

Tirocinio: Istruzione per l'uso

| | | |
|-------|--------------|-------|
| 19751 | TIROCINIO I | 7 CFU |
| 19752 | TIROCINIO II | 3 CFU |

[Sito CDS: Tirocini](#)

Commissione Tirocini

Prof.ssa [Elisabetta Salatelli](#)

Prof.ssa [Maria Carmela Iapalucci](#)

Prof.ssa [Patricia Benito Martin](#)

Ufficio tirocinio Scienze

Scuola di Scienze - Tirocini scienze.tirocini@unibo.it

Francesca Cavazza

Ufficio tirocini area scientifica

Via Filippo Re , 8 - 40126 Bologna

Coordinatore CdS: mariafrancesca.fochi@unibo.it

Tutor CdS: andrea.pellegrini11@studio.unibo.it

Tirocinio presso il Dipartimento di Chimica Industriale

Chimica Inorganica

Chimica Organica

Chimica Analitica

Chimica Fisica

Chimica Ambientale

Chimica Industriale (catalisi)

Chimica Industriale (polimeri)

Impianti Chimici

Chimica e Biotecnologia delle Fermentazioni

In ogni ambito sono attivi diversi gruppi di ricerca

Chimica Fisica

Docenti

Marco Garavelli

Ivan Rivalta

Irene Conti

Artur Nenov

Silvia Orlandi

Luca Muccioli

Elisabetta Venuti

Tommaso Salzillo

Elisabetta Canè

Filippo Tamassia

Alberto Arcioni

Dottorandi/Assegnisti/Borsisti

Flavia Aleotti

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Lorenzo Soprani

Lorenzo Pandolfi

Silvia Cristofaro silvia.cristofaro@unibo.it

Francesco Segatta francesco.segatta@unibo.it

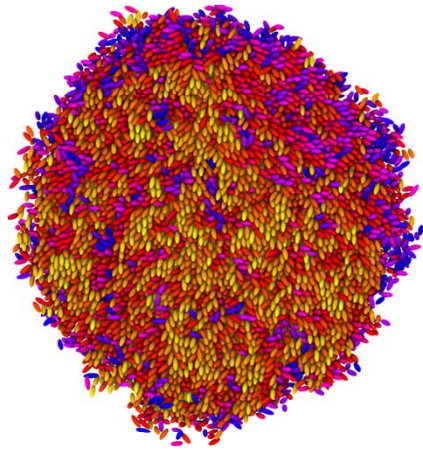
Vishal Kumar Jaiswal Mohammad

Giacomo Fanciullo

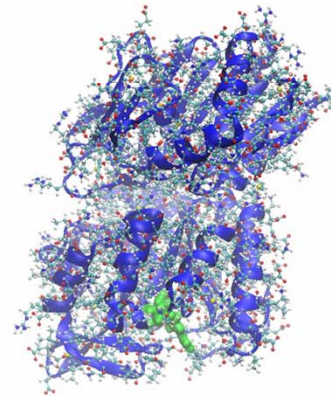
Mario Taddei

Emilio Lorini

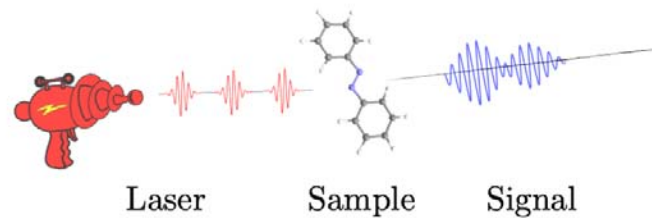
Chimica Fisica Computazionale



... tante "molecole"...



... catalisi e trasporto ...



... fotochimica e fotofisica ...



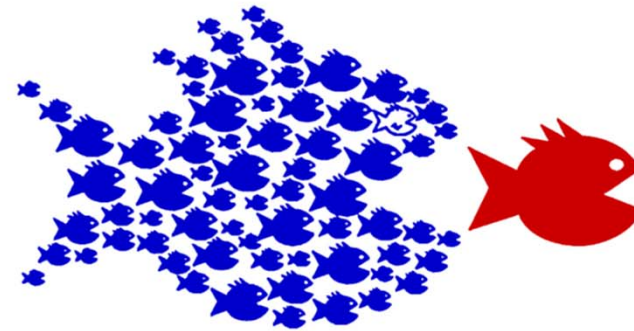
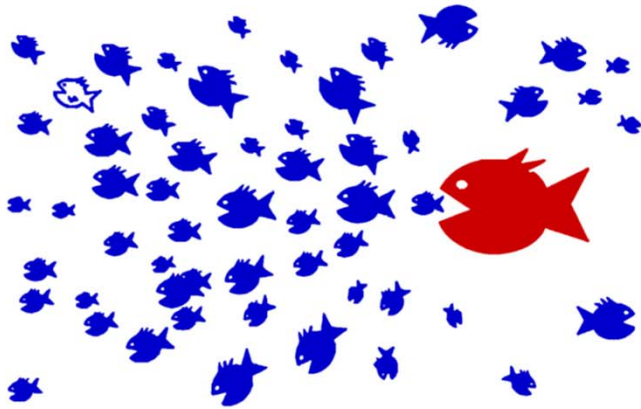
Chimica Computazionale

... con tante “molecole”

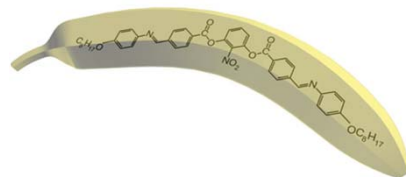
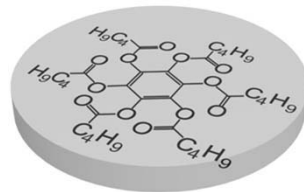
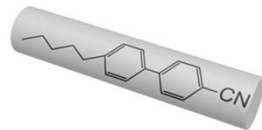
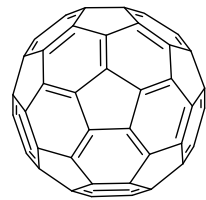
SC² group

Presentazione originale: Prof. Roberto Berardi

... con **tante** "molecole"



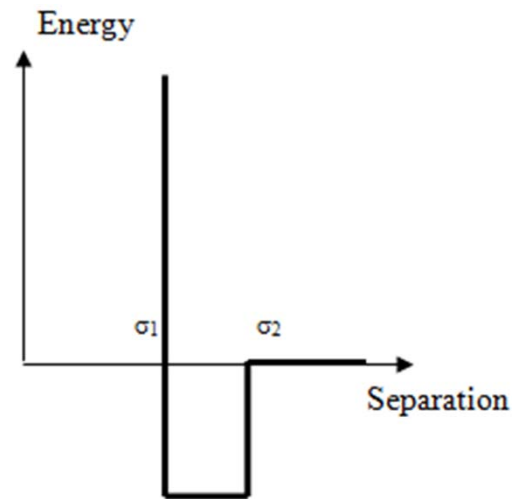
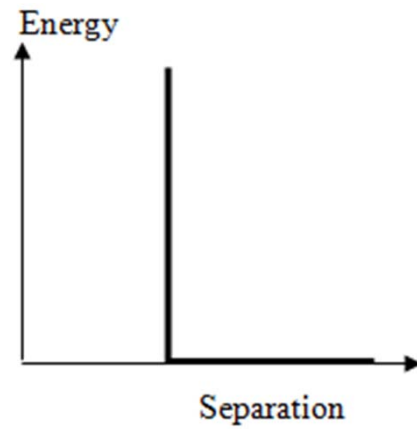
... con tante "molecole"



Interazioni semplificate



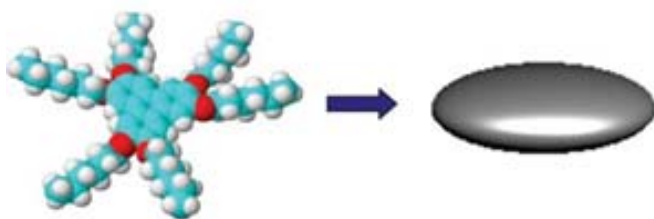
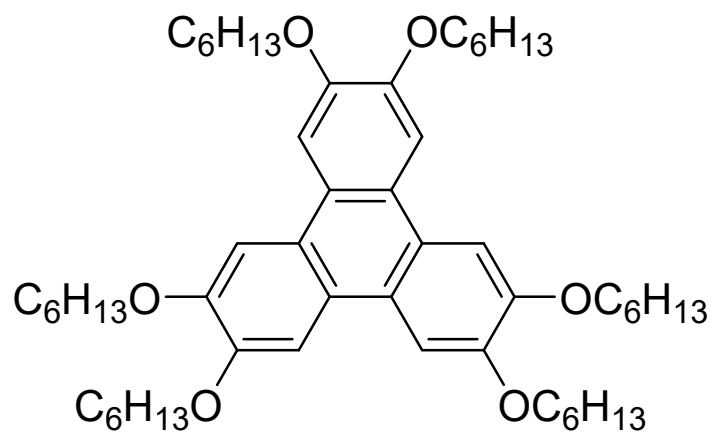
Hard spheres



Square well



Previsioni sulle fasi di aggregazione



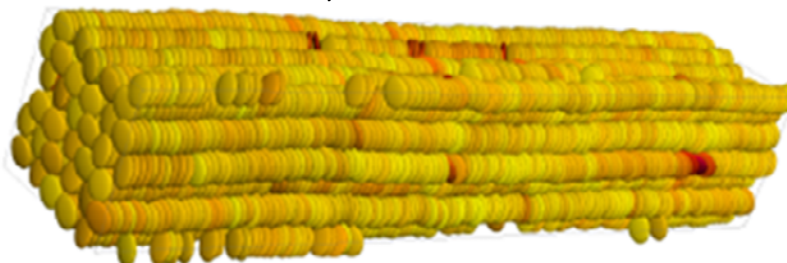
Isotropic



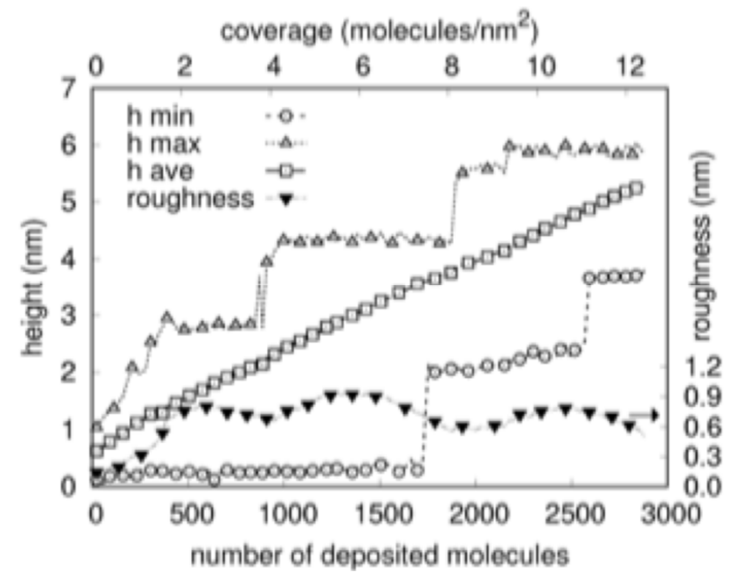
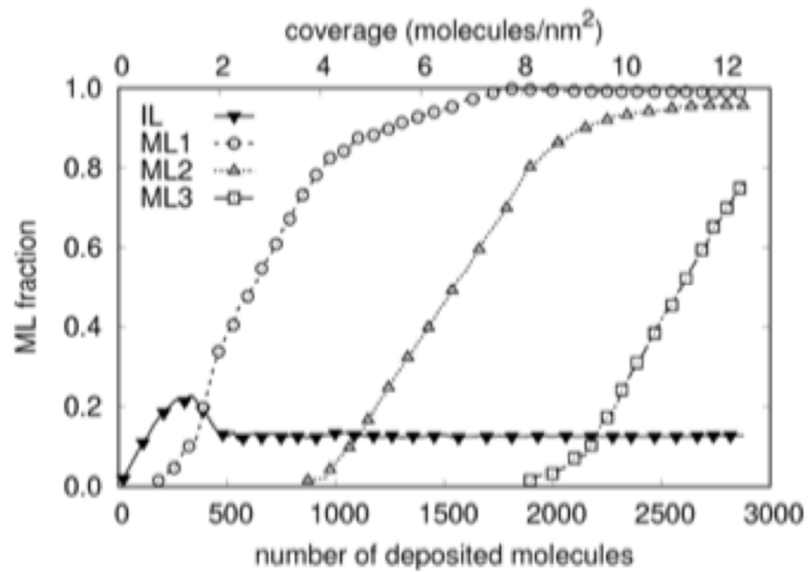
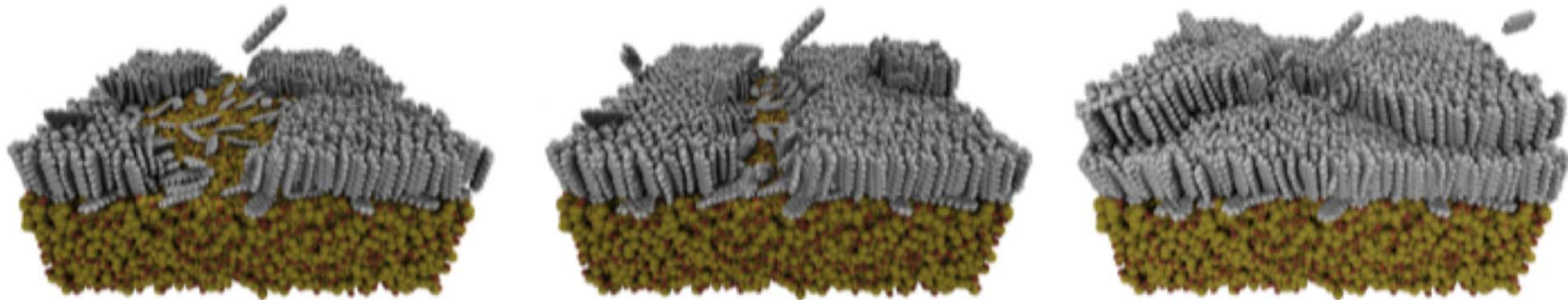
Columnar



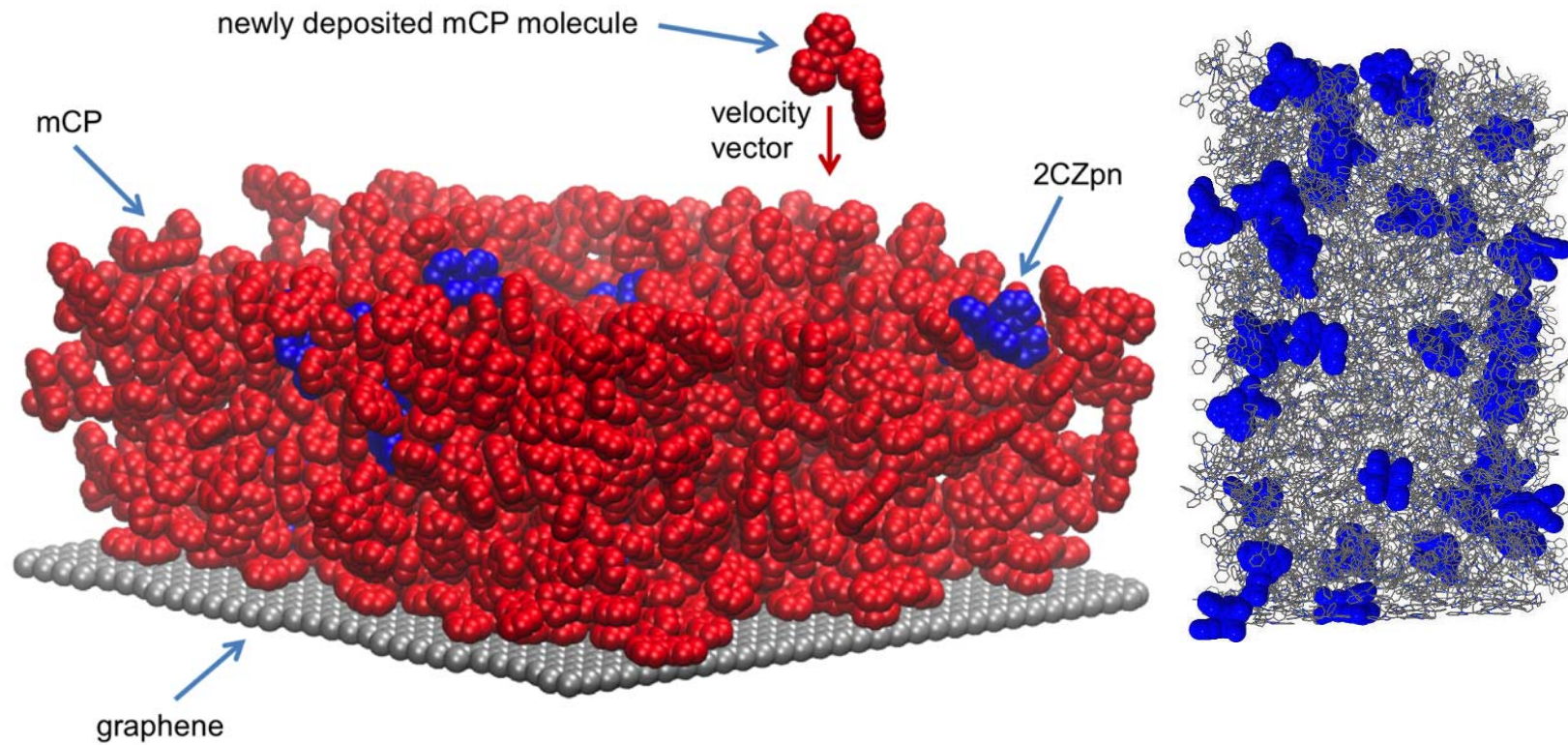
Crystal



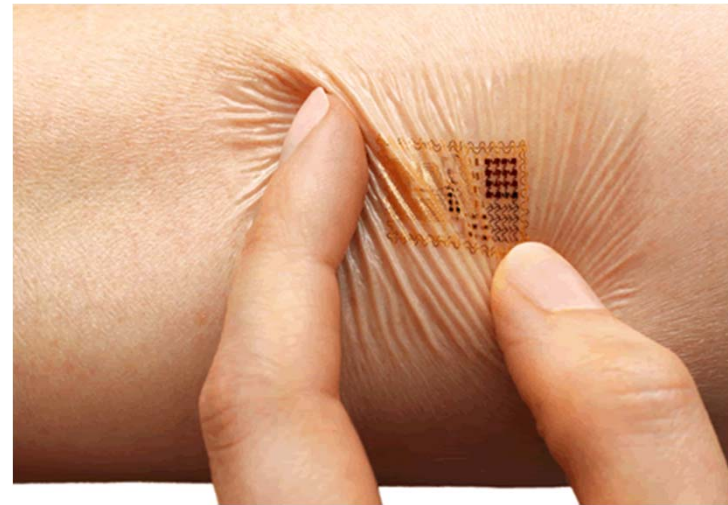
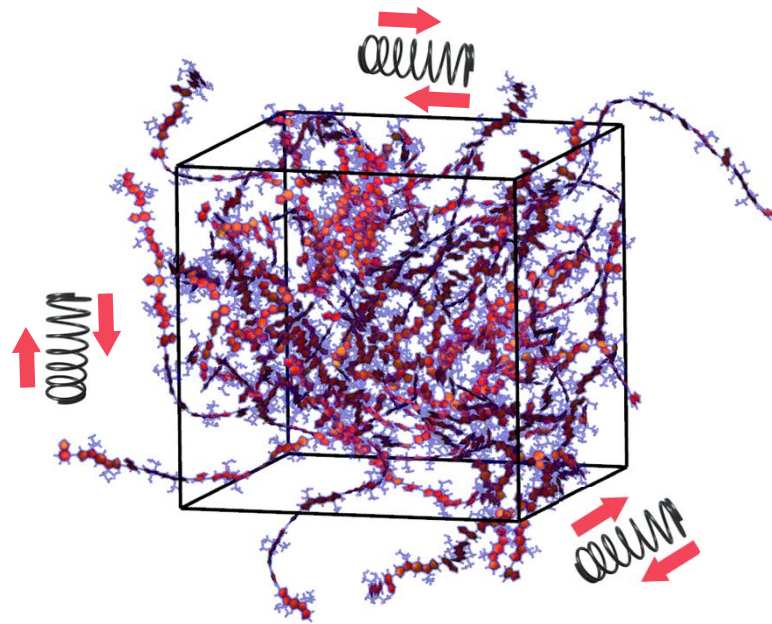
Accrescimento di cristalli



