ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

Area of Organic Chemistry

Dept. of Industrial Chemistry
University of Bologna

Area of Organic Chemistry – staff

Mauro Comes Franchini	full professor
Andrea Mazzanti	full professor
Paolo Melchiorre	full professor
Giorgio Bencivenni	associate professor
Luca Bernardi	associate professor
Carla Boga	associate professor
Mariafrancesca Fochi	associate professor
Erica Locatelli	associate professor
Michele Mancinelli	associate professor
Paolo Righi	associate professor
Letizia Sambri	associate professor
Ciro Romano	RTD-A
Cecilia Sasso D'Elia	laboratory technician
Riccardo Ocello	laboratory technician

PhDs: 6-7; post-docs: 4-5; post-grad grants; 1-2; Master internships: 8-10

Main area and department research facilities

- NMR spectrometers (2 x 400 MHz, 2 x 600 MHz)
- Analytical HPLC with chiral stationary phase
- Preparative HPLC also with chiral stationary phase
- HPLC-MS
- GC-MS
- VCD-ECD
- MS spectrometers (GC-MS, ESI, MALDI-TOF)
- Single-crystal X-Ray diffractometer (access to powder XRD)

Topics & Laboratories

- Development of new catalytic enantioselective reactions (OCSA Bernardi-Fochi)
- «Blue chemistry»: marine biopolymer gels in catalysis (OCSA Bernardi-Fochi)
- Synthesis and Spectroscopic Characterization of Atropisomeric Organic Molecules Useful as Catalysts in Photochemistry: Investigation of Physicochemical Properties (OCSA – Mancinelli – Mazzanti)
- Synthesis of Organic Molecules for Applications of Interest such as OLEDs or Photovoltaic Panels (OCSA – Mazzanti – Mancinelli)

- Synthesis of compounds as anticancer agents and related studies on their drug delivery (Boga)

Topics & Laboratories

- **New organocatalytic enantioselective vinylogous reactions (Bencivenni-Righi)**
- **Organocatalytic enantioselective formation of atropisomers (Bencivenni-Righi)**
- **Study of organic reaction using computational methods (Bencivenni-Righi)**

- **Making chiral molecules using organocatalysis, photocatalysis, and enzymes (Asymmetric Catalysis and Photochemistry Lab / Melchiorre)**

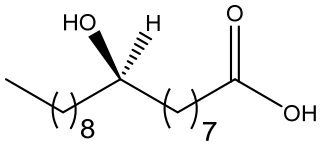
- **Additive Manufacturing (3D-Printing) (ASOM-Comes-Sambri-Locatelli)**
- **Bio-Gels for biomedicine and catalysis (ASOM-Comes-Sambri-Locatelli)**
- **Theranostic: Therapeutic + Diagnostic (ASOM-Comes-Sambri-Locatelli)**
- **Sensing for organic electronics (ASOM-Comes-Sambri-Locatelli)**

Research topics – (Boga)

Synthesis of compounds as anticancer agents and related studies on their drug delivery

Synthesis of (*R*)-9-hydroxystearic acid [(*R*)-9-HSA] and its derivatives

(*R*)-9-HSA can be obtained in high yield from *Dimorphotheca sinuata* seed oil through a simple multistep procedure.

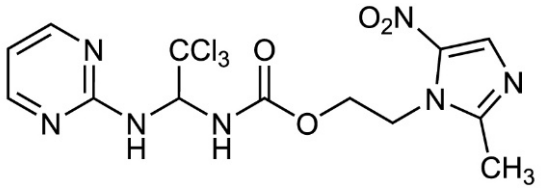


(*R*)-9-hydroxystearic acid

(*R*)-9-HSA is an endogenous cellular lipid that, when administered to different human cancer cell lines (colon, bone, leukemia cells, etc.) produces tumor cell growth arrest without effect on normal cell lines.

It acts as an inhibitor of enzymes belonging to the hystone deacetylase classes. Along the years, we focused on its drug-delivery: it has been succesfully inserted in hydroxyapatite nanoparticles (*Langmuir* 2016), Keratin nanoparticles (*Mol Pharm* 2019) and magnetite nanoparticles (ACS Omega 2020). Insertion of (*R*)-9-HSA in alginate and chitosane matrix has been recently studied. Further, since 5-HSA also has interesting antiproliferative activity against cancer cell lines (Molecules 2022) the synthesis of structural hybrids bearing the 5-HSA scaffold has been started.

