kawai, M. Louis, Nara Institute of Science and Technology, (Supra)molecular Architectures with Chiroptical Properties

## • SELECTED PUBLICATIONS

10. Chiral and Conductive Viologen-based Supramolecular Gels Exhibiting Tunable Charge-Transfer Properties. V. Andrieux, T. Gibaud, J. Bauland, T. Divoux, S. Manneville, S. Guy, A. Bensalah-Ledoux, L. Guy, F. Chevallier, <u>D. Frath</u>, C. Bucher, J. Mater. Chem C. **2023**, 11, 12764-12775 (10.1039/D3TC02076B).

9. Photoredox Processes in the Aggregation and Gelation of Electron-responsive Supramolecular Polymers Based on Viologens. C. Roizard, V. Andrieux, S. Al Shehimy, S. Chowdhury, Q. Reynard-Feytis, F. Chevallier, C. Bucher, T. Gibaud, <u>D. Frath</u>, ECS Adv. **2022**, *1*, 020502 (10.1149/2754-2734/ac6ad4) {hal-03722425}

8. Light-controlled aggregation and gelation of viologen-based coordination polymers. S. Chowdhury, Q. Reynard-Feytis, C. Roizard, D. Frath, F. Chevallier, C. Bucher, T. Gibaud, J. Phys. Chem. B. 2021, 125, 12063–12071 (10.1021/acs.jpcb.1c06090) {hal-03374166}

7. Highly Efficient Photoswitch in Diarylethene-Based Molecular Junctions. I. Hnid, <u>D. Frath</u>, F. Lafolet, X. Sun, J.-C. Lacroix, J. Am. Chem. Soc. **2020**, 142, 7732–7736 (10.1021/jacs.0c01213) {hal-03206807}

6. *Photo/Redox-Responsive 2D-Supramolecular Assembly Involving Cucurbit[8]uril and a Star-Shaped Porphyrin Tecton.* S. Chowdhury, Y. Nassar, L. Guy, <u>D. Frath</u>, F. Chevallier, E. Dumont, A. P. Ramos, G. J.-F. Demets, C. Bucher, *Electrochim. Acta*, **2019**, *316*, 79–92 (10.1016/j.electacta.2019.05.077) {hal-02146626}

5. *Highly Efficient Long-Range Electron Transport in Viologen-based Molecular Junction*. V. Q. Nguyen, P. Martin, <u>D. Frath</u>, M. L. Della Rocca, F. Lafolet, S. Bellinck, P. Lafarge, J.-C. Lacroix, *J. Am. Chem. Soc.* **2018**, *140*, 10131–10134 (10.1021/jacs.8b05589) {hal-01946033}

4. Vectorization and Intracellular Distribution of a Two Photon- Absorbing, Near Infra-Red (NIR) Emitting  $\pi$ -Extended Boranil Dye. <u>D. Frath</u>, P. Didier, Y. Mély, J. Massue, G. Ulrich, *ChemPhotoChem* **2017**, *1*, 109–112 (10.1002/cptc.201700012) {hal-02001853}, selected as Cover Picture

3. Polyanils and polyboranils: Synthesis, Optical Properties and Aggregation-Induced Emission. <u>D. Frath</u>, K. Benelhadj, M. Munch, J. Massue, G. Ulrich, J. Org. Chem. **2016**, 81, 9658–9668 (10.1021/acs.joc.6b01756) {hal-02001847}

2. Diarylethene Self-Assembled Monolayers: Cocrystallization and Mixing-Induced Cooperativity Highlighted by Scanning Tunneling Microscopy at the Liquid/Solid Interface. <u>D. Frath</u>, T. Sakano, Y. Imaizumi, S. Yokoyama, T. Hirose, K. Matsuda, *Chem. Eur. J.* **2015**, *21*, 11350–11358 (10.1002/chem.201500804) {hal-01916046}, selected as Full Papers Frontispiece

1. *Luminescent materials: Locking*  $\pi$ *-conjugated and heterocyclic ligands with boron (III)*. <u>D. Frath</u>, J. Massue, G. Ulrich, R. Ziessel, *Angew. Chem., Int. Ed.* **2014**, *53*, 2290–2310 (10.1002/anie.201305554) {hal-02001845}

# • INVITED LECTURES

4. *Metamorphic Supramolecular Materials: Towards Switches for Chiroptical Properties.* Institute for Chemical Research Symposium, Kyoto, Japon, Oct. 2024

3. *Boranils: from the origins to the metamorphic control of chiroptical properties.* 3<sup>rd</sup> International Symposium on Photonic and Electronic Molecular Machines, Nara, Japon, Oct. 2024

2. *Synthetic versatility of Boranils: from the origins to the chiroptical properties.* Journée de Chimie Organique Victor Grignard, Lyon, France, Sept. 2024

1. *Photoinduced Electron Transfer as a Trigger for Molecular and Supramolecular Metamorphism.* 6<sup>th</sup> International Workshop on Nano and Bio-Photonics, Annecy, France, Sept. 2022

## • SELECTED COMMUNICATIONS AT INTERNATIONAL CONFERENCES

4. *Photo/Redox-responsive Supramolecular Materials Based on Viologens*. 10<sup>th</sup> International Symposium On Photochromism, Nara, Japan, Nov. 2023

3. Viologen  $\pi$ -Dimerization as Trigger for Metamorphism in Supramolecular Stimuli-Responsive Materials. 6<sup>th</sup> Ed. Smart Materials and Surfaces, Milan, Italy, Oct. 2021

2. *Photo/Redox Control of*  $\pi$ -*Dimerization as a Trigger for Molecular and Supramolecular Metamorphism.* 9<sup>th</sup> International Symposium On Photochromism, *Nanosynergetics Workshop*, Paris, France, Sept. 2019

 Diarylethene Self-Assembled Monolayers: Cocrystallization and Mixing-Induced Cooperativity Highlighted by Scanning Tunneling Microscopy at the Liquid/Solid Interface.
 95<sup>th</sup> Annual Meeting of the Chemical Society of Japan, Tokyo, Japan, March 2015 CSJ presentation award