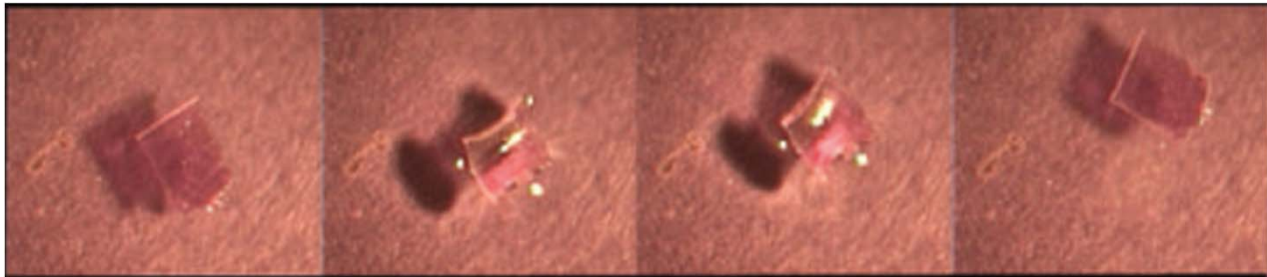
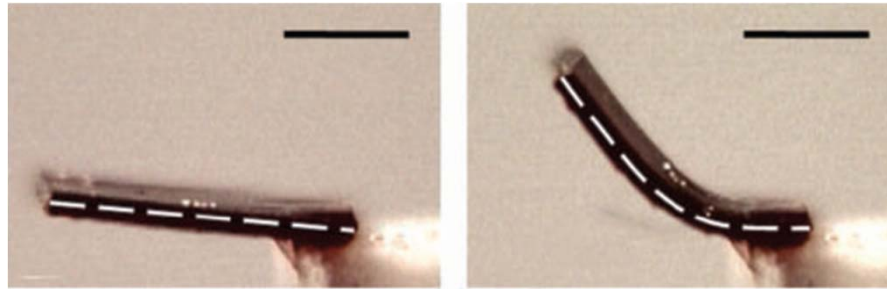
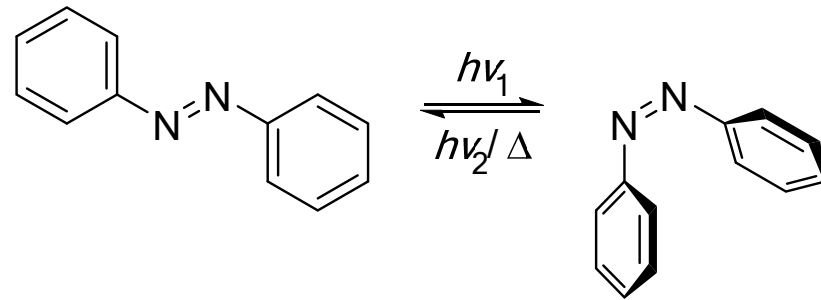
Simulazione di deposizione di materiali per OLED



Studio delle proprietà meccaniche di polimeri semiconduttori



Simulazioni semiclassiche di fenomeni fotochimici (azobenzene)

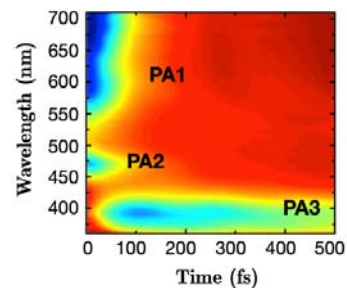
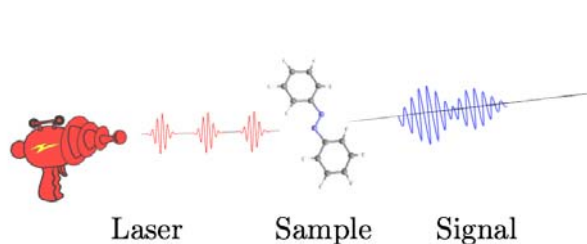


Contatti

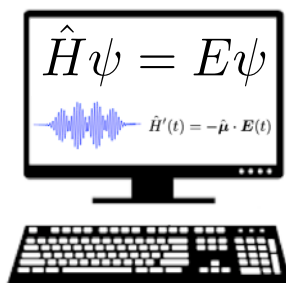
- Luca Muccioli – luca.muccioli@unibo.it
- Silvia Orlandi – s.orlandi@unibo.it
- Lorenzo Soprani – lorenzo.soprani4@unibo.it
- Silvia Cristofaro – silvia.cristofaro@unibo.it
- Emilio Lorini – emilio.lorini2@unibo.it

FOTOCHIMICA COMPUTAZIONALE (Prof. Marco Garavelli)

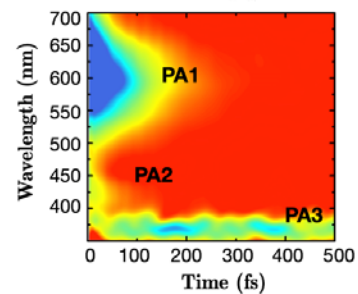
Simulazioni al CALCOLATORE di proprietà statiche e dinamiche
di STATO ECCITATO usando metodi QUANTOMECCANICI



Esperimento



1011010110010010011101000101.



Simulazione

COSA FACCIAMO?



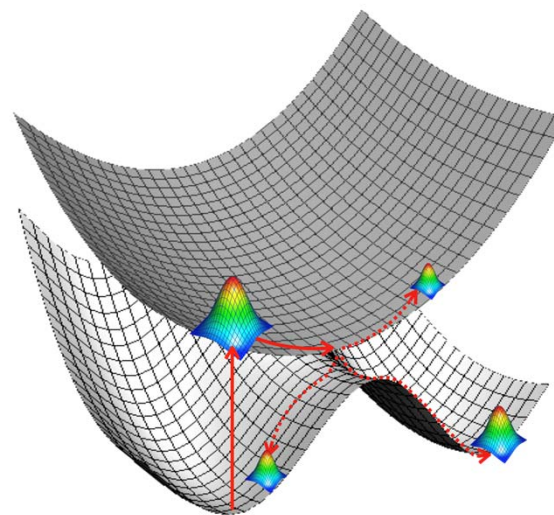
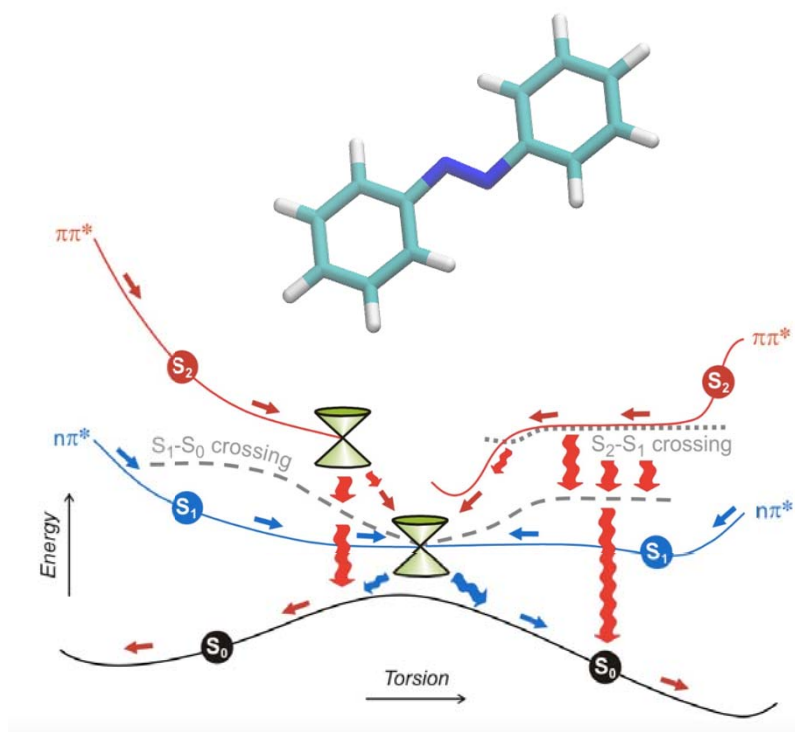
Calcoli di Chimica Quantistica



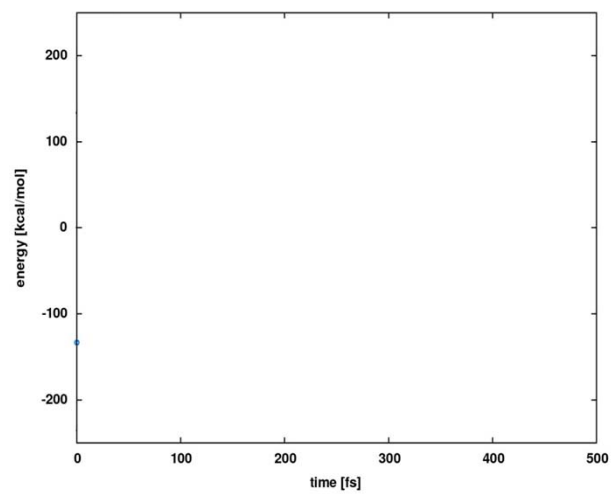
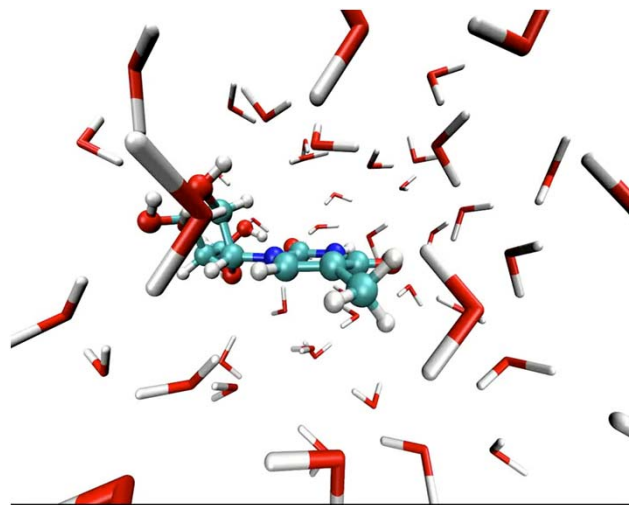
Simulazioni di Spettroscopia

COSA FACCIAMO?

Meccanismi di reazione su STATO ECCITATO



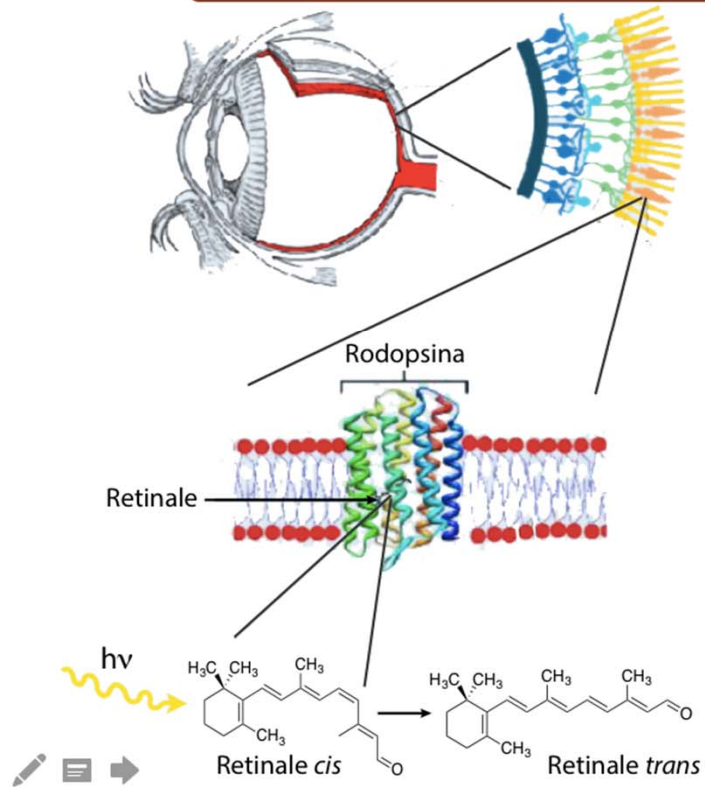
COSA FACCIAMO?



COSA FACCIAMO?

Cosa succede a un sistema molecolare quando viene eccitato dalla luce?

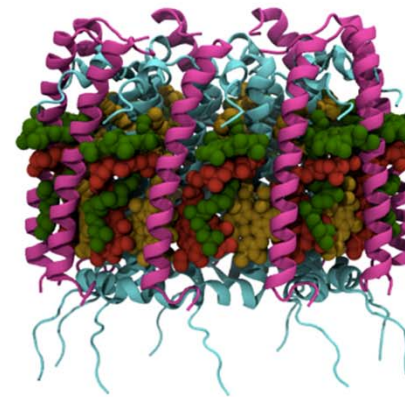
Meccanismo della visione



DNA



Light Harvesting complexes



CONTATTI

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Prof. Artur Nenov: artur.nenov@unibo.it

Dott.ssa Irene Conti: irene.conti@unibo.it

Dr.ssa Flavia Aleotti: flavia.aleotti@unibo.it

Dr. Francesco Segatta: francesco.segatta@unibo.it



ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

Chimica Computazionale:

- *Catalisi*
- *Trasporto in sistemi complessi*

Contatti:

Prof. Ivan Rivalta, i.rivalta@unibo.it

Dr. Francesco Calcagno, francesco.calcagno@unibo.it

Dr. Alessia Ventimiglia, alessia.ventimiglia3@unibo.it

Dr. Giacomo Fanciullo, giacomo.fanciullo2@unibo.it

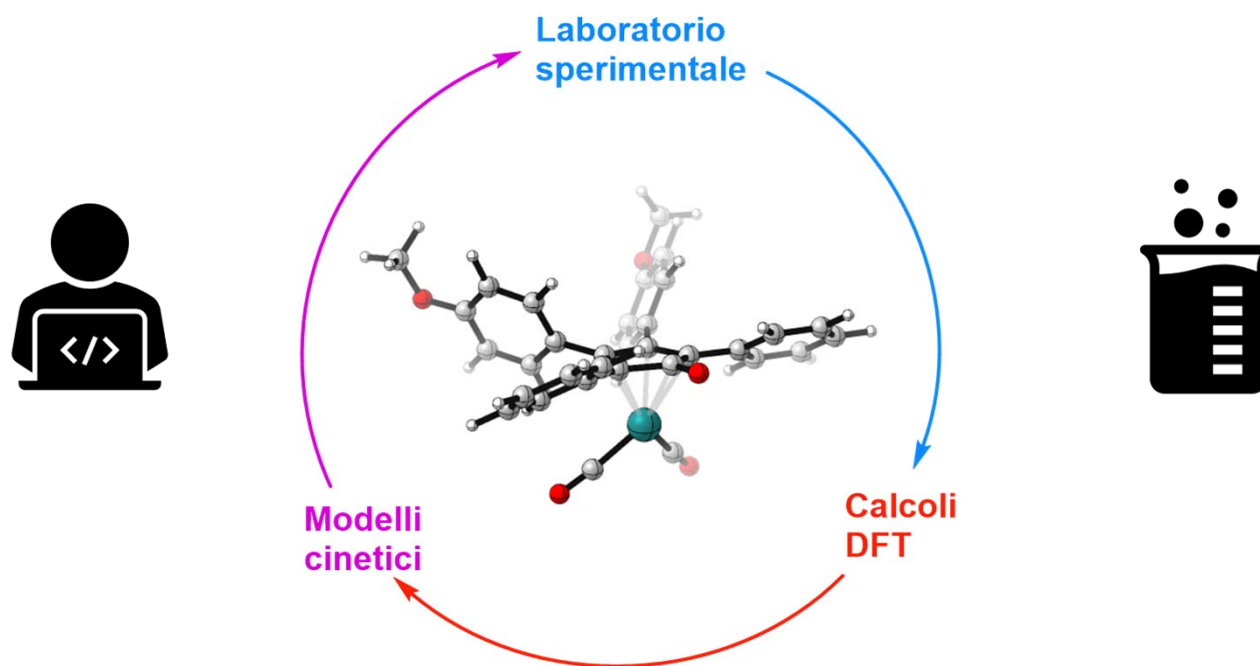
Dr. Aria Gheeraert, aria.gheeraert3@unibo.it

Dipartimento di Chimica Industriale "Toso
Montanari"

Studio teorico di catalizzatori omogenei

Sistemi metallorganici
(catalizzatori organorutenenici)

Reattività
(meccanismi e cinetiche)



Formazione e ricerca:

- **Modeling** (molecolare e sistemi in soluzione)
- **Chimica quantistica** (teoria DFT)
- **Reattività** (teoria dello stato di transizione e modelli cinetici)

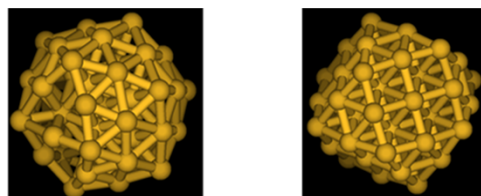
Dr. Francesco Calcagno
francesco.calcagno@unibo.it

Studio teorico di catalizzatori eterogenei

Modeling di nano-materiali

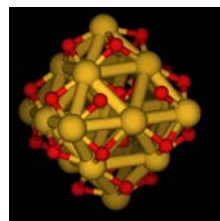
Nanoparticelle
metalliche

Au_{55}

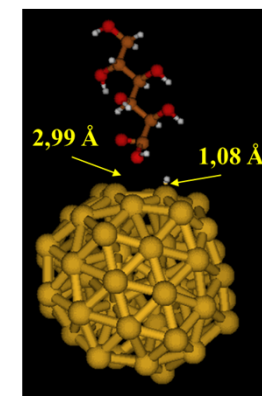
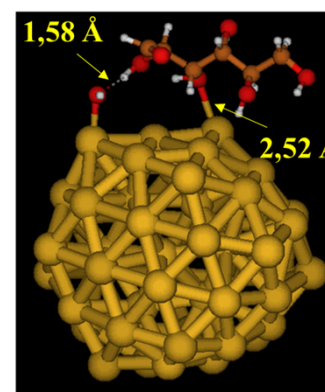


Nanoparticelle
ossidi metallici

ZrO_2



Reattività (adsorbimento e meccanismi)



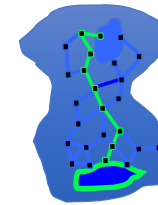
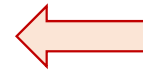
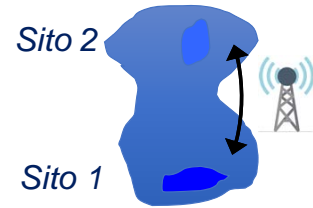
Formazione e ricerca:

- **Modeling** (molecolare e nanosistemi)
- **Chimica quantistica** (teoria DFT)
- **Reattività** (teoria dello stato di transizione e modelli cinetici)

Dr. Alessia Ventimiglia
alessia.ventimiglia3@unibo.it

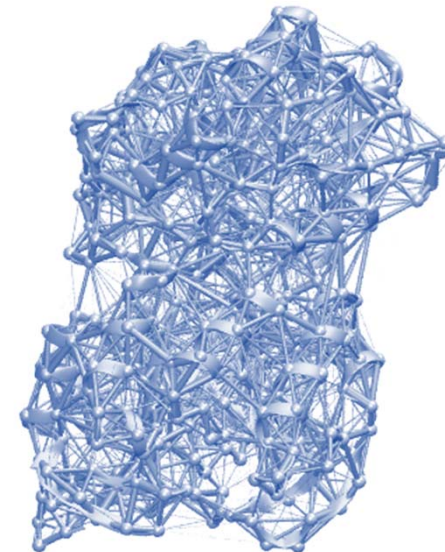
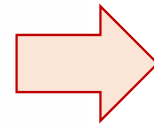
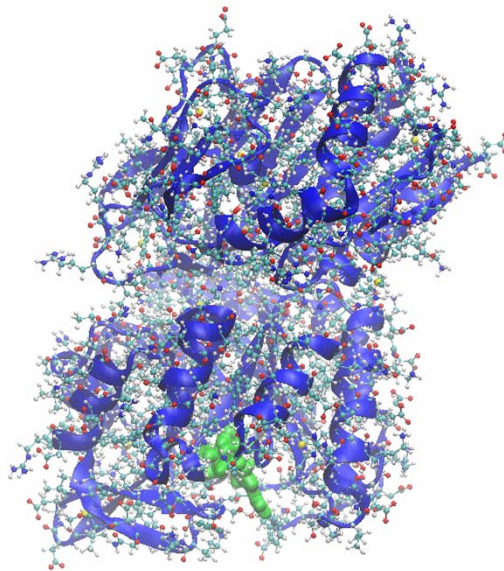
Segnali chimici nei sistemi biologici