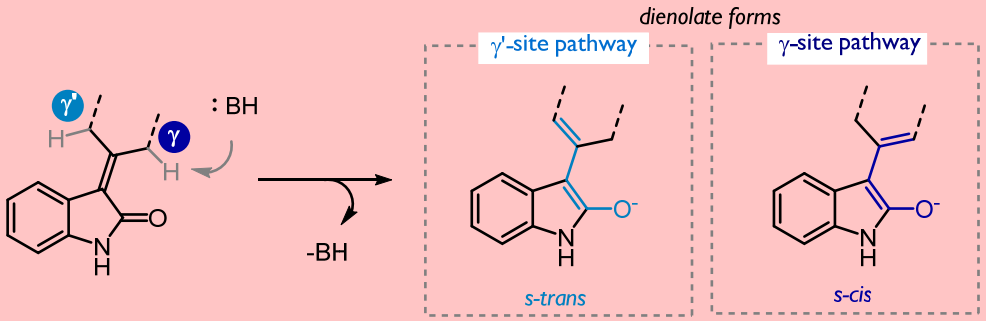
Synthesis of APCIN analogues



Recent studies have been devoted also on the synthesis of novel compounds as substitutes of APCIN in the treatment of acute myeloid leukemia.
The synthesis of 5 novel derivatives has been realized and biological investigation on them is underway in collaboration with biochemists.

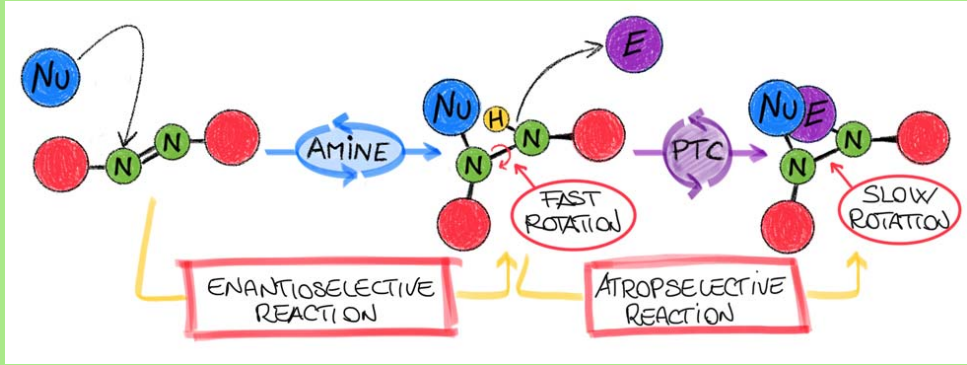
Research topics – ORG (Bencivenni*-Righi)

1 - New organocatalytic enantioselective vinylogous reactions:



1 PhD student
1-3 Master (6-9 months) students
1 Bachelor (3-6 months) students
1 post-doc

2 – Organocatalytic enantioselective formation of atropisomers:



3-Collaboration with fine chemical SMEs:

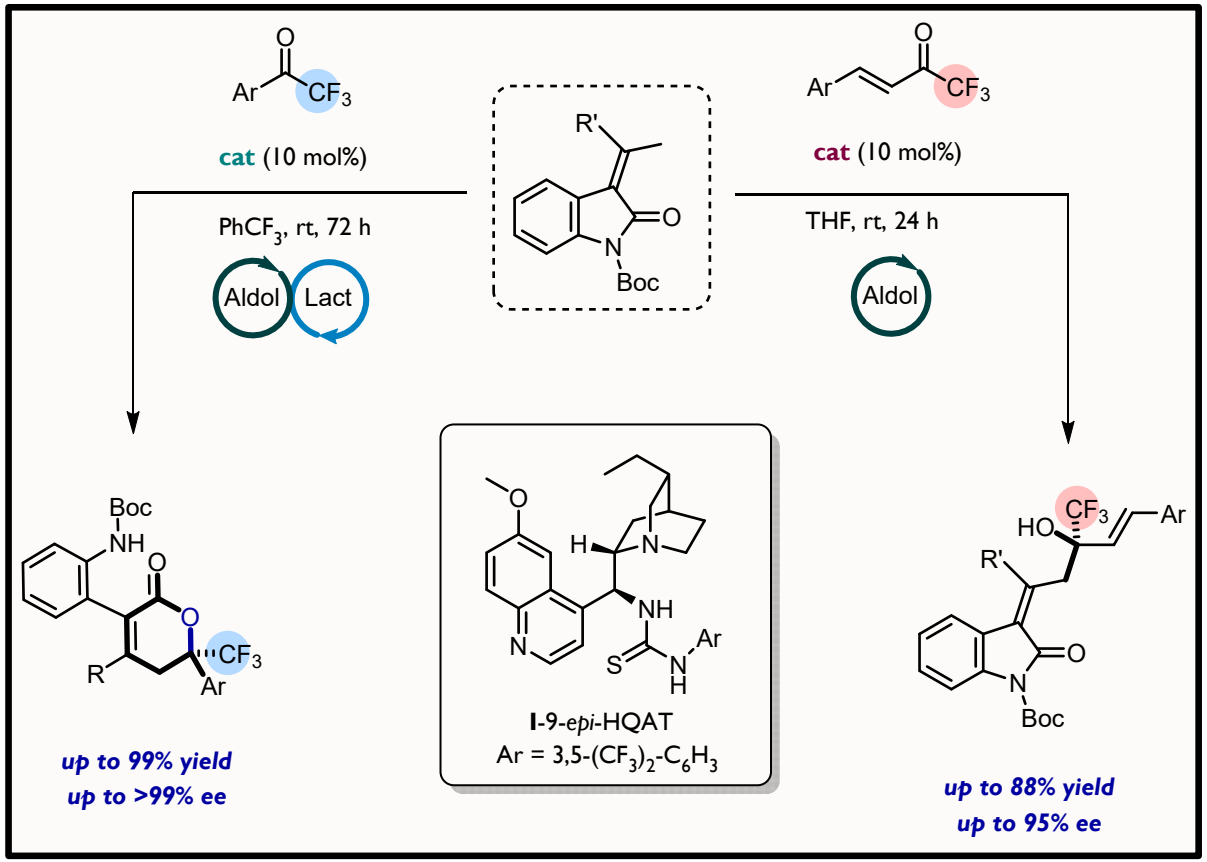
FATRO S.p.A. - Veterinary Pharmaceutical Industry
40064 Ozzano dell'Emilia (BO) Italy

Endura S.p.A. - PBO and synthetic pyrethroids
Headquarters in Bologna, manufacturing and R&D in Ravenna

Research topics – (Bencivenni-Righi)

1) New organocatalytic enantioselective vinylogous reactions:

- Vinylogous reactivity is a valuable strategy for the remote modification of a molecule.
- Vinylogous addition of alkylidene oxindole on aryl trifluoromethyl ketone resulted in a rare aldol reaction-lactonization cascade. The reaction, catalyzed by a bifunctional tertiary amine, provides an efficient entry to enantioenriched trifluoromethylated a,β-unsaturated δ-lactones.
- The addition on a,β-unsaturated trifluoromethyl ketones provided an efficient preparation of enantioenriched trifluoromethylated allylic alcohols

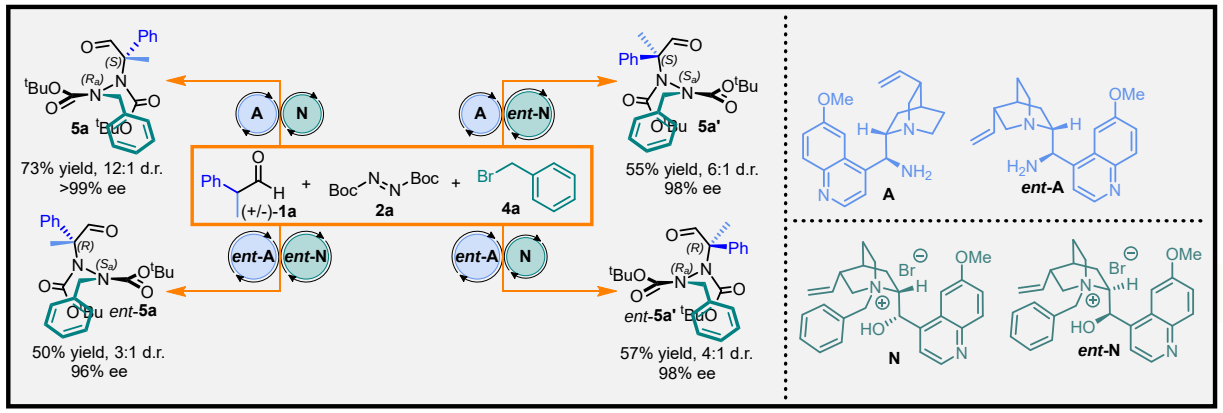


Bencivenni, et al. *J. Org. Chem*. **2018**, *83*, 12440.
Bencivenni, et al. *RSC Adv.*, **2018**, *8*, 33451

Research topics – (Bencivenni-Righi)