Proteine



Rete di comunicazione proteica

Dinamica
molecolare
classica



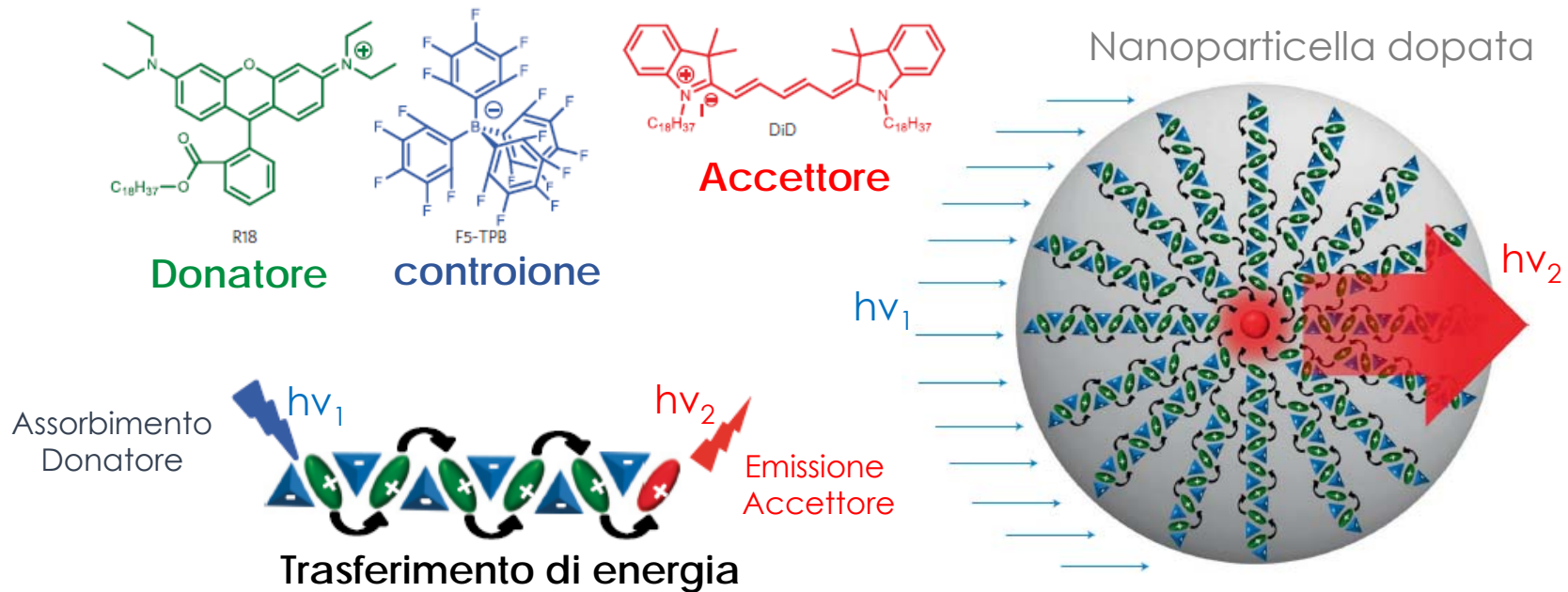
Formazione e ricerca:

- Dinamica molecolare (meccanica classica)
- Analisi di sistemi complessi (teoria delle reti ed intelligenza artificiale)

Dr. Aria Gheeraert
aria.gheeraert3@unibo.it

Trasporto di energia luminosa in sistemi artificiali

Nanoantenna



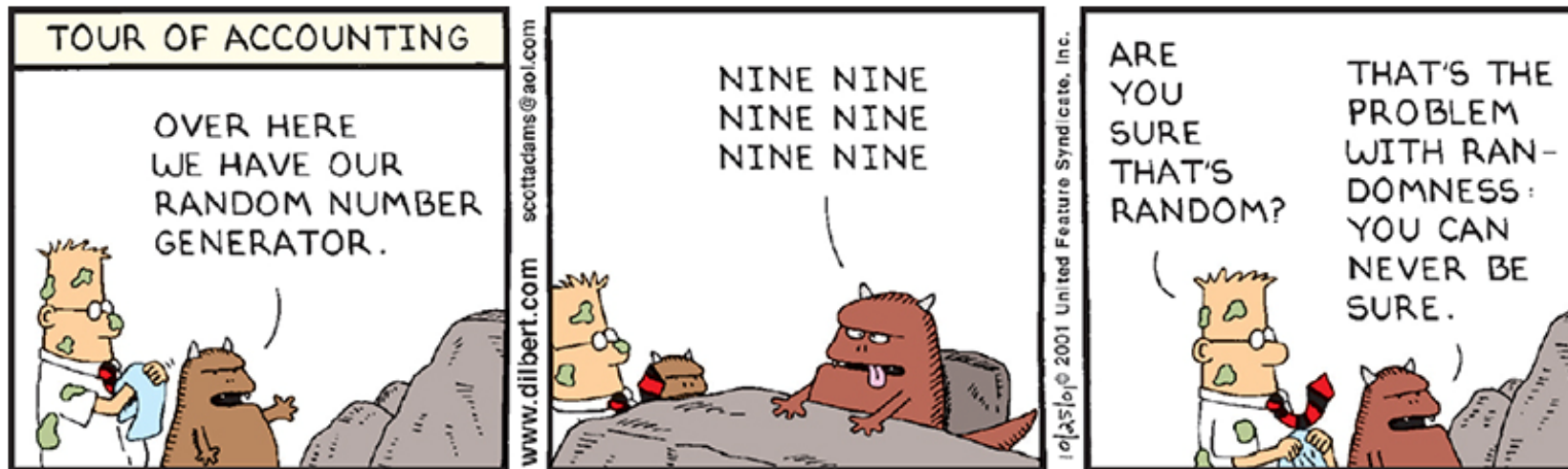
Formazione e ricerca:

- **Modeling** (molecolare e sistemi complessi)
- **Chimica quantistica** (teoria DFT e time-dependent DFT)
- **Dinamica molecolare e trasporto** (meccanica classica e modelli cinetici)

Dr. Giacomo Fanciullo
giacomo.fanciullo2@unibo.it

Effetti collaterali positivi (?)

- Sviluppo di *soft skills* (pazienza)
- Si diventa bravi col computer
- Spazio per arte e creatività



Chimica Inorganica

Docenti

Stefano Zacchini
Maria Carmela Iapalucci
Cristina Femoni
Cristiana Cesari
Silvia Bordoni
Rita Mazzoni
Stefano Stagni
Maria Cristina Cassani
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Andrea Masetti
Valentina di Matteo valentina.dimatteo5@unibo.it
Giacomo Drius
Federico Nicoli
Erica Paltrinieri
....



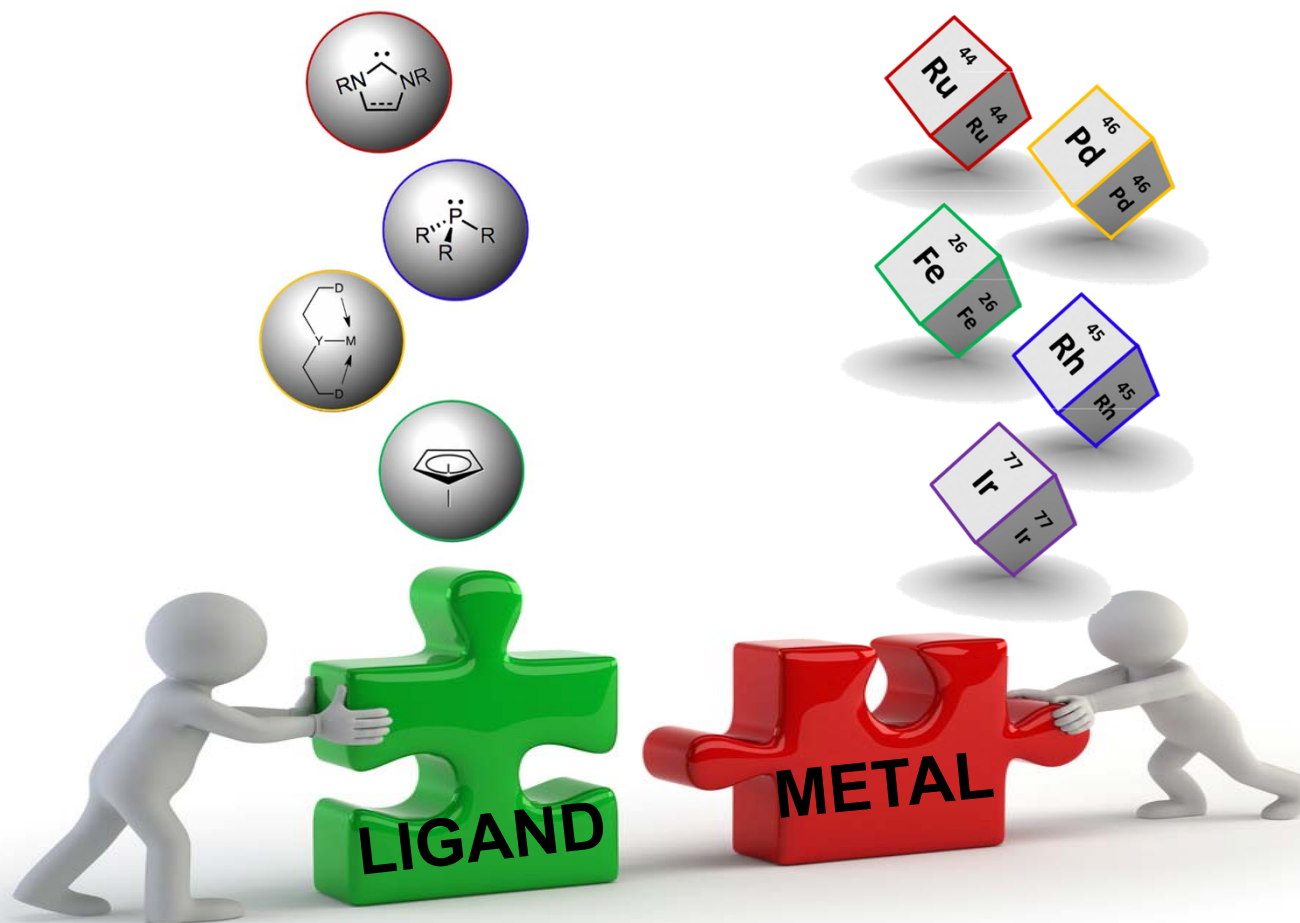
ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

Laboratory of organometallic chemistry

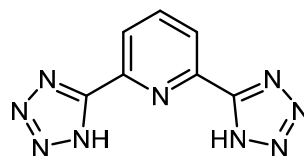
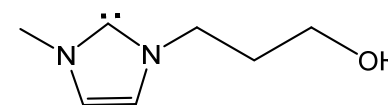
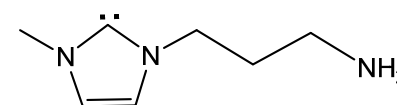
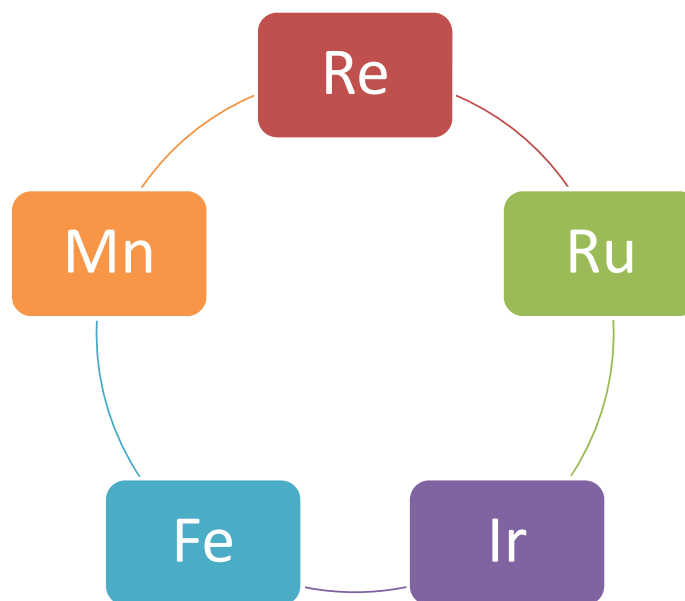
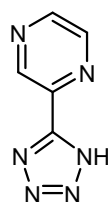
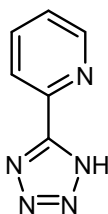
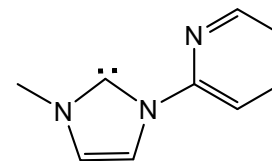
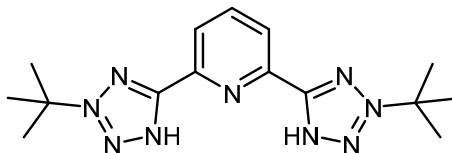
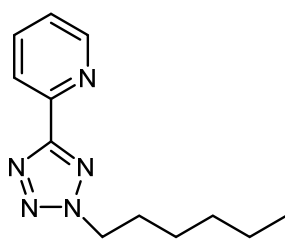
Prof.: Valerio Zanotti, Rita Mazzoni,
Stefano Stagni.

Dipartimento di Chimica Industriale «Toso Montanari»

Organometallic chemistry

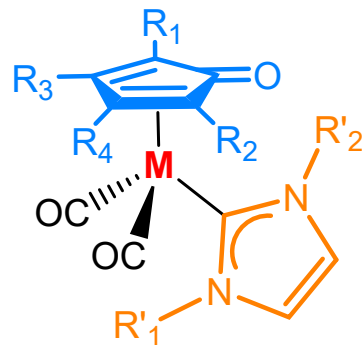


Organometallic chemistry



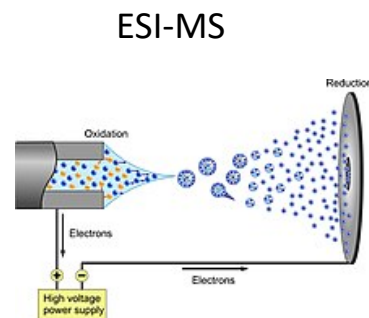
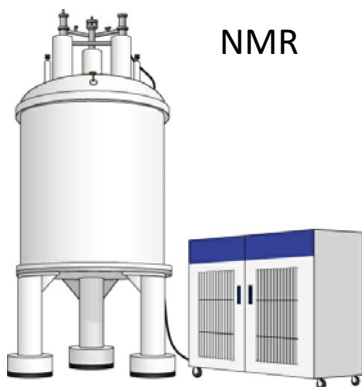
E-mail: rita.mazzoni@unibo.it

**LIGANDS COMBINATIONS
ON TRANSITION METAL
(Fe, Ru, Mn)
ORGANOMETALLIC
COMPLEXES**

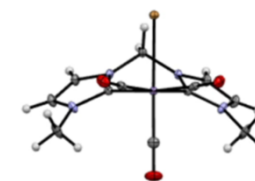


M = e.g. (Fe, Ru, Mn)

• **CHARACTERIZATION**

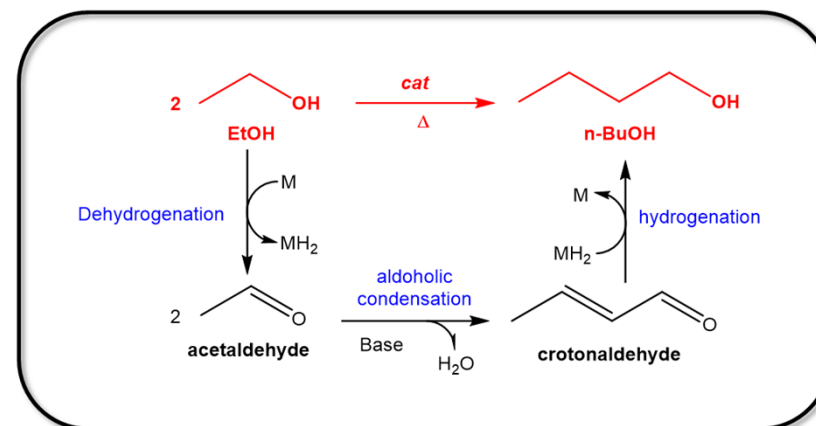
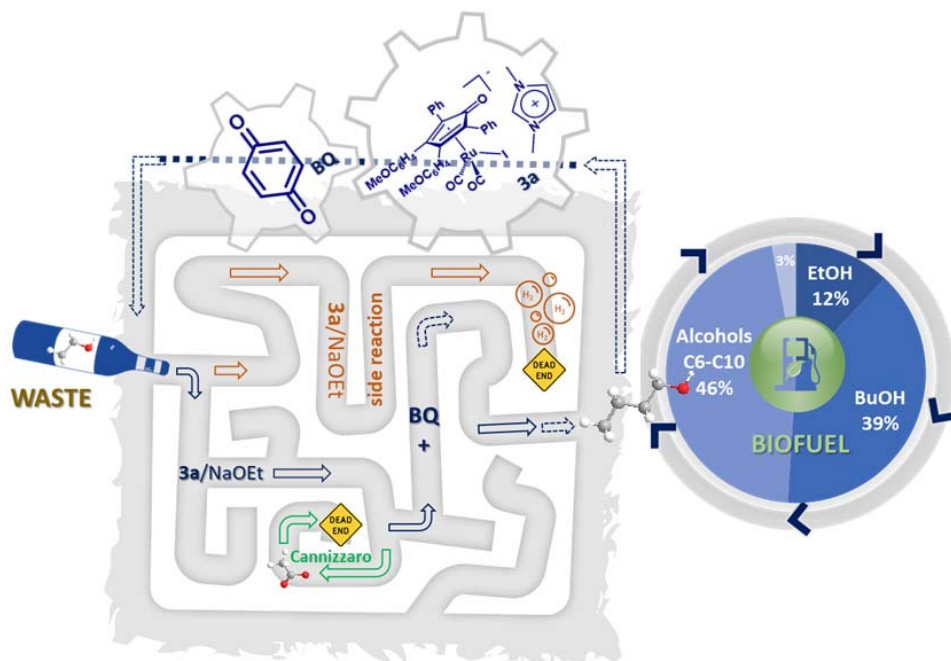


X-RAY DIFFRACTION



HOMOGENEOUS CATALYSIS APPLIED TO SUSTAINABILITY

- Valorization of biomass derivatives (e.g. Bio-ethanol homologation);



C. Cesari, A. Gagliardi, A. Messori, N. Monti, V. Zanotti, S. Zacchini, I. Rivalta, F. Calcagno, C. Lucarelli, T. Tabanelli, F. Cavani, R. Mazzoni, J. Catal. 405 2022 47–59

rita.mazzoni@unibo.it

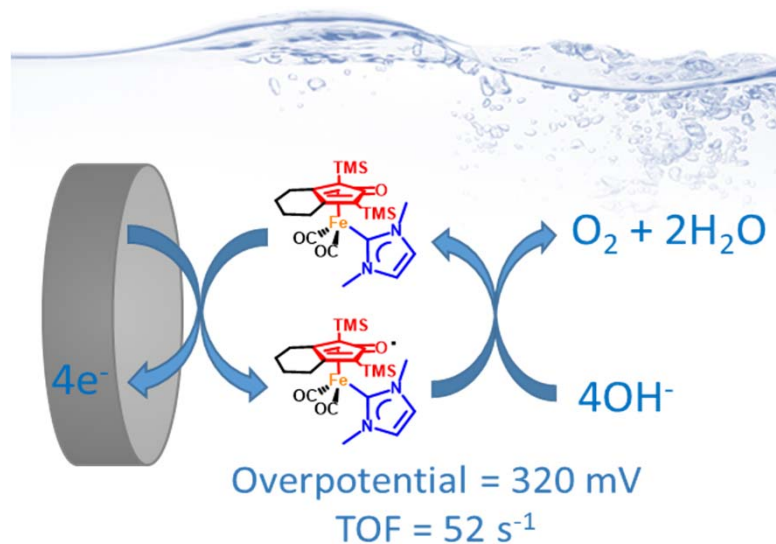


ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

HOMOGENEOUS CATALYSIS APPLIED TO SUSTAINABLE ENERGY

- **Electrocatalytic water oxidation;**

Design and application of earth abundant iron based molecular electrocatalysts for water oxidation, an essential challenge for sustainable energy applications.



A. Cingolani, I. Gualandi, E. Scavetta, C. Cesari, S. Zacchini, D. Tonelli, V. Zanotti,ab P. Franchi, M. Lucarini, E. Sicilia, G. Mazzone, D. Nanni, R. Mazzoni, *Catal. Sci. Technol.*, **2021**, 11, 1407–1418.

- **«Hydrogen storage»:** *de-hydrogenation of amino-borane;*

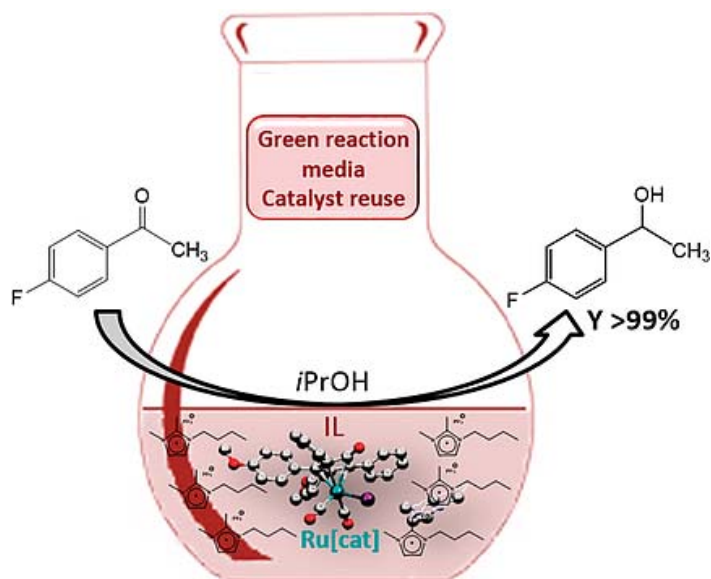
rita.mazzoni@unibo.it



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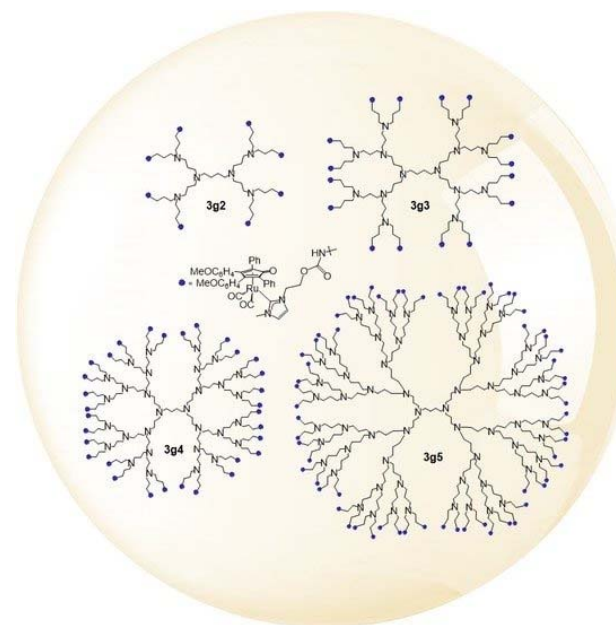
MOLECULAR CATALYSTS IMMOBILIZATION

- **Hydrogen transfer in Biphasic mixtures (e.g. *i*PrOH/ionic liquids);**



C. Cesari, A. Cingolani, M. Teti, A. Messori, S. Zacchini, V. Zanotti, R. Mazzoni, *Eur. J. Inorg. Chem.* **2020**, 1114–1122

- **Immobilized Ruthenium molecular catalysts (e.g. H-transfer on polymeric dendrimers);**



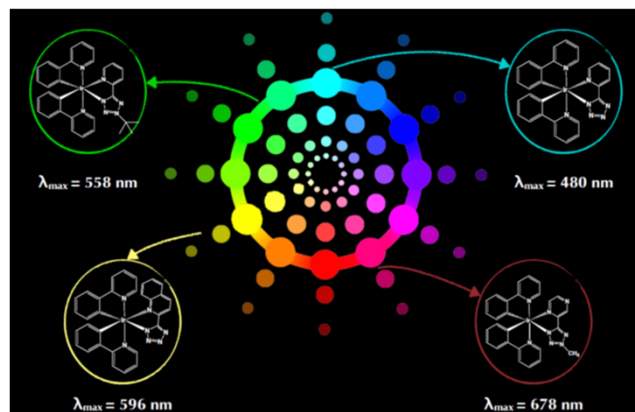
C. Cesari, R. Conti, A. Cingolani, V. Zanotti, M. C. Cassani, L. Rigamonti, R. Mazzoni, *Catalysts* **2020**, 10, 264-275

- **Design and synthesis of suitable polymers for recycle and reuse;**

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Photoactive Metal Complexes for Materials Science

Organic molecules are combined with transition metal ions such as Ir(III), Re(I), Ru(II), Cu(I), Pt(II), to prepare coordination/organometallic complexes that can efficiently absorb visible light, can display bright luminescence, are able to transfer electrons or, possibly, can do all these things together.

Luminescent Metal Complexes are designed for obtaining a full-coloured palette of emissive molecules to be used in photocatalysis, light emitting devices (OLEDs, LEECs), luminescent solar concentrators, white light emitters.



LSC
 Luminescent Solar Concentrators
 with Proffs Andrea Pucci @UniPI
 and Loris Giorgini @UniBO

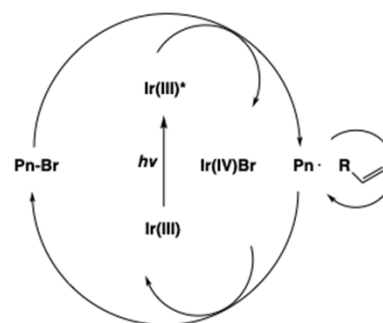
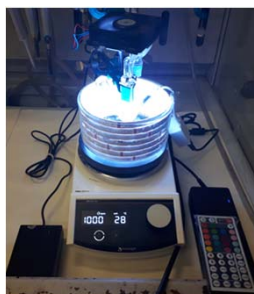
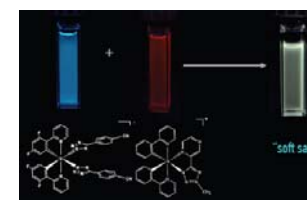
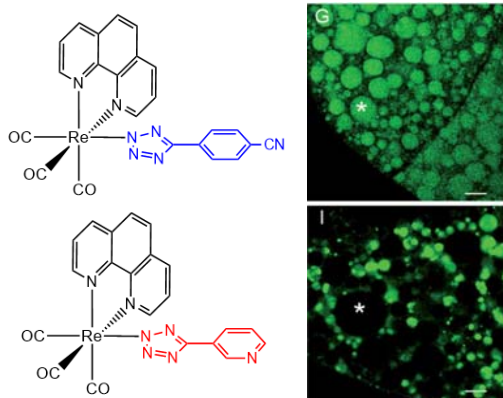


Photo-ATRP
 Atom Transfer Radical Polymerization
 with Prof. Loris Giorgini @UniBO

White Light emission

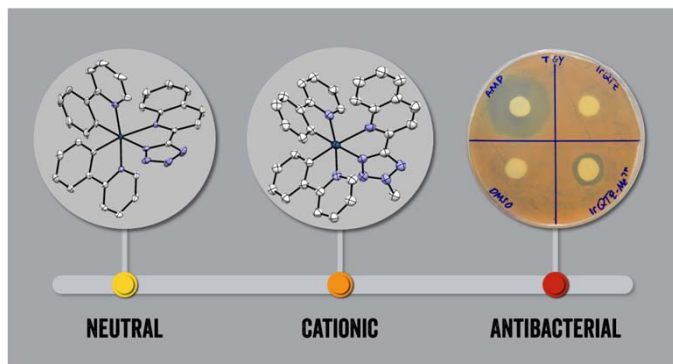


Stefano Stagni Dip. Chimica Industriale Toso Montanari
stefano.stagni@unibo.it



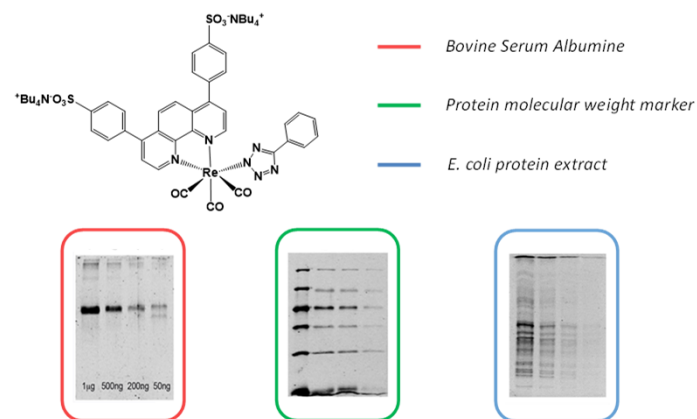
Photoactive Metal Complexes for Life Science
 Luminescent metal complexes of Ir(III), Re(I), and Ru(II), are designed and synthesized for obtaining new **optical markers for live cells**, new classes of **selective antibacterials** and new **luminescent dyes for protein staining**.

Luminescent Imaging of Live Eukaryotic Cells and Live Bacteria
 with Prof. **Max Massi** @Curtin Uni. Australia



Metal complexes as new ANTIBACTERIALS
 with Dr. **Alessandra Stefan** @UniBO
alessandra.stefan@unibo.it

Luminescent Staining of Proteins
 with Dr. **Alessandra Stefan** @UniBO





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TRANSITION METAL CARBONYL CLUSTER COMPOUNDS

DESIGN, SYNTHESIS AND CHARACTERIZATION OF METAL
CARBONYL CLUSTERS AS MOLECULAR METAL
NANOPARTICLES

Area di Chimica Inorganica

Dipartimento di Chimica Industriale "Toso Montanari"

RESEARCH GROUP



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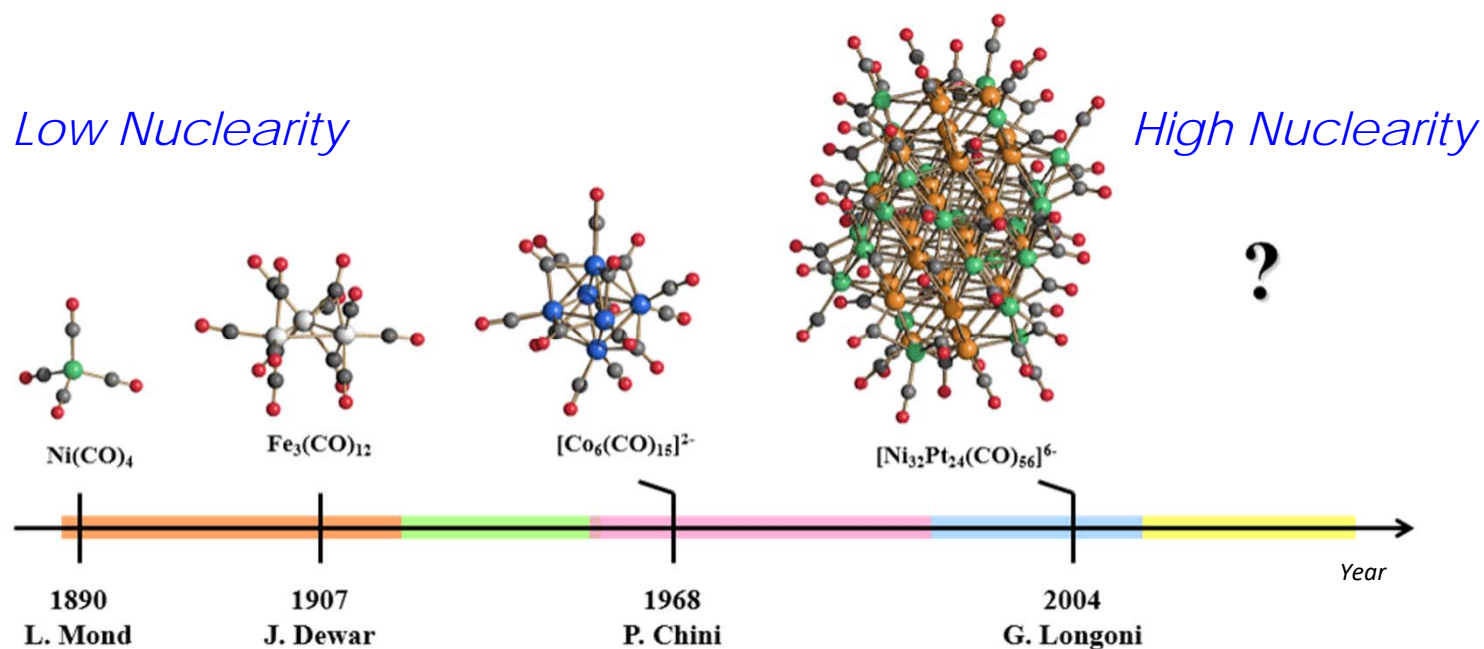


Dott. Guido Bussoli (Dottorando)
guido.bussoli@unibo.it



What is a Metal Cluster?

F. A. Cotton (1966): a metal cluster is a molecular species consisting of "...a finite group of metal atoms held together mainly, or at least to a significant extent, by metal-metal bonds."



Coord. Chem. Rev., **2006**, 250, 1580; *Eur. J. Inorg. Chem.*, **2011**, 4125; *J. Clust. Sci.*, **2014**, 25, 115;
Coord. Chem. Rev., **2018**, 335, 27; *Eur. J. Inorg. Chem.*, **2018**, 3285, *Acc. Chem. Res.*, **2018**, 51,
2748



Periodic Table of the Elements

Atomic Number → **1** ← Symbol
 Name → **Hydrogen** ← Atomic Weight
 Electrons per shell → **1**

State of matter (color of name)
 GAS LIQUID SOLID UNKNOWN

Subcategory in the metal-metalloid-nonmetal trend (color of background)
 Alkali metals Lanthanides Metalloids
 Alkaline earth metals Actinides Reactive nonmetals
 Transition metals Post-transition metals Noble gases
 Unknown chemical properties

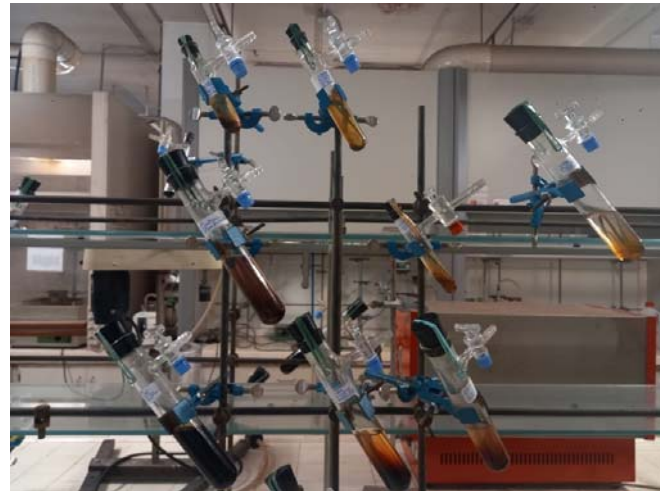
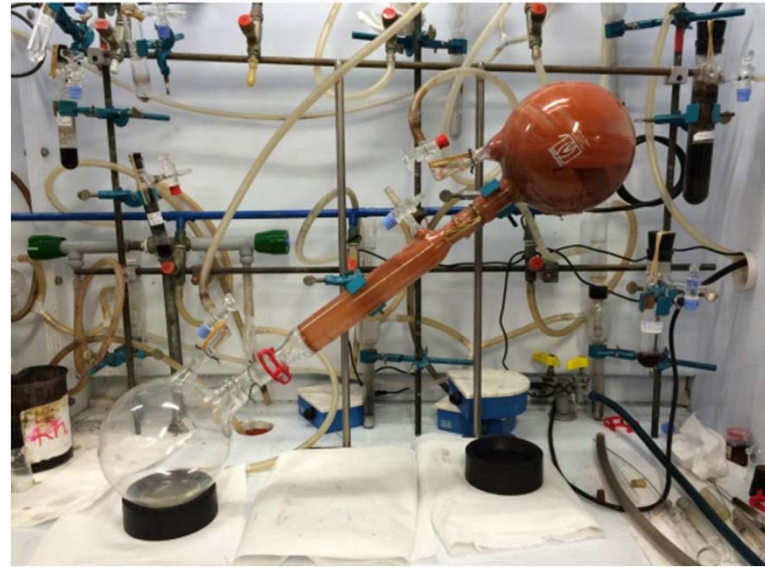
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|--|---|--|--|--|---|---|---|---|---|--|--|--|--|--|---|---|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|
| 1 IA H Hydrogen 1.008 1 | | | | | | | | | | | | | | | | | 18 VIIIA He Helium 4.0026 2 | | | | | | | | | | | | | | | | |
| 3 Li Lithium 6.94 3 | 4 IIA Be Beryllium 9.012 4 | | | | | | | | | | | | | | | | | 10 Ne Neon 20.180 10 | | | | | | | | | | | | | | | |
| 11 Na Sodium 22.990 11 | 12 IIA Mg Magnesium 24.305 12 | 13 IIIA B Boron 10.81 13 | 14 IVA C Carbon 12.011 14 | 15 VA N Nitrogen 14.007 15 | 16 VIA O Oxygen 15.999 16 | 17 VIIA F Fluorine 18.998 17 | 18 Ar Argon 39.948 18 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 19 K Potassium 39.098 19 | 20 Ca Calcium 40.078 20 | 21 Sc Scandium 44.956 21 | 22 IVB Ti Titanium 47.88 22 | 23 VB V Vanadium 50.942 23 | 24 VIB Cr Chromium 51.996 24 | 25 VIIB Mn Manganese 54.938 25 | 26 VIII Fe Iron 55.845 26 | 27 VIII Co Cobalt 58.933 27 | 28 VIII Ni Nickel 58.693 28 | 29 VIII Cu Copper 63.546 29 | 30 IIB Zn Zinc 65.38 30 | 31 IIIA Ga Gallium 69.723 31 | 32 IVA Ge Germanium 72.63 32 | 33 VA As Arsenic 74.922 33 | 34 VIA Se Selenium 78.971 34 | 35 VIIA Br Bromine 79.904 35 | 36 Kr Krypton 83.798 36 | | | | | | | | | | | | | | | | |
| 37 Rb Rubidium 85.468 37 | 38 Sr Strontium 87.62 38 | 39 Y Yttrium 88.906 39 | 40 Zr Zirconium 91.224 40 | 41 Nb Niobium 92.906 41 | 42 Mo Molybdenum 95.94 42 | 43 Tc Technetium 98 43 | 44 Ru Ruthenium 101.07 44 | 45 Rh Rhodium 102.91 45 | 46 Pd Palladium 106.42 46 | 47 Ag Silver 107.87 47 | 48 Cd Cadmium 112.41 48 | 49 In Indium 114.82 49 | 50 Sn Tin 118.71 50 | 51 Sb Antimony 121.76 51 | 52 Te Tellurium 127.6 52 | 53 I Iodine 126.90 53 | 54 Xe Xenon 131.29 54 | | | | | | | | | | | | | | | | |
| 55 Cs Cesium 132.905 55 | 56 Ba Barium 137.33 56 | 57-71 Lanthanides | 72 Hf Hafnium 178.49 72 | 73 Ta Tantalum 180.948 73 | 74 W Tungsten 183.84 74 | 75 Re Rhenium 186.21 75 | 76 Os Osmium 190.23 76 | 77 Ir Iridium 192.22 77 | 78 Pt Platinum 195.08 78 | 79 Au Gold 196.97 79 | 80 Hg Mercury 200.59 80 | 81 Tl Thallium 204.38 81 | 82 Pb Lead 207.2 82 | 83 Bi Bismuth 208.98 83 | 84 Po Polonium 209 84 | 85 At Astatine 210 85 | 86 Rn Radon 222 86 | | | | | | | | | | | | | | | | |
| 87 Fr Francium 223 87 | 88 Ra Radium 226 88 | 89-103 Actinides | 104 Rf Rutherfordium 261 104 | 105 Db Dubnium 262 105 | 106 Sg Seaborgium 263 106 | 107 Bh Bohrium 264 107 | 108 Hs Hassium 265 108 | 109 Mt Meitnerium 266 109 | 110 Ds Darmstadtium 267 110 | 111 Rg Roentgenium 268 111 | 112 Cn Copernicium 269 112 | 113 Nh Nihonium 270 113 | 114 Fl Flerovium 271 114 | 115 Mc Moscovium 272 115 | 116 Lv Livermorium 273 116 | 117 Ts Tennessine 274 117 | 118 Og Oganesson 276 118 | | | | | | | | | | | | | | | | |
| 57 La Lanthanum 138.905 57 | 58 Ce Cerium 140.12 58 | 59 Pr Praseodymium 140.908 59 | 60 Nd Neodymium 144.24 60 | 61 Pm Promethium 145 61 | 62 Sm Samarium 150.36 62 | 63 Eu Europium 151.964 63 | 64 Gd Gadolinium 157.25 64 | 65 Tb Terbium 158.925 65 | 66 Dy Dysprosium 162.50 66 | 67 Ho Holmium 164.93 67 | 68 Er Erbium 167.26 68 | 69 Tm Thulium 168.93 69 | 70 Yb Ytterbium 173.05 70 | 71 Lu Lutetium 174.967 71 | | | | | | | | | | | | | | | | | | | |
| 89 Ac Actinium 227 89 | 90 Th Thorium 232.04 90 | 91 Pa Protactinium 231.04 91 | 92 U Uranium 238.03 92 | 93 Np Neptunium 237 93 | 94 Pu Plutonium 244 94 | 95 Am Americium 243 95 | 96 Cm Curium 247 96 | 97 Bk Berkelium 247 97 | 98 Cf Californium 251 98 | 99 Es Einsteinium 252 99 | 100 Fm Fermium 257 100 | 101 Md Mendelevium 258 101 | 102 No Nobelium 259 102 | 103 Lr Lawrencium 260 103 | | | | | | | | | | | | | | | | | | | |

what do we do?