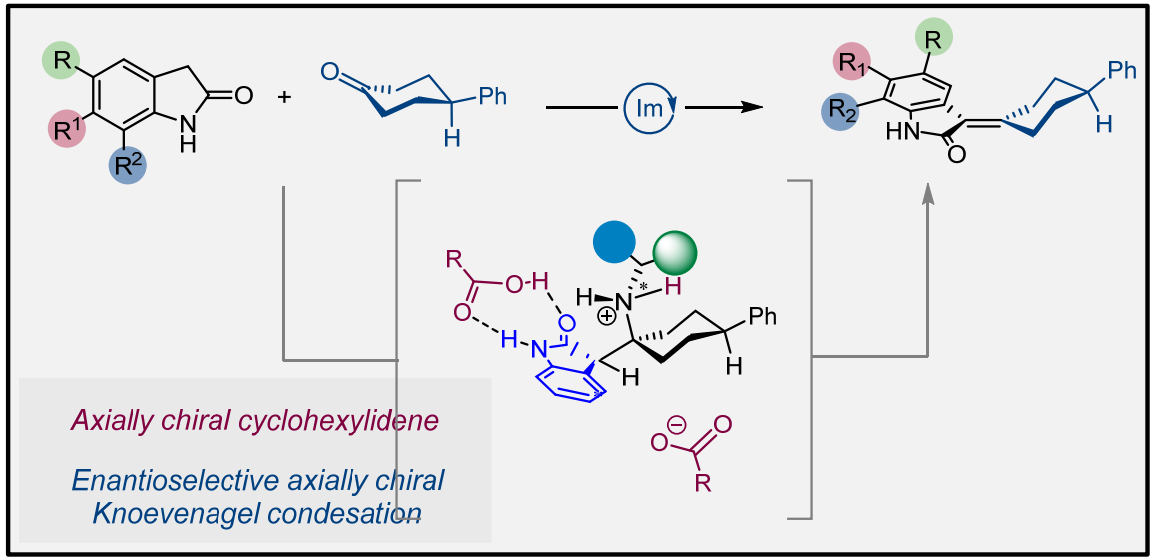
2) Organocatalytic enantioselective formation of atropisomers:

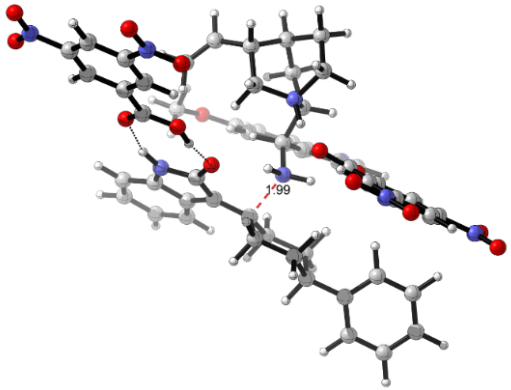
- Enantioselective organocatalysis has been successfully applied to the synthesis of atropisomers
- Synthesis of atropisomeric hydrazides via diastereoconvergent sequential catalysis



Bencivenni, et al. *Angew. Chem. Int. Ed.*, **2022**, *61*, e202209895

- Axially chiral cyclohexylidene oxindoles were selectively obtained by means of organocatalytic Knoevenagel condensation. Insights on the mechanism were obtained by DFT methods





Bencivenni, et al. *Org. Lett.*, **2019**, *21*, 3013.

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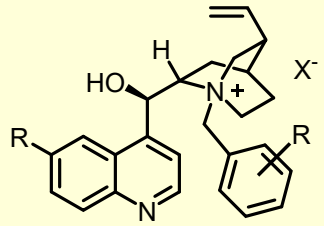
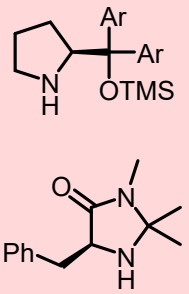
Research topics – (Bernardi-Fochi)

1) Development of new catalytic enantioselective reactions:
Using known organic catalysts (different classes), we explore new chemistry and reactivity.

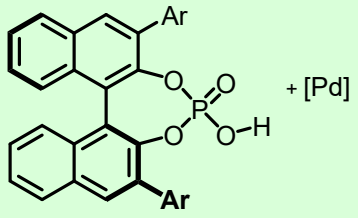
Phase-Transfer Catalysis



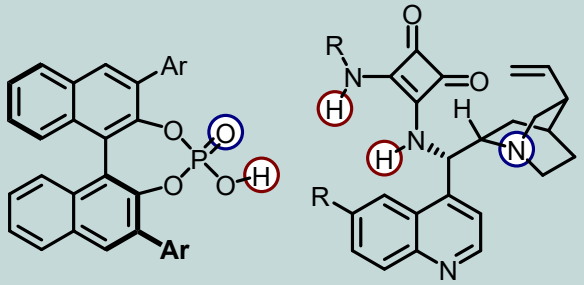
Aminocatalysis



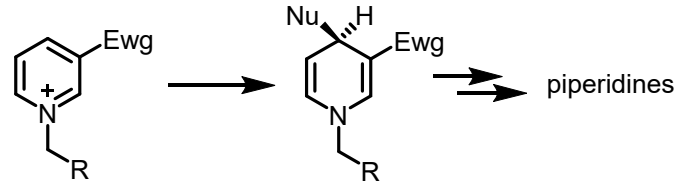
Synergistic Catalysis



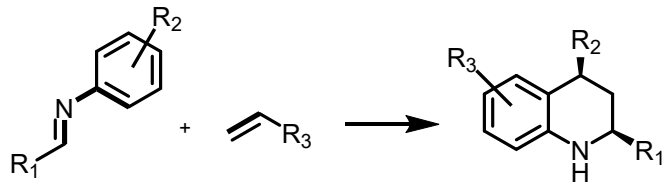
H-Bond and bifunctional catalysts



-Dearomatization of activated pyridines:



-aza-Diels-Alder cycloadditions:



A student involved in such a project will learn how to:
-perform multi-step organic synthesis (catalysts and substrates)
-characterise organic compounds (NMR, HPLC analysis)
-perform extensive optimisation of reaction conditions.