- Synthesis of inorganic compounds under an inert atmosphere (Schlenk technique)
- Spectroscopic and structural characterization (IR, multinuclear NMR, XRD)
- Electrochemical and spectrochemical studies (Prof. Tiziana Funaioli, Università di Pisa)
- Determination of the magnetic properties of molecular nanocluster through SQUID (Prof. Mauro Riccò, Università di Parma)
- Computational studies and DFT calculations (Prof. Marco Bortoluzzi, Università di Venezia)
- Use of molecular clusters as precursors of nanostructured catalytic materials or precursor of catalysts in homogeneous catalytic reactions (Prof.ssa S. Albonetti and F. Basile, Università di Bologna)

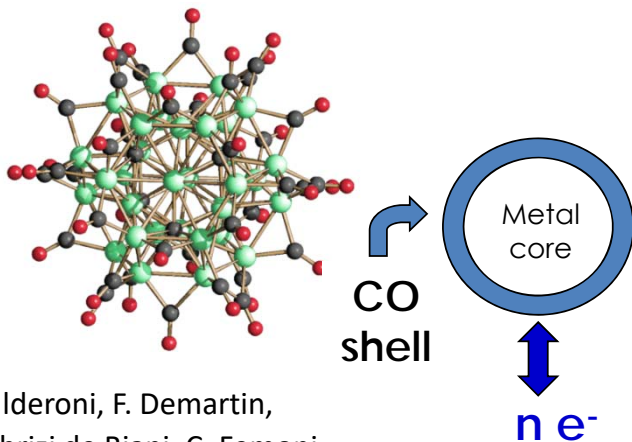
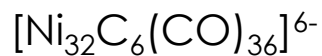




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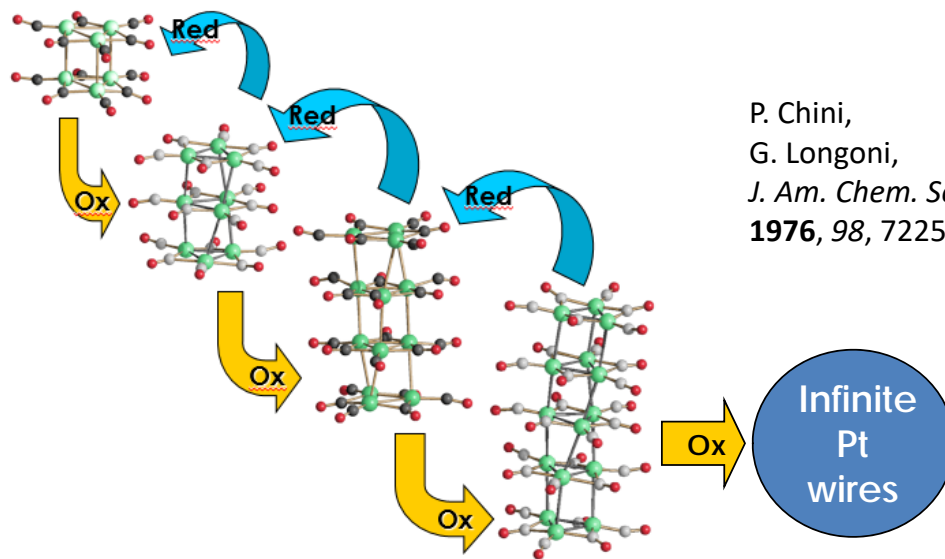
Application of Metal Carbonyl Clusters MCCs

Possible
Molecular
Nanocapacitors



F. Calderoni, F. Demartin,
F. Fabrizi de Biani, C. Femoni,
M. C. Iapalucci, G. Longoni,
P. Zanello, *Eur. J. Inorg. Chem.*,
1999, 663

Molecular Conductive Platinum Nanowires



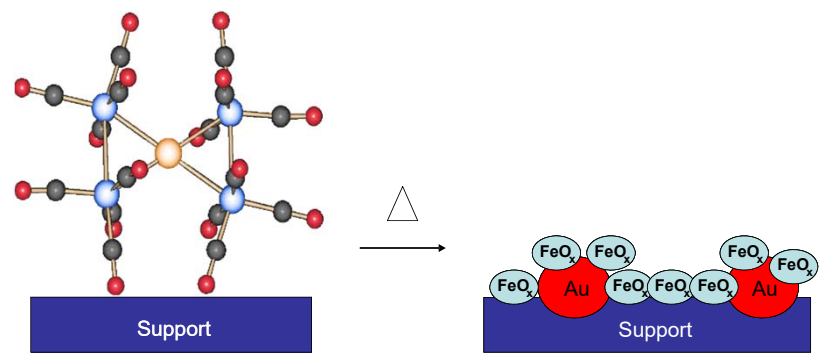
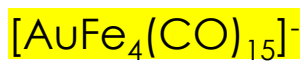
P. Chini,
G. Longoni,
J. Am. Chem. Soc.,
1976, 98, 7225

Angew. Chem., Int. Ed., **2006**,
45, 2060; *Eur. J. Inorg. Chem.*, **2007**,
1483-1486 ; *Inorg. Chem.*, **2010**,
49, 5992-6004.



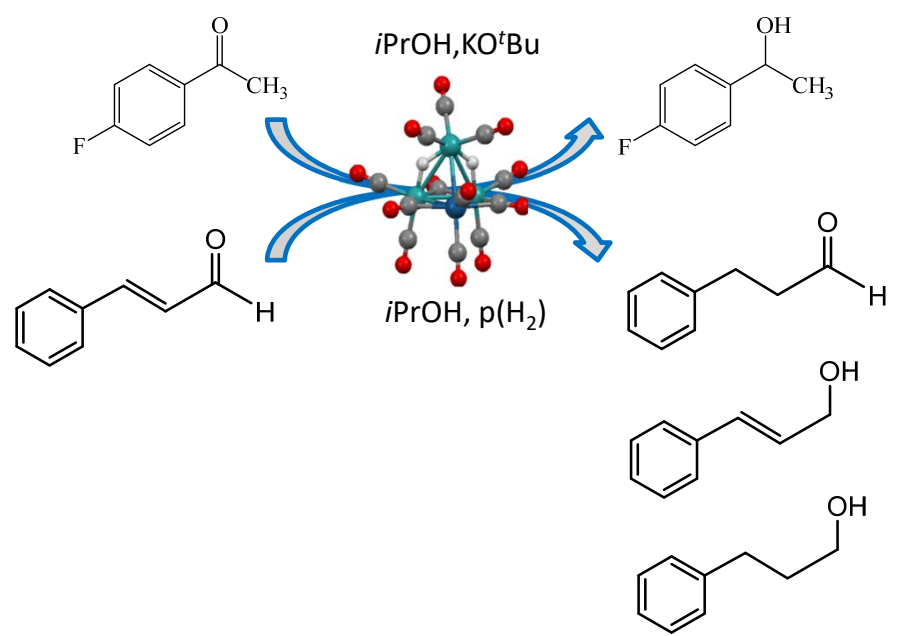
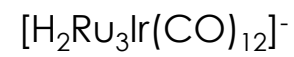
Application of Metal Carbonyl Clusters MCCs

Precursor for TiO₂-supported Catalysts



Catalysts, **2012**, 2, 1; *Appl. Catal. A*, **2011**, 400, 54,
Appl. Catal. A, **2010**, 372, 138

Precursor for omogeneous catalytic reactions





CHINANOR NANOMATERIALS



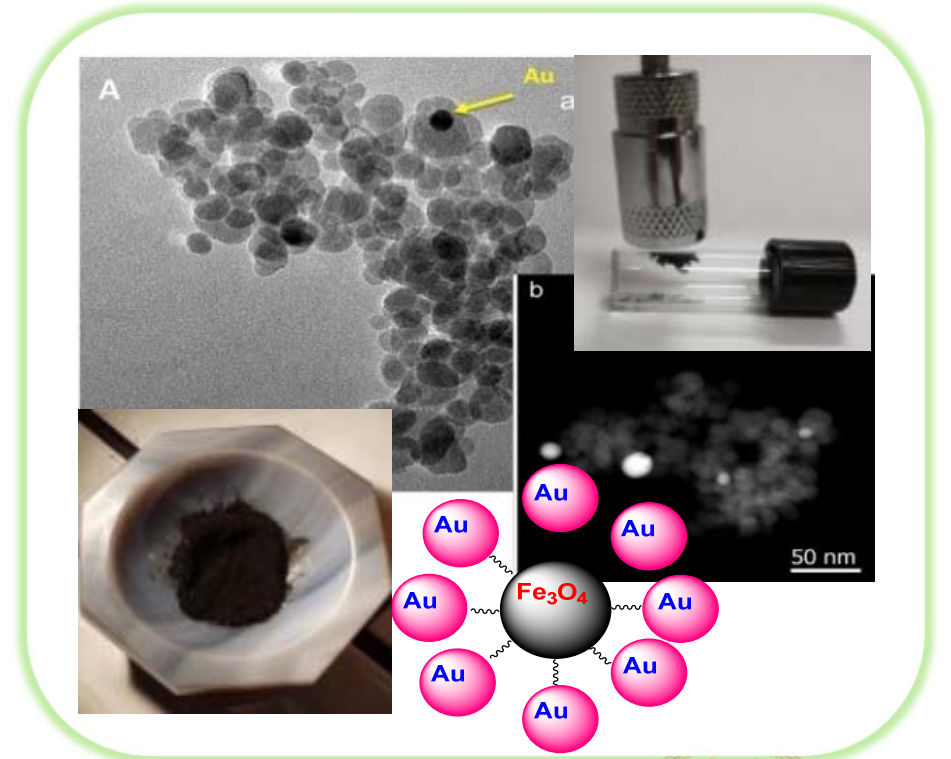
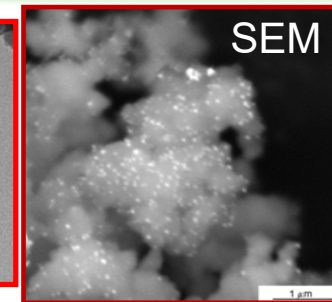
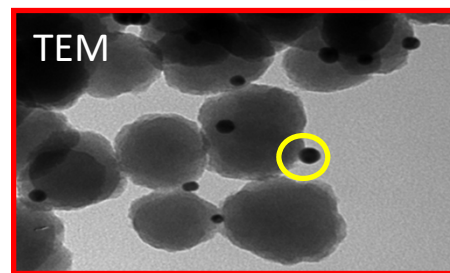
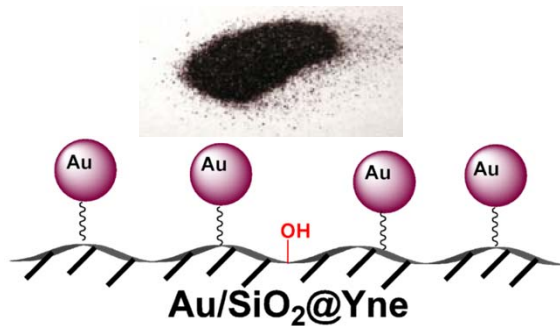
«solo la conoscenza a 360° dei materiali permette di sfruttare totalmente le loro proprietà»

Progettazione, preparazione e caratterizzazione di materiali nanostrutturati innovativi per applicazioni nel settore catalitico, ambientale ed energetico.

IL NANOMONDO PER APPLICAZIONI INDUSTRIALI

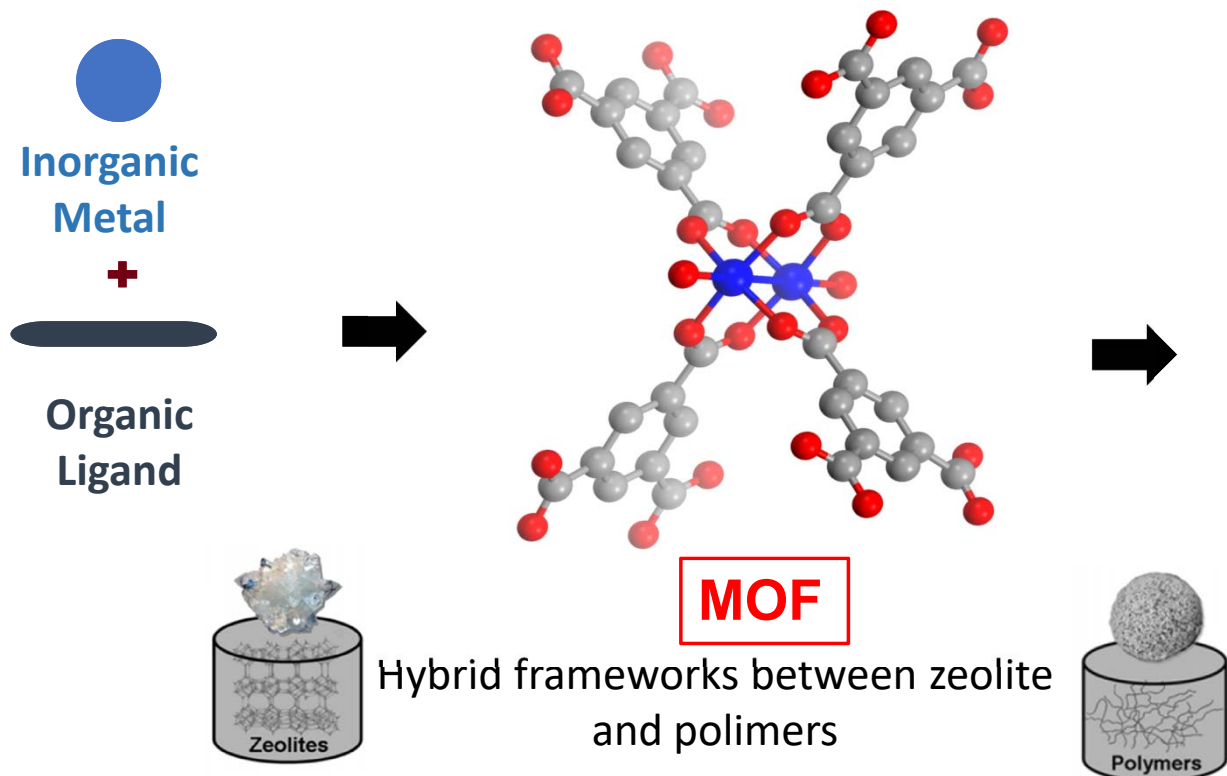
Sviluppo di sistemi nanostrutturati basati su nanoparticelle metalliche

Questa linea di ricerca riguarda la messa a punto di procedure sintetiche/elettrosintetiche atte all'ottenimento di sistemi nanostrutturati a base di nanoparticelle metalliche (Au, Ag, Pt ecc.) supportate su materiali di vario tipo (silice, allumina, titania, magnetite, idrotalcite, cellulosa, ecc.) funzionalizzati con residui organici. Tali nuove procedure riguardano sistemi che siano in grado sia di formare le nanoparticelle sia di stabilizzarle con gruppi funzionali opportuni (ammine, tioli, ecc.). Modulando opportunamente la scelta del supporto e/o del funzionalizzante utilizzato si riesce a controllare la distribuzione dimensionale delle nanoparticelle.

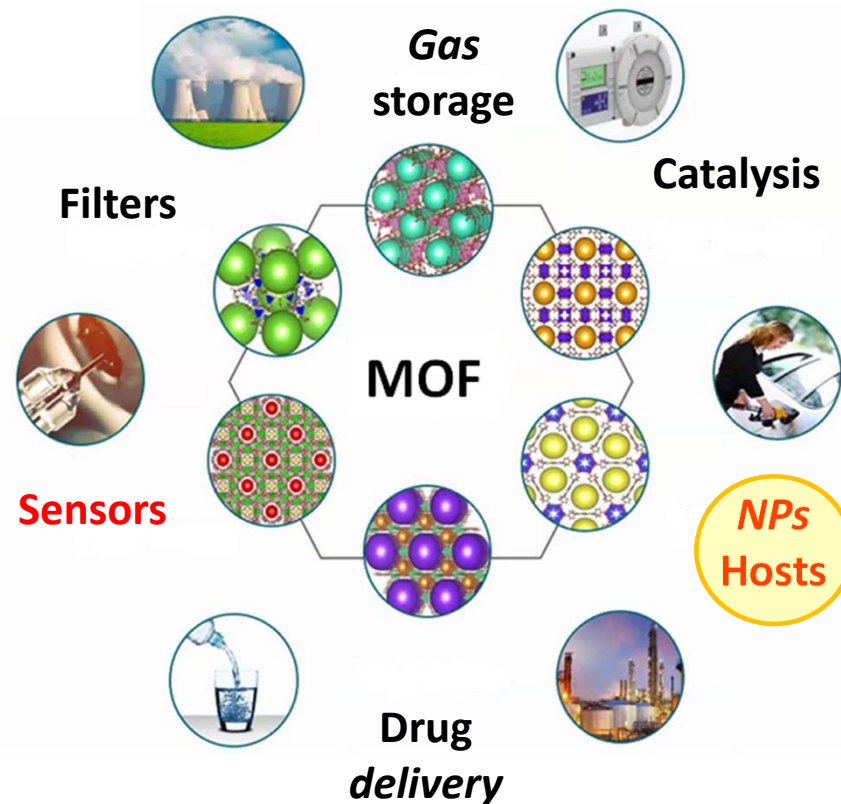


MOFs: Metal Organic Frameworks

I MOFs sono una classe di materiali cristallini con alta area superficiale. Rispetto ai tradizionali adsorbenti porosi, l'unicità della struttura cristallina dei MOFs permette di progettare strutture con dimensioni e proprietà chimico-fisiche della superficie interna dei pori predeterminate, per applicazioni specifiche.



Large variety of applications



METAL ORGANIC FRAMEWORKS (MOFs)

Sintesi

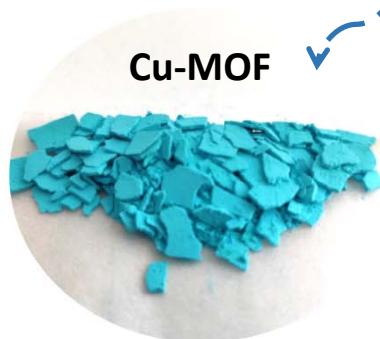
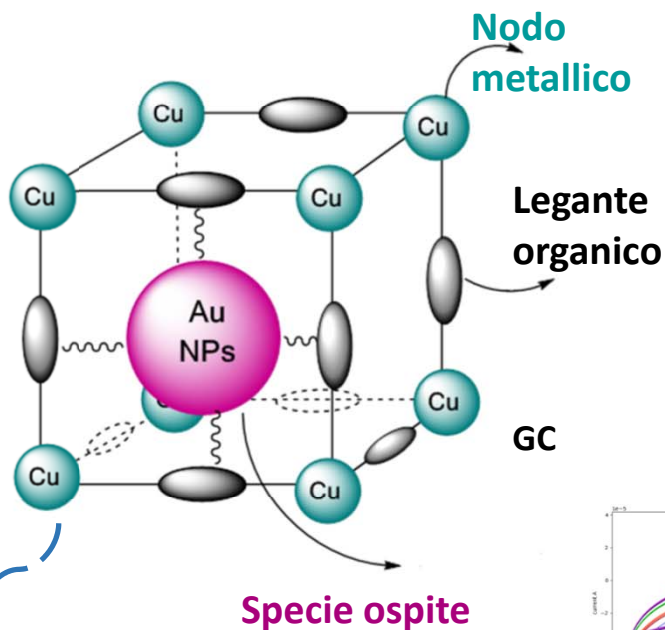
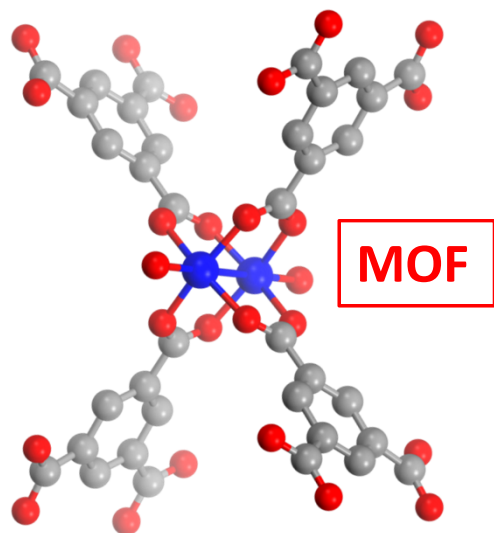
Legante



+



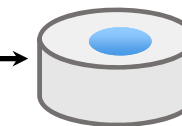
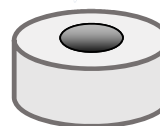
Metallo



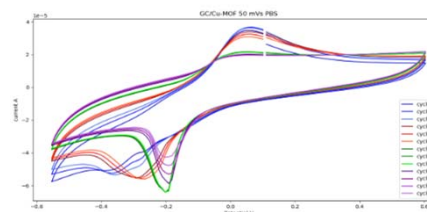
Sensore per nitriti



Synthesis of drop casted electrode



GC/Cu-MOF

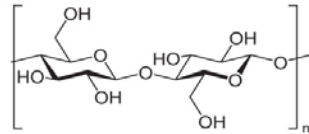


GC/Cu-MOF electrode with AuNPs

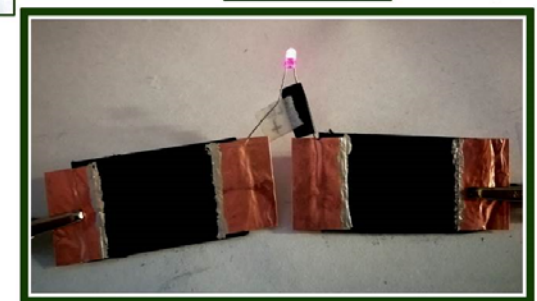
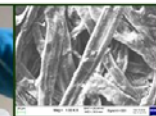
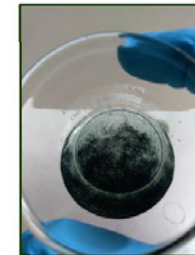
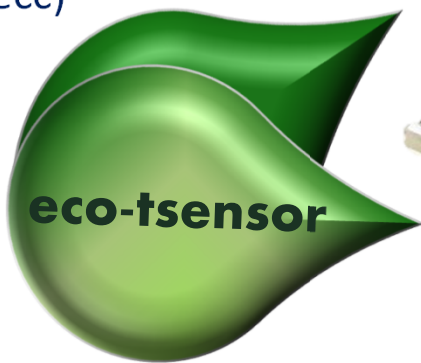
Dalla carta all'elettronica

Sviluppo di sistemi compositi per applicazioni nel settore energetico e sensoristico

Sintesi e/o elettrosintesi di film compositi a base di **polimeri conduttori**. Oltre ai polimeri, i materiali utilizzati nel composito possono essere ossidi, materiali conduttori, ma anche la più economica cellulosa.