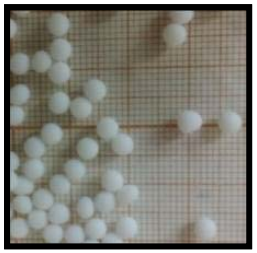
For additional information:
luca.bernardi2@unibo.it
mariafrancesca.fochi@unibo.it

Research topics – (Bernardi-Fochi)

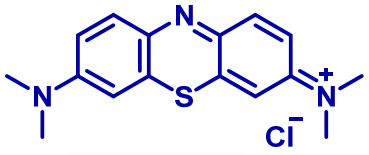
2) «Blue chemistry»: marine biopolymer gels in catalysis:

Aginate biopolymers (algae extracts) readily form gels (solvogels, aerogels) with high surface areas and functional group density: applications in catalysis and adsorption.

1) **Purification**
2) **Acidification and gelification**
3) **From hydrogel to solvogel to aerogel**



Aerogel:
Same properties of a gel (surface are 600 m^2g^{-1})
All functionalities are accessible



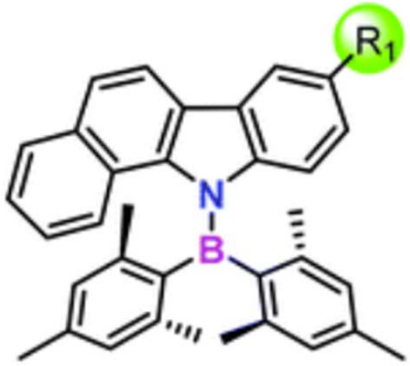
A student involved in such a project will learn how to:
-perform simple organic synthesis
-prepare and manipulate hydro and solvogels
-characterise organic compounds (NMR, HPLC analysis)
-perform extensive optimisation of reaction coinditions

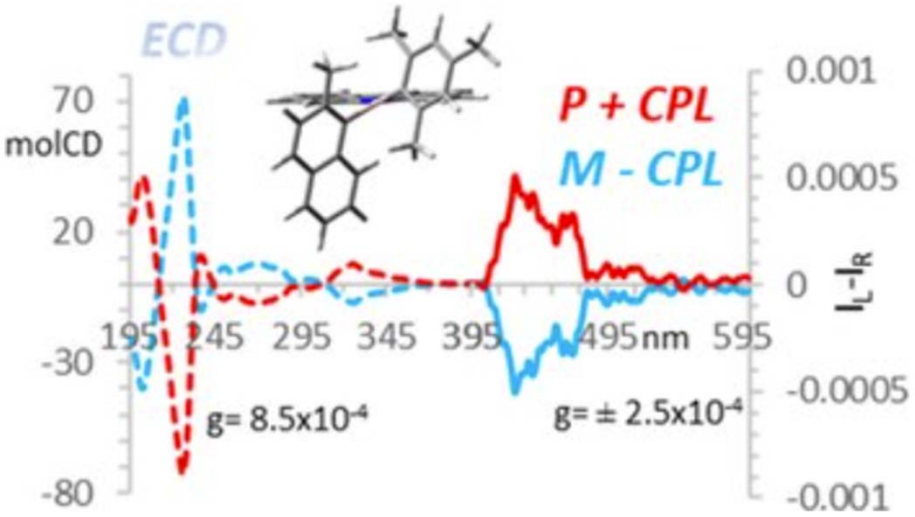
Currently pursued: is it possible to exploit the intrinsic homochirality for enantioselective processes?

For information:
luca.bernardi2@unibo.it
mariafrancesca.fochi@unibo.it

Research topics – (Mazzanti - Mancinelli)

Synthesis of Organic Molecules for Optoelectronic Applications such as OLEDs and CPL-OLEDs (OCSA – Mazzanti – Mancinelli)