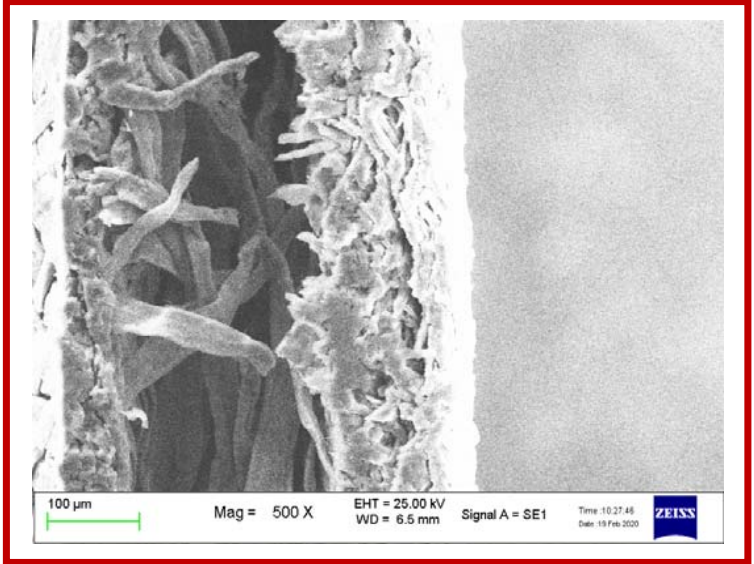
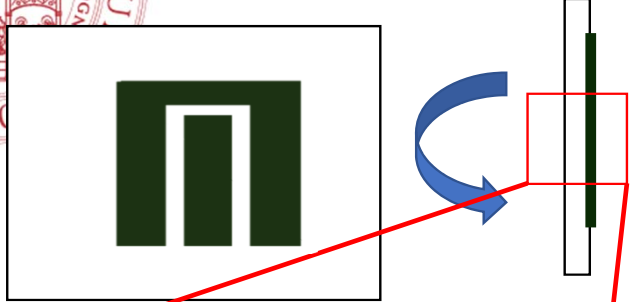


L'obiettivo è la costruzione di dispositivi in grado di accumulare energia, nel caso dei pseudocapacitori, o compiere funzioni utili, come nel caso della paper electronics (esempio sensori tattili, sensori per gas ecc)

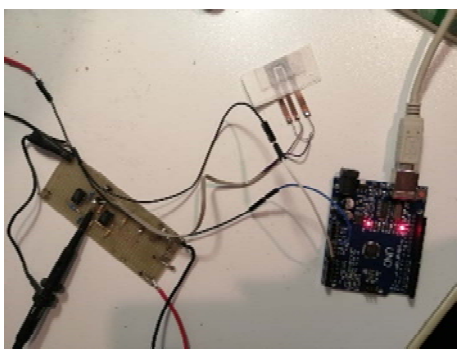
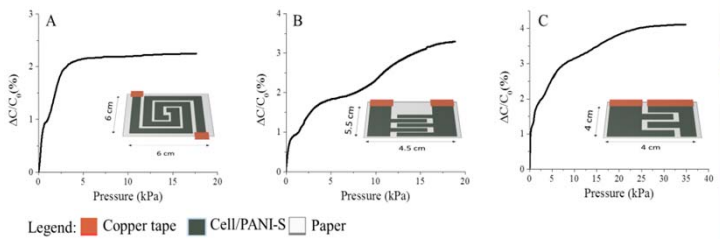




Smart paper: sensori di pressione e umidità

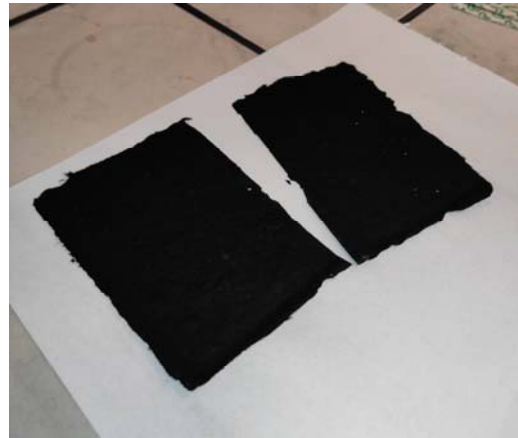
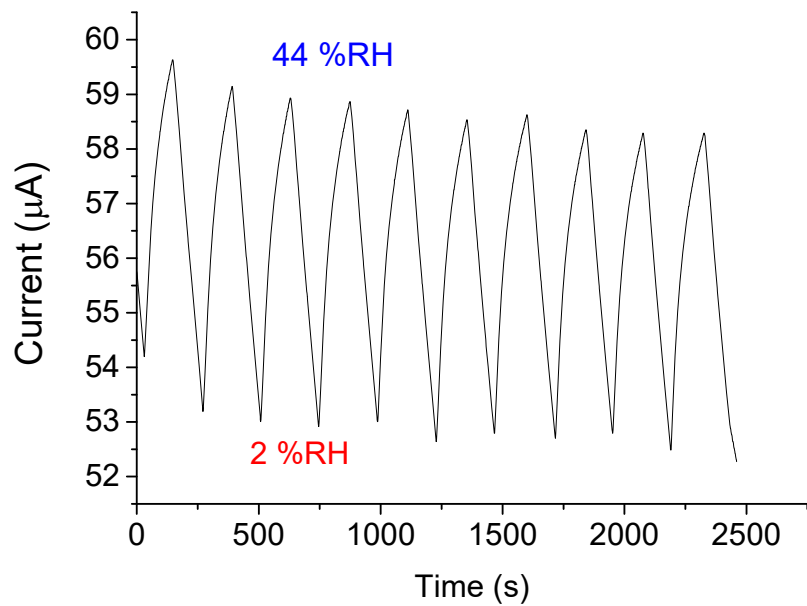
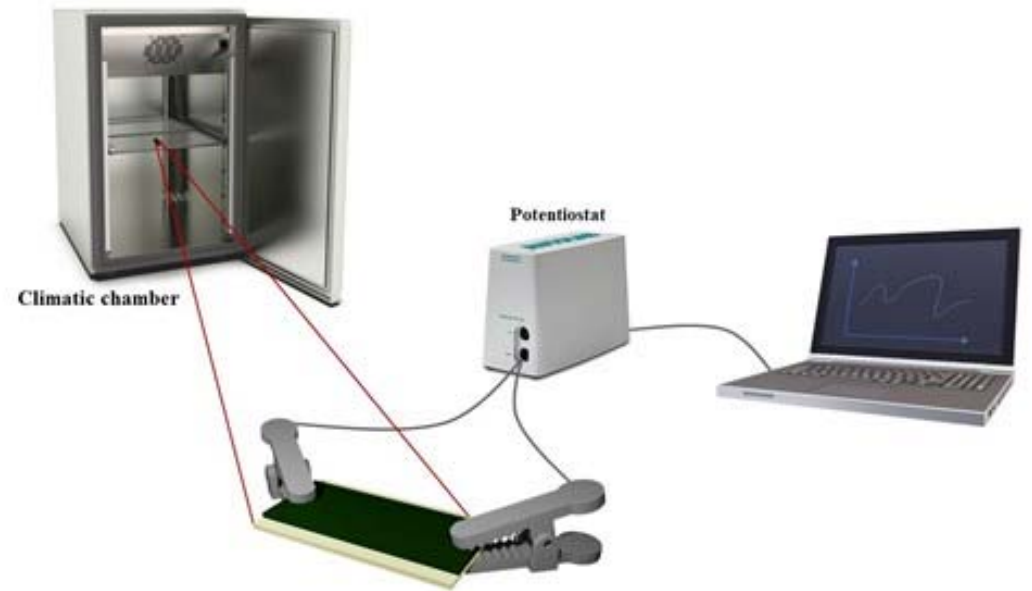


response time: 52 ms



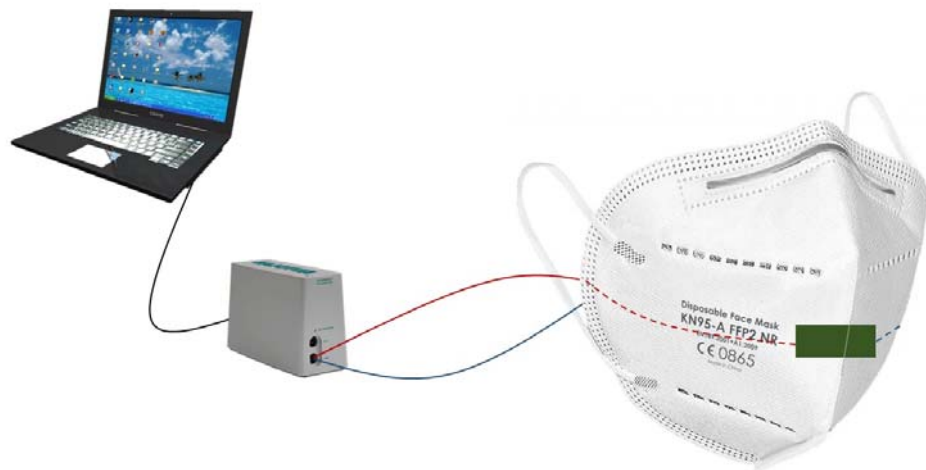
Interruttore
Misuratore di P

Smart paper: sensori di pressione e umidità

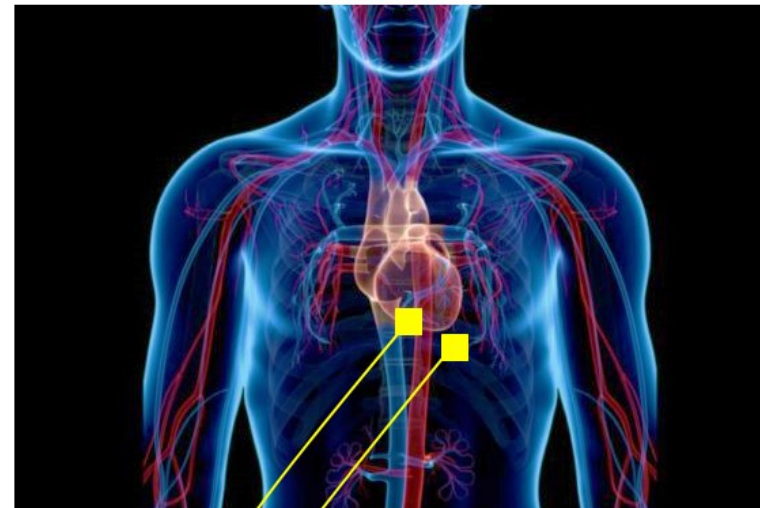


Smart paper: sensori FLESSIBILI

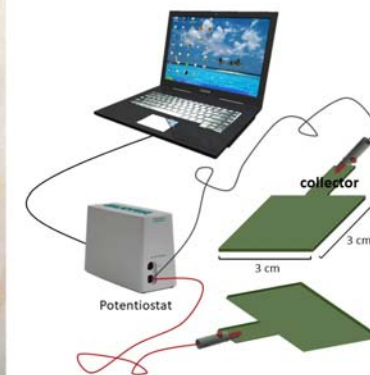
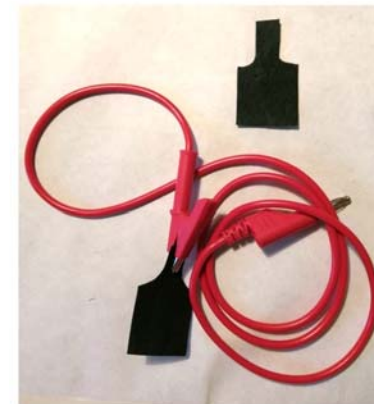
Controllo Respirazione



Controllo Attività Cardiaca



Potentiostat





IL NOSTRO GRUPPO DI RICERCA

<https://chimica-industriale.unibo.it/it/ricerca/gruppi-di-ricerca/chinanor>

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<https://www.unibo.it/sitoweb/daniele.nanni>



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maria.cassani@unibo.it

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Dr. Francesca Gambassi, studente PhD

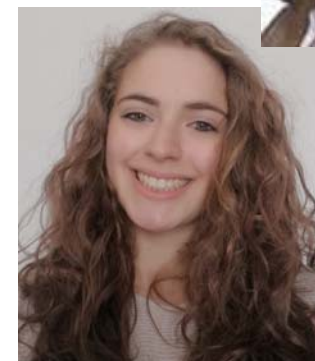
francesca.gambassi2@unibo.it

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Mauro Comes Franchini
Letizia Sambri
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Carla Boga

Dottorandi/Assegnisti/Borsisti

Giovanni Centonze
Chiara Portolani
Denisa Bisag
Chiara Spanu
Veronica Vetri Buratti
Mirko Maturi
Gabriele Micheletti
Francesca Gambassi
.....



ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

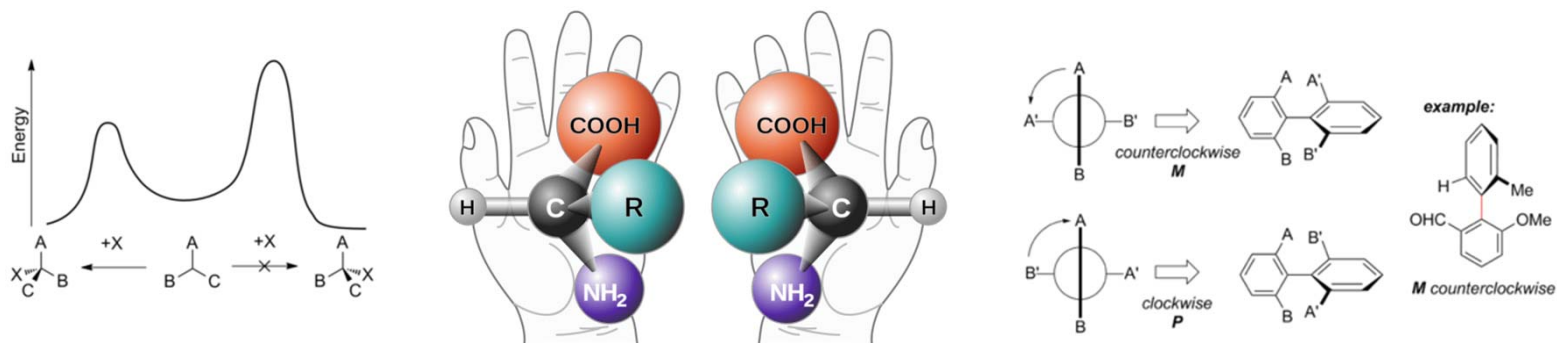
ORGANIC CHEMISTRY

- Prof Giorgio Bencivenni, Emanuela Marotta, Paolo Righi
- Prof Andrea Mazzanti
- Prof Luca Bernardi, Mariafrancesca Fochi

Dipartimento di Chimica Industriale «Toso Montanari»

ASYMMETRIC SYNTHESIS

Chemical reaction in which one or more new elements of **chirality** are formed in a substrate molecule and which produces the **enantiomeric** or **diastereomeric** products in **unequal amounts**.



Organocatalysis



**Nobel Prize In
Chemistry
2021**

Awarded for

**Developing
Organocatalysis**



ORGANIC SYNTHESIS

- Substrate synthesis and purification
- Reaction optimization



- Product characterization

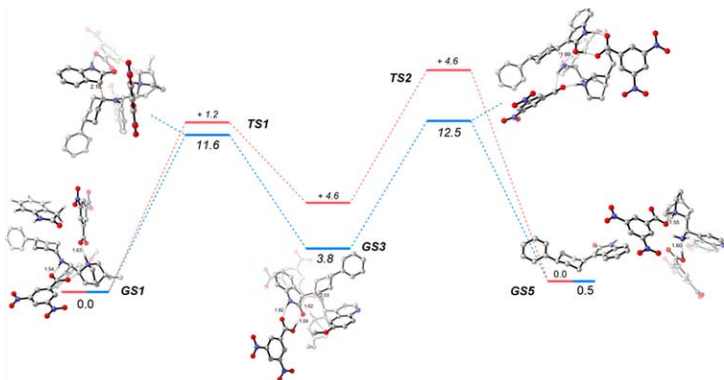


Nuclear
Magnetic
Resonance

Chiral
High Performance
Liquid
Chromatography



COMPUTATIONAL STUDIES



Gas
Chromatography

- DFT calculation

OCSA – Organic Catalysis Structural Analysis

Asymmetric Synthesis Lab

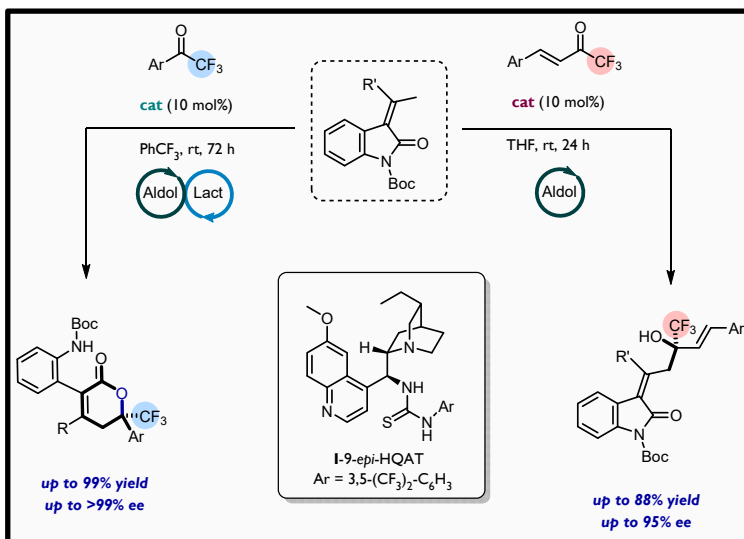
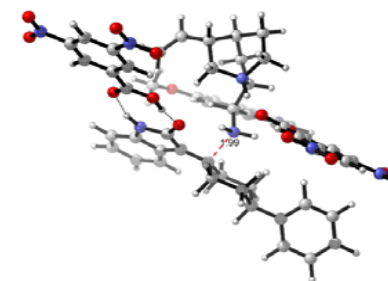
Prof. Giorgio Bencivenni – giorgio.bencivenni2@unibo.it

Prof. Emanuela Marotta – emanuela.marotta@unibo.it

Prof. Paolo Righi – paolo.righi@unibo.it

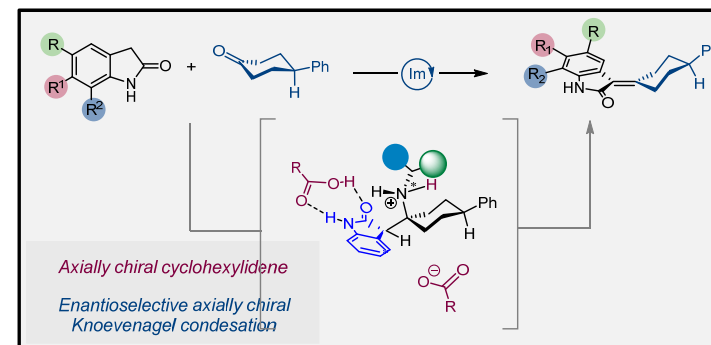
PhD Chiara Portolani – chiara.portolani2@unibo.it

PhD Giovanni Centonze – giovanni.centonze2@unibo.it



Bencivenni, et al. *J. Org. Chem.* **2018**, *83*, 12440.