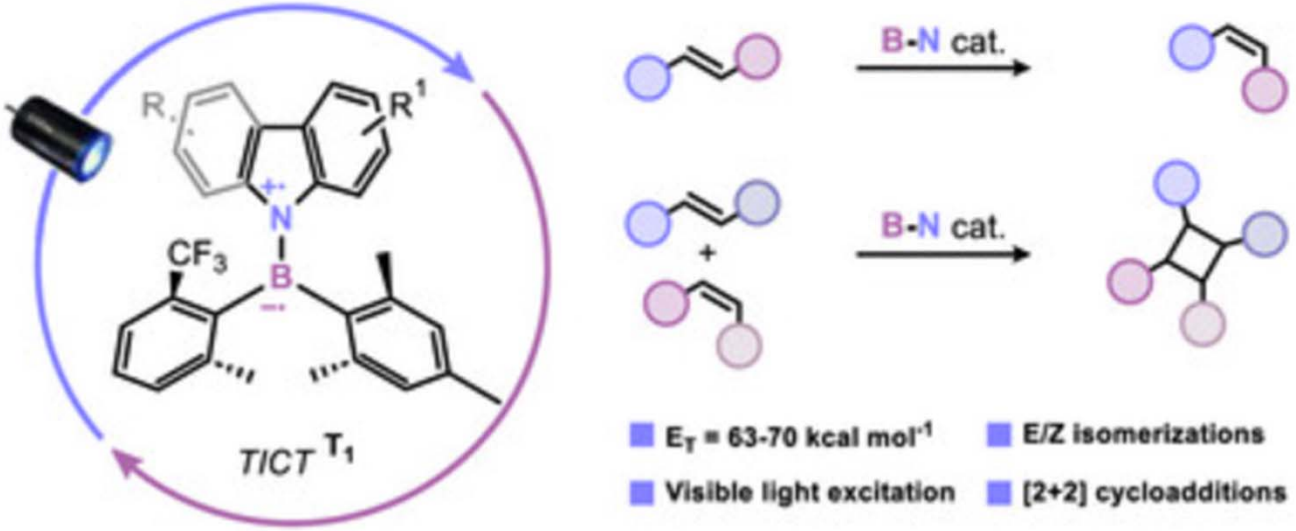


Org. Chem. Front., **2021**, Advance Article
DOI: 10.1039/D1QO00715G

J. Org. Chem. **2023**, *88*, 2, 871–881
https://dx.doi.org/10.1021/acs.joc.2c02209

Research topics – (Mazzanti - Mancinelli)

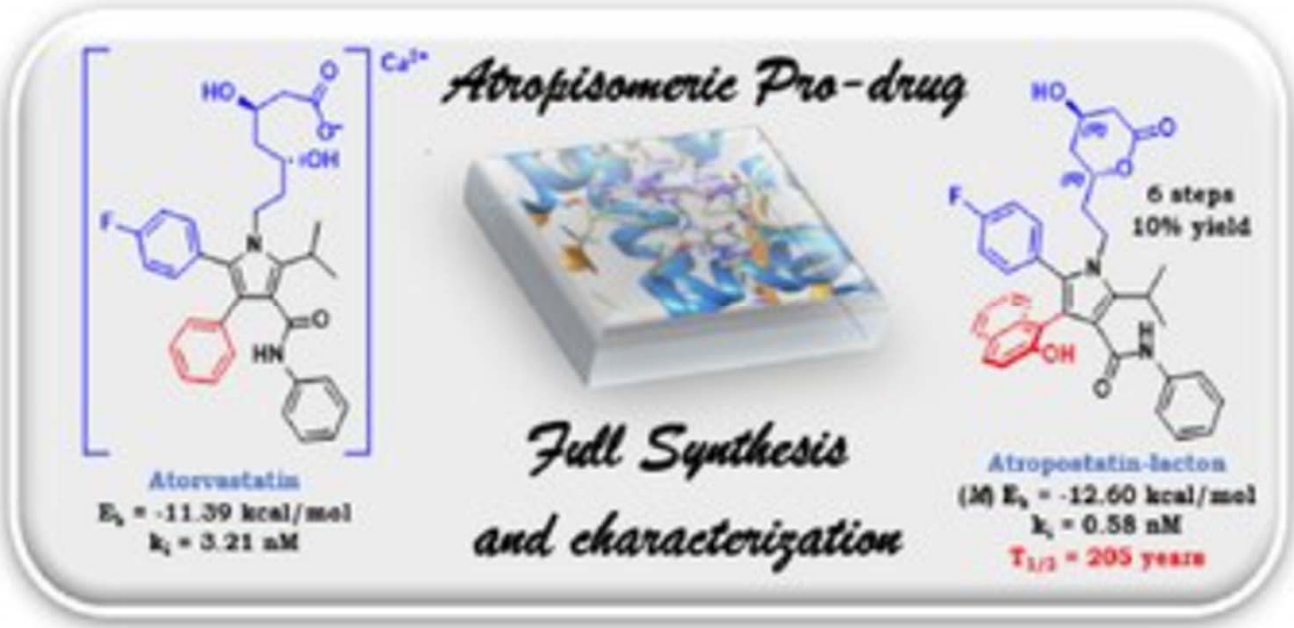
- **Synthesis and Spectroscopic Characterization of Atropisomeric Organic Molecules Useful as Catalysts in Photochemistry: Investigation of Physicochemical Properties (OCSA – Mancinelli – Mazzanti)**