Bencivenni, et al. *RSC Adv.*, **2018**, *8*, 33451



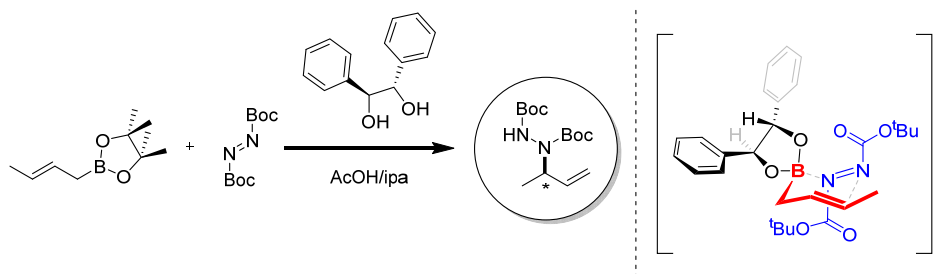
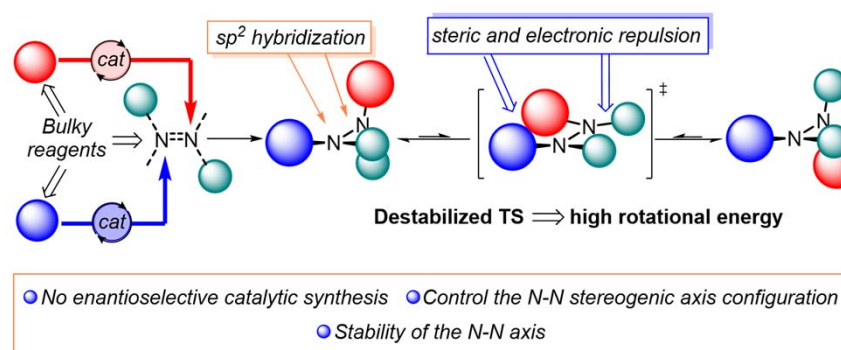
Bencivenni, et al. *Org. Lett.*, **2019**, *21*, 3013.

OCSA – Organic Catalysis Structural Analysis

Asymmetric Synthesis Lab

Current projects

- Asymmetric synthesis and computational studies of N-N atropisomers.



- Asymmetric crotylation of di-*tert*-butyl azodicarboxylates.

OCSA – Organic Catalysis Structural Analysis

Organic Spectroscopy

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Dr. Michele Mancinelli - michele.mancinelli@unibo.it

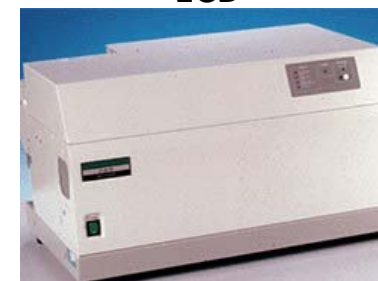
Synthesis of atropisomers.

Research on the conformational analysis of organic molecules.

- ^1H -NMR, ^{13}C -NMR, NOESY and bidimensional experiments, Dynamic Nuclear Magnetic Resonance (D-NMR).
- DFT and TD-DFT calculations associated with chiro-optical methods (ECD and VCD) can provide the absolute configuration of organic molecules.



NMR



ECD



VCD

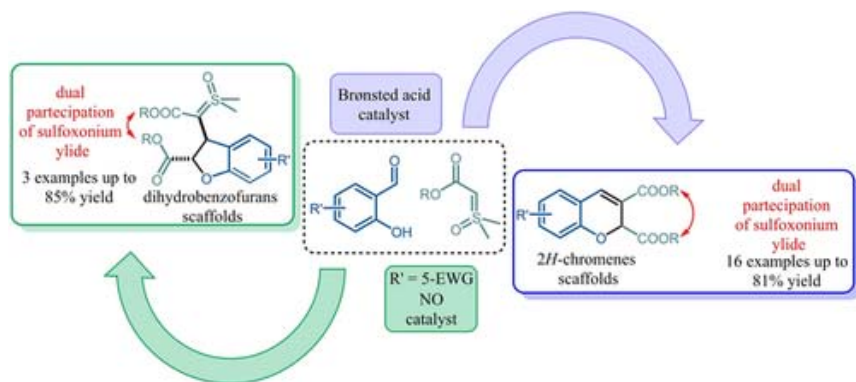
OCSA – Organic Catalysis Structural Analysis

BF Laboratory

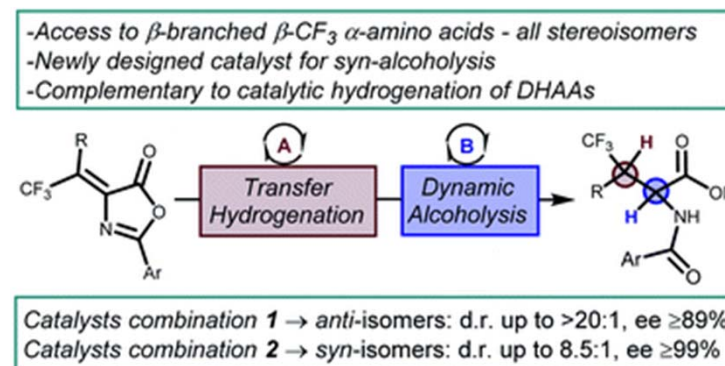
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PhD Giorgia Denisa Bisag - denisa.bisag@unibo.it



Bernardi et al. *Advanced Synthesis & Catalysis*, 2021, 363, 3053 – 3059.



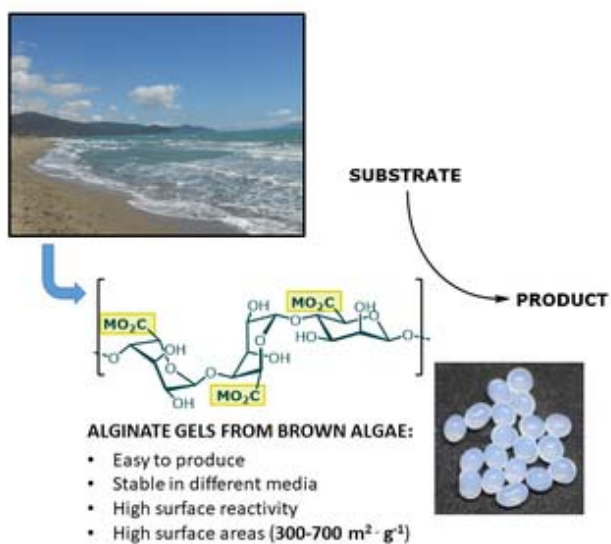
Bernardi et al. *Chemical Science*, 2021, 12, 10233 – 10241.

OCSA – Organic Catalysis Structural Analysis

BF Laboratory

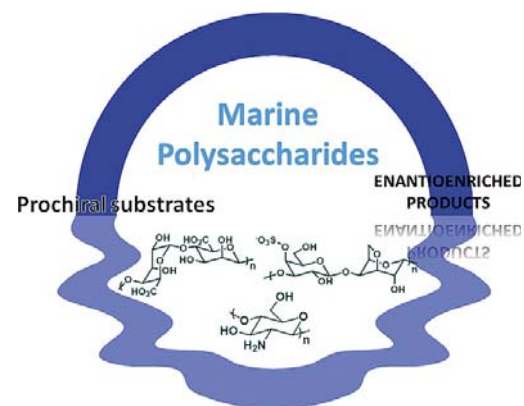
Blue chemistry: valorisation of marine biomass (polysaccharides)

From sea to flask!



In collaboration with Dr. Nathalie Tanchoux (CNRS, Montpellier, France).

Use of aginates from brown algae in enantioselective catalysis.





ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

MATERIAL PORTFOLIO 2022

Chimica Organica per i Materiali Avanzati
(Comes Franchini – Sambri)

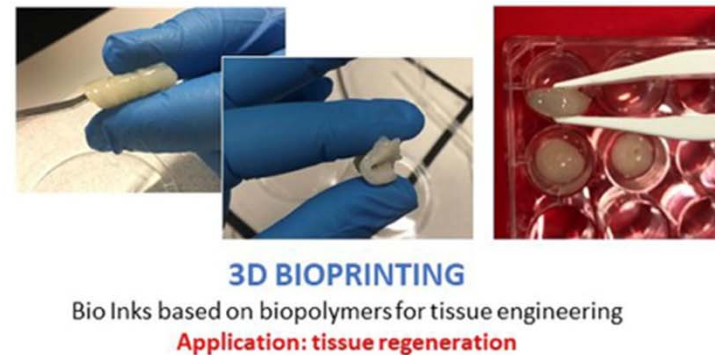
Dipartimento di Chimica Industriale "Toso Montanari"

Advanced Smart Organic Materials (ASOM)

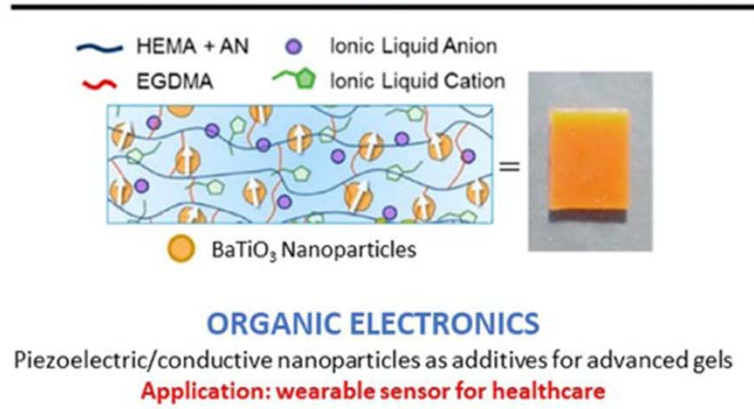
Sviluppo di materiali organici innovativi derivanti da fonti naturali aggiungendo funzioni “smart” quali la conduttività, la piezoelettricità e la fotoluminescenza



3D PRINTING
Bio-based luminescent resins for SLA printers.
Application: scaffold bone regeneration



3D BIOPRINTING
Bio Inks based on biopolymers for tissue engineering
Application: tissue regeneration



— HEMA + AN ● Ionic Liquid Anion
— EGDMA ● Ionic Liquid Cation

● BaTiO₃ Nanoparticles

ORGANIC ELECTRONICS
Piezoelectric/conductive nanoparticles as additives for advanced gels
Application: wearable sensor for healthcare



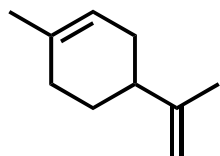
NC(=O)c1ccc(OCC(O)CNC(=O)c2ccc(OCC(O)CNC(=O)c3ccc(O)cc3)cc2)cc1

=

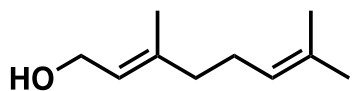
SMART DRUG DELIVERY
Nanocellulose as carrier for selective drug loading and release
Application: Slow prolonged drug release

Additive Manufacturing (3D-PRINTING)

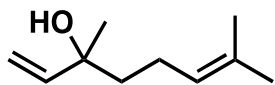
Additive Manufacturing (3D-printing) utilizzando resine biobased derivanti da molecole del pool naturale quali carboidrati, proteine, terpeni.



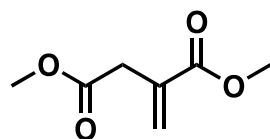
Limonene



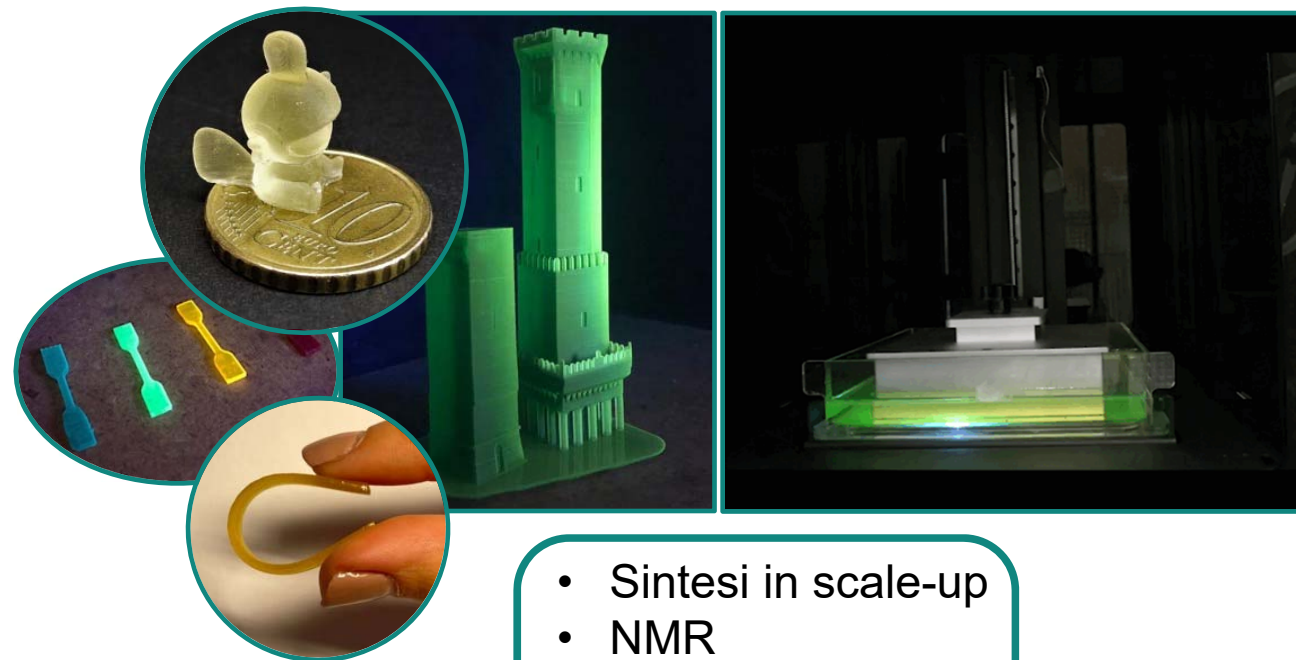
Geraniol



Linalool



Dimethyl itaconate



Stampanti 3D SLA (LCD e laser)



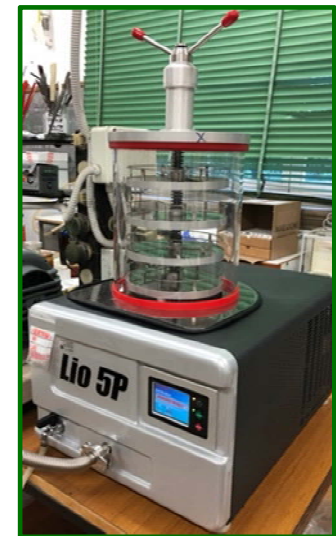
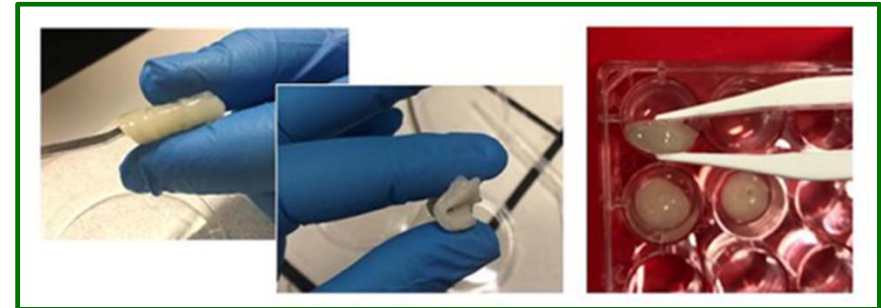
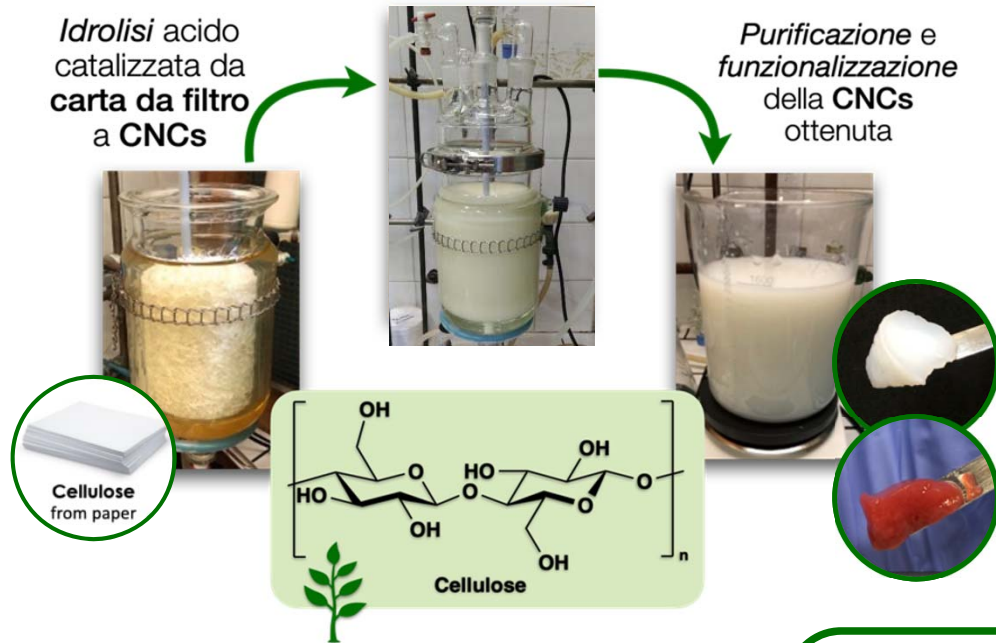
- Sintesi in scale-up
- NMR
- GPC
- Reologia
- Prove Meccaniche



3D-Bioprinting

Bio-ink partendo da Cellulosa, Zein per applicazioni in tissue regeneration

Laboratory Scale-Up

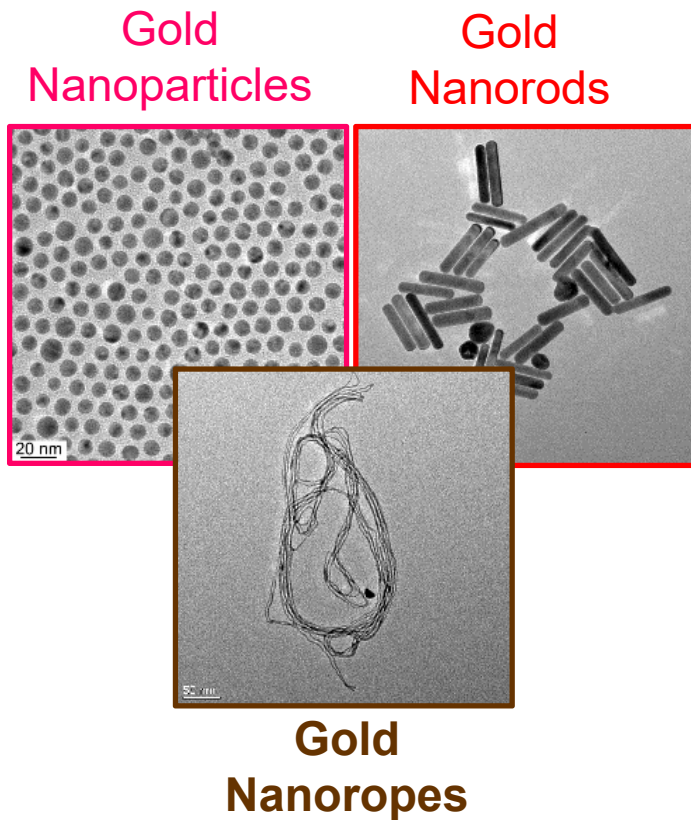


- Lavoro in cappa sterile
- Dialisi
- Liofilizzazione
- DLS
- SEM



Organic Electronics

Nanostrutture metalliche oro, argento, c-nanodots e molecole luminescenti per applicazioni sensoristiche o di imaging



Red-emitting Carbon Nano-Dots



Molecole Luminescenti

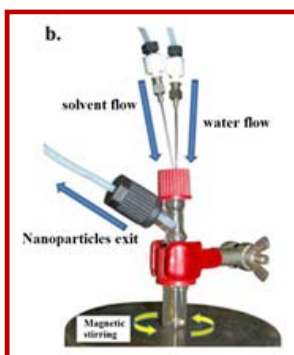
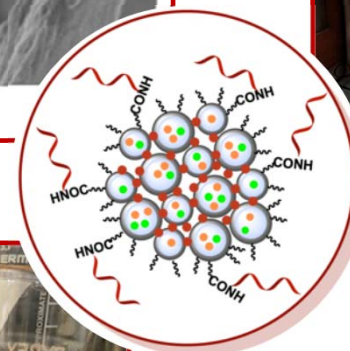
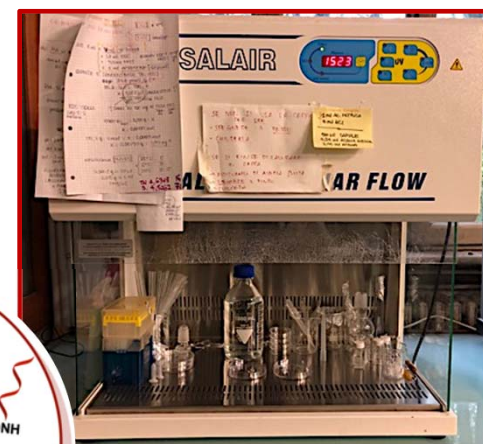
- UV-Vis
- Assorbimento atomico (AAS)
- Inductively coupled plasma mass spectrometry (ICP-MS)
- Spettrofluorimetro
- TEM/SEM
- Raggi X



Drug Delivery in NANOMEDICINE

Smart Drug Delivery utilizzando materiali quali nanocellulosa, caseina o PLGA-*b*-PEG per creare carrier per il trasporto e il rilascio prolungato di farmaci (*lipofilici o idrofilici*).

- Nanoprecipitazione
- Ultrasonificazione
- Lavoro in cappa sterile
- Dialisi
- Centrifuga
- Dynamic Light Scattering (DLS)
- Spettrofluorimetro
- UV-Vis



Nanoprecipitazione



Ultrasonicator





ALMA MATER STUDIORUM
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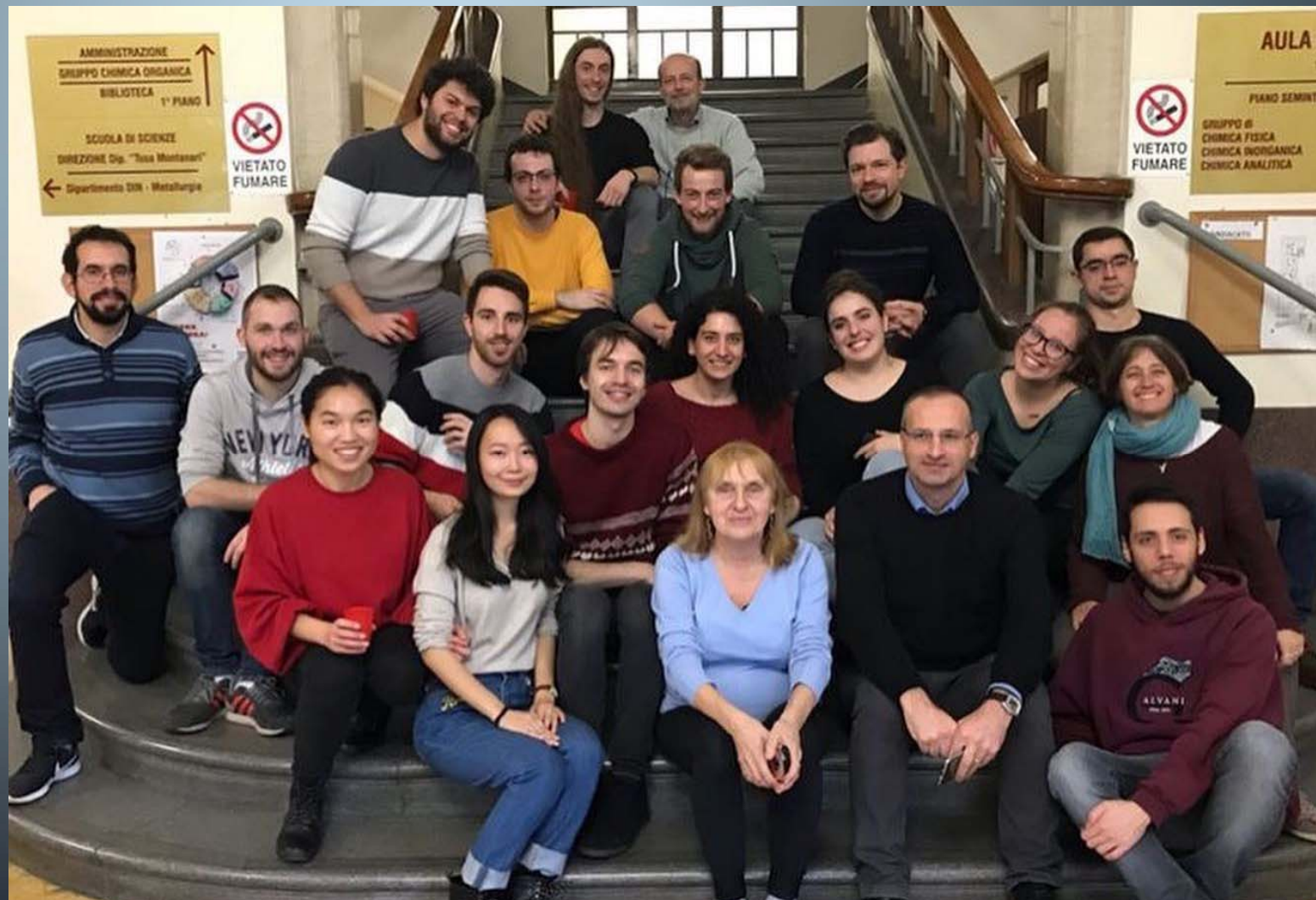
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Martina Serafini
Min Li
Mariam Maisuradze
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GRUPPO DI CHIMICA ANALITICA



**ELEKTRO
ANALYTICAL**



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TEMA DI RICERCA : IDROSSIDI DOPPI A STRATO (LDH)

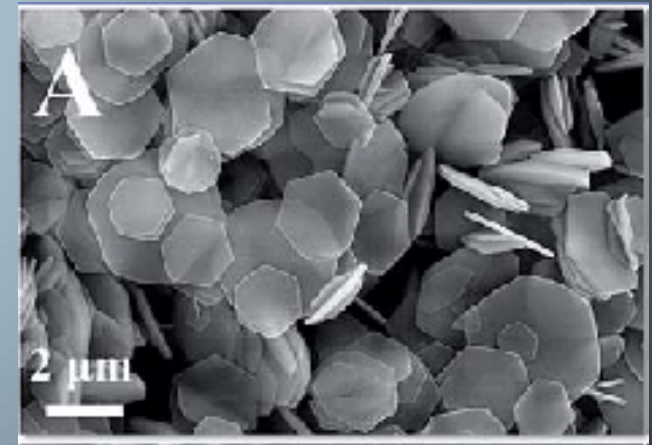
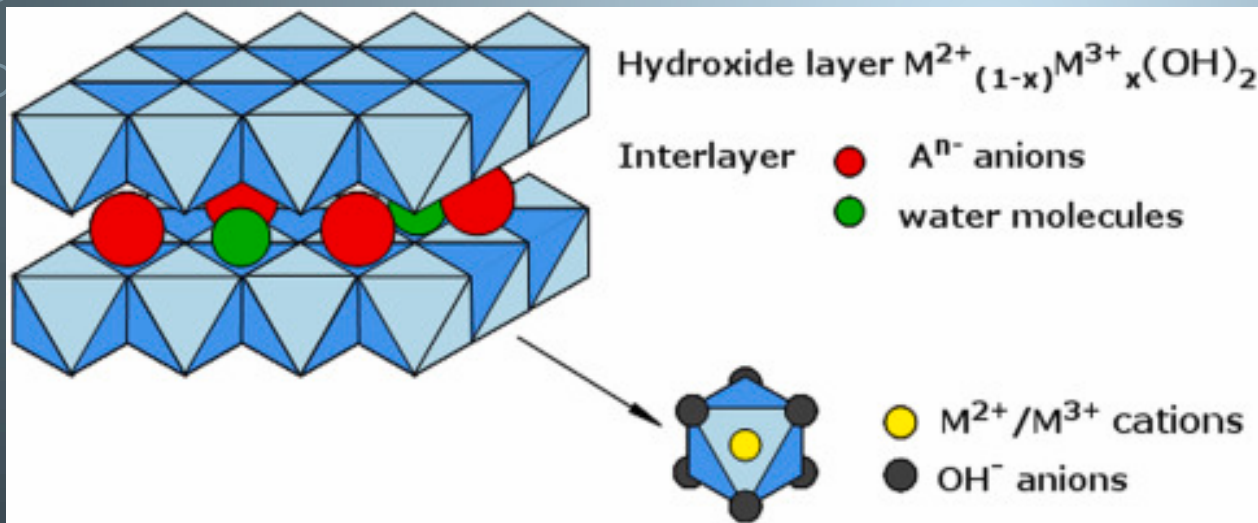


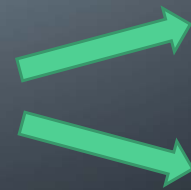
Immagine SEM di un LDH

Modifica di substrati elettrodi (Pt, Au, Grafoil) con LDH contenenti cationi metallici in vario rapporto ed eventuali specie intercalate

SINTESI
ELETTOCHIMICA



CARATTERIZZAZIONE



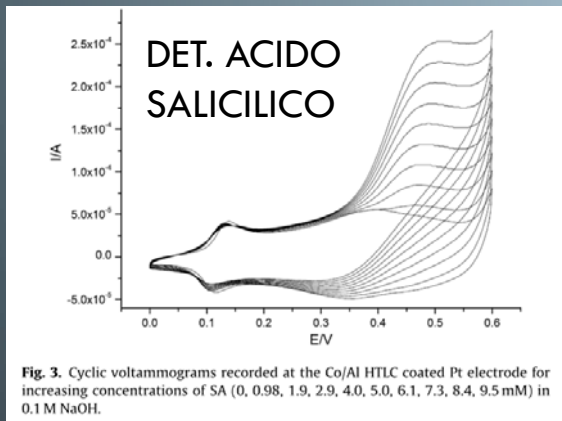
ELETTOCHIMICA

FISICA

TEMA DI RICERCA : IDROSSIDI DOPPI A STRATO (LDH)

SENSORI

ENERGY STORAGE

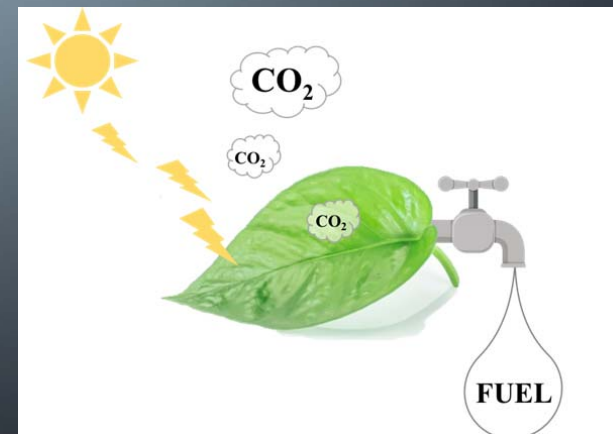
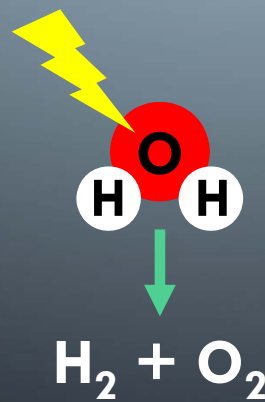
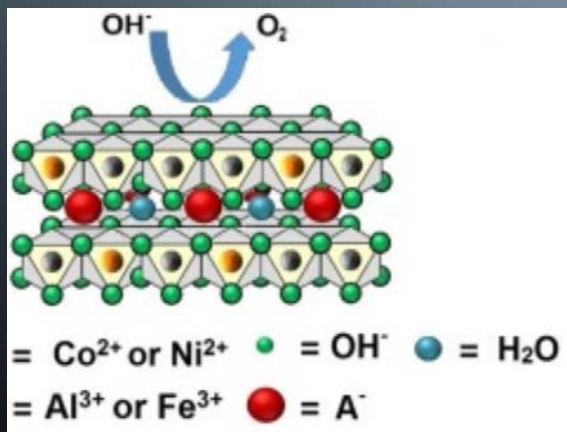


LDH

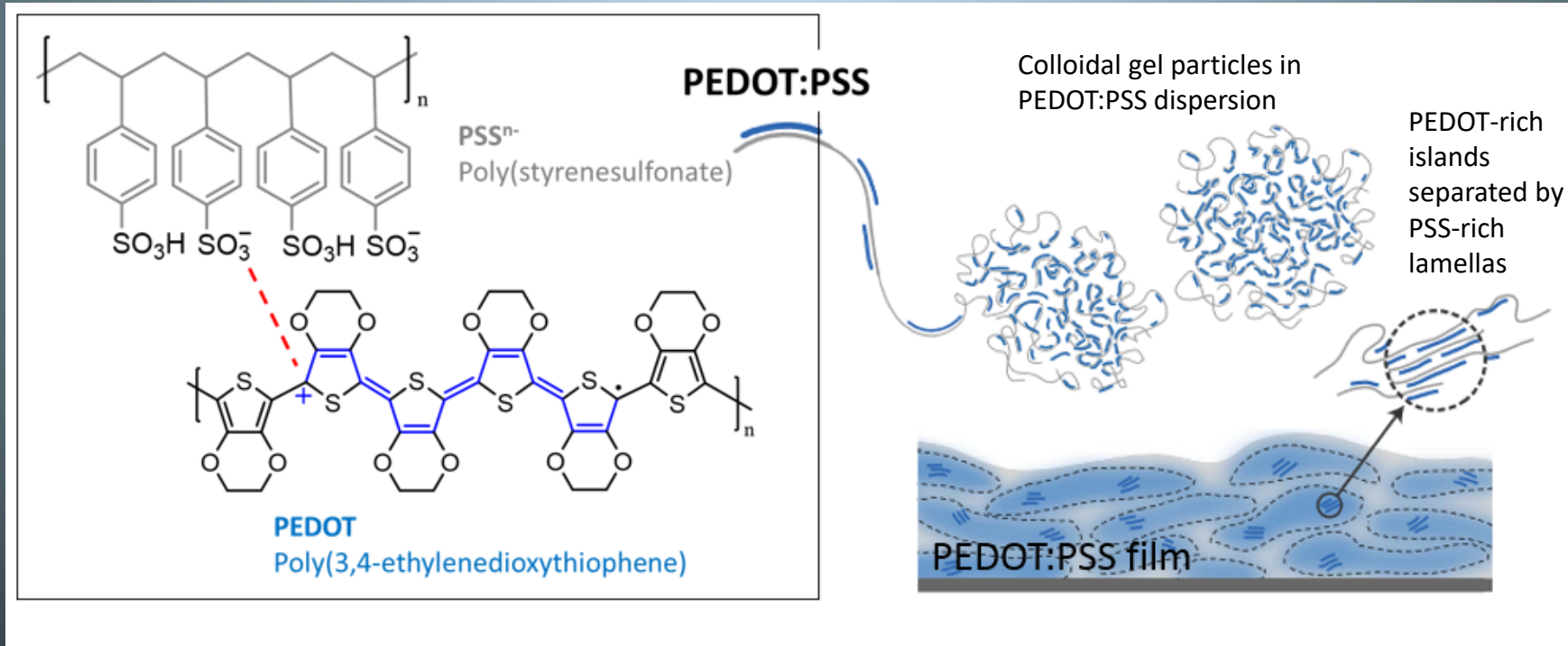


WATER SPLITTING

ELETTORIDUZIONE CO₂

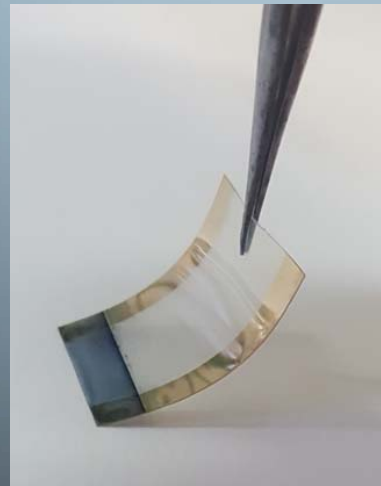
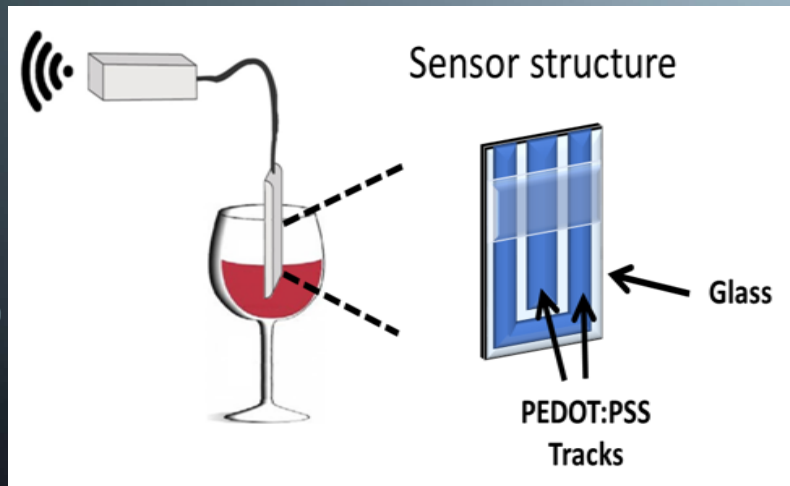
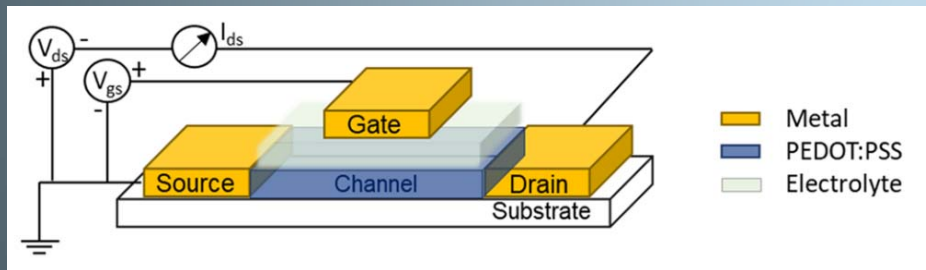


TEMA DI RICERCA : BIOELETTRONICA ORGANICA

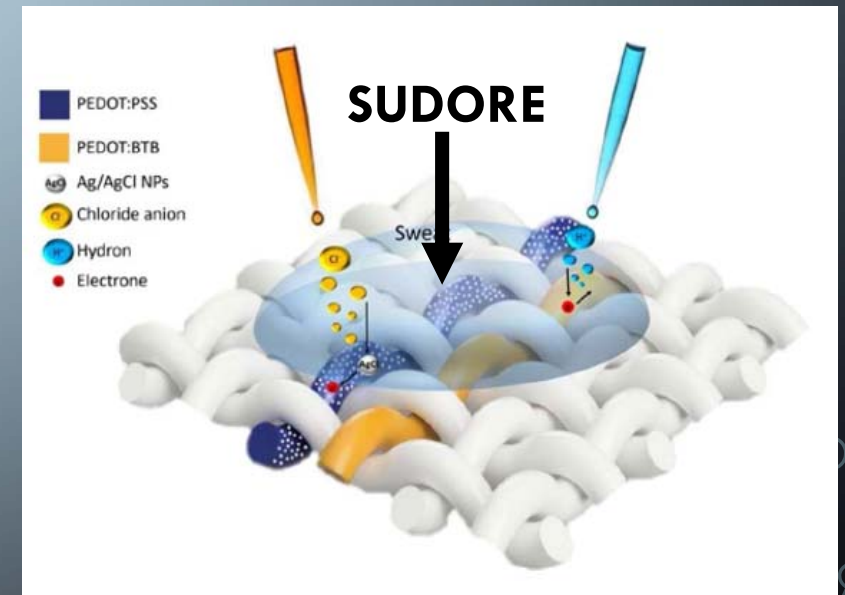


- Solido con basso Modulo di Young
- Biocompatibile
- Conduttore misto (conversione tra corrente ionica ed elettronica)
- Particolarmente adatto alla formazione di film sottili
- Leggero & flessibile

TEMA DI RICERCA : BIOELETTRONICA ORGANICA



Sensori per la determinazione di specie chimiche in matrici alimentari e gas pericolosi nell'ambiente