Angew. Chem. Int. Ed. **2026**, 65, e20339
https://doi.org/10.1002/anie.202520339

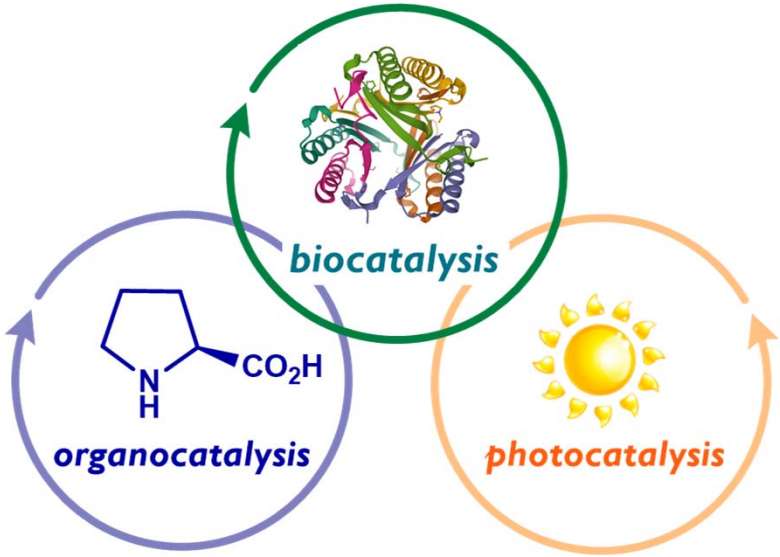
Research topics – (Mazzanti - Mancinelli)

- **Synthesis and Spectroscopic Characterization of Atropisomeric Drug (OCSA – Mancinelli – Mazzanti)**



Molecules **2023**, *28*(7), 3176
https://dx.doi.org/10.3390/molecules28073176

Melchiorre Lab



Check our website for more info

https://melchiorrelab.weebly.com/

Melchiorre Lab

Home People Publications Research Pics Paolo Contact

PHOTOZYME ERC AdG project

The Team

7 Postdocs
8 PhD Students
1 Lab Technician
1 Administrative assistant

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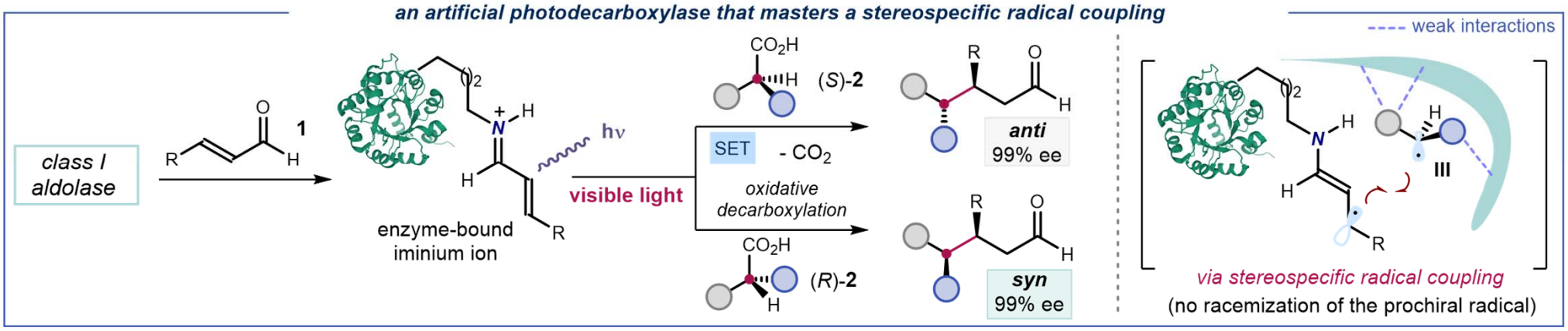
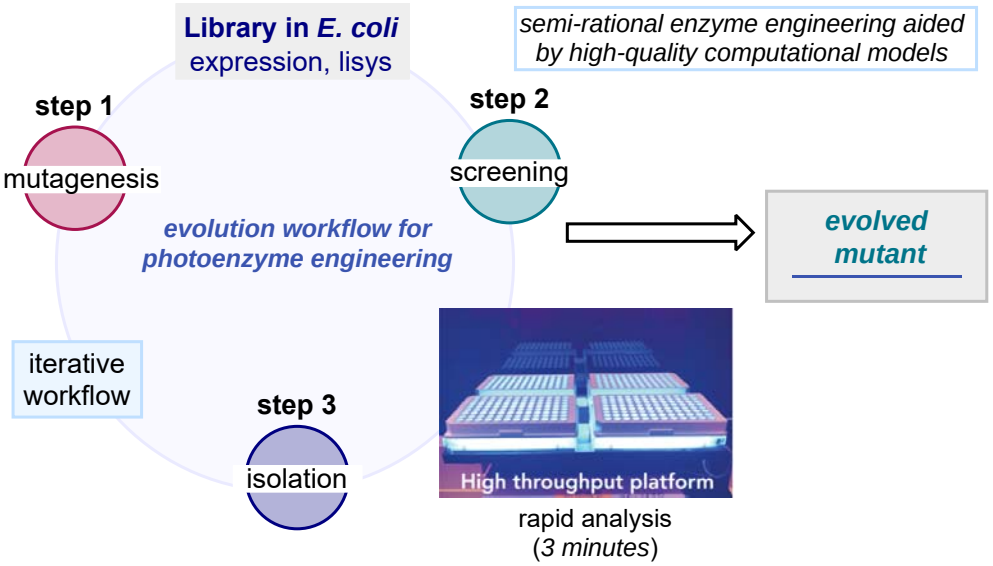
Melchiorre Lab

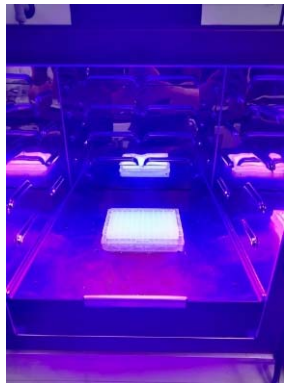


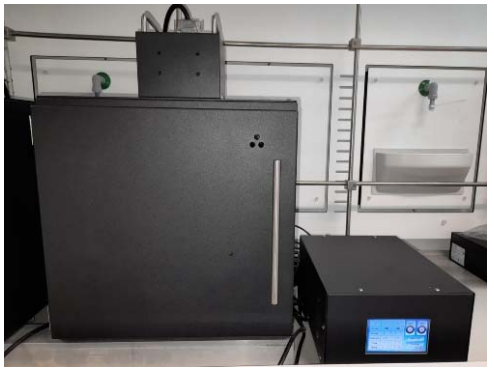
Nature **2024**, *634*, 848–854

Our Tools



Iterative saturation mutagenesis by high-throughput experimentation (*HTE*)





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Advanced Sustainable Organic Materials (ASOM)



WEB: https://chimica-industriale.unibo.it/it/ricerca/gruppi-di-ricerca/advanced-smart-organic-materials-asom

Prof. Mauro Comes Franchini mauro.comesfranchini@unibo.it Prof. Letizia Sambri letizia.sambri@unibo.it Prof. Erica Locatelli erica.locatelli2@unibo.it

The research group activity is focused on the optimization of **innovative processing techniques** with the aim of **developing new organic sustainable materials** for applications in the field of **nanomedicine, organic electronics and sustainable organic materials** for industrial applications. Processing techniques include:

- **Additive Manufacturing (3D-Printing):** Sustainable new materials starting from natural pool sources, such as terpenes, carbohydrates and proteins. The starting biomaterials are synthetically modified before being applied to the manufacturing.

- **Compounding and extrusion processes** using natural organic filler and recycled polymers. Collaborations with industries and University of Cadice/Erasmus+ (Spain)

- **Bio-Gel for biomedical applications:** Biocompatible materials are investigated and their formulations are thoroughly explored and optimized to obtain suitable rheology for building scaffolds eligible for Tissue Engineering and drug delivery. **Collaborations with Istituto Toscano Tumori (Siena), CNR Napoli, University Saragozza (Spain).**

- **Gels for photocalaytic applications:** sustainable materials for the formation of gels able to embed catalyst for CO_2 reduction or electrophotocatalysis (**Collaboration with University of Rome-Tor Vergata and ISOF CNR (Bologna)**

Advanced Sustainable Organic Materials (ASOM)

The group has proven expertise in synthesis of luminescent molecules, chemical modification of biomaterials and organic functionalization of metal-conductive and piezoelectric nanostructures (gold, silver, metal oxides) with different size and shapes. Integration of these features with the above-mentioned Processing Techniques give main applications as:

Theranostic (Therapeutic + Diagnostic) in medical field: **Breast, Brain and Bladder cancer** Collaborations with CNR (Napoli) in **AIRC project** (**Associazione Italiana Ricerca Cancro**) and Ospedale San Raffaele (Milano) (Funded Projects, European Community).

Sensing for Organic Electronics. Collaborations with **University of Milano.**

Organic Dyes for cotton and wool in collaboration with industries. Use of enzyme for sustainable production.

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Advanced Sustainable Organic Materials (ASOM)

Emanuela Bua (Post-Doc)

Aqsa Majeed (Post Doc)

Simone Maturi (Post-Doc)

Leonardo Mannino (Industrial Fellowship)

Filippo Capancioni (PhD)

Gaia Ghiselli (PhD)

Giuseppe Ferrara (PhD)

New PhD To Be Hired (Start November26)

Available Positions: three October 2026 and three March 2027

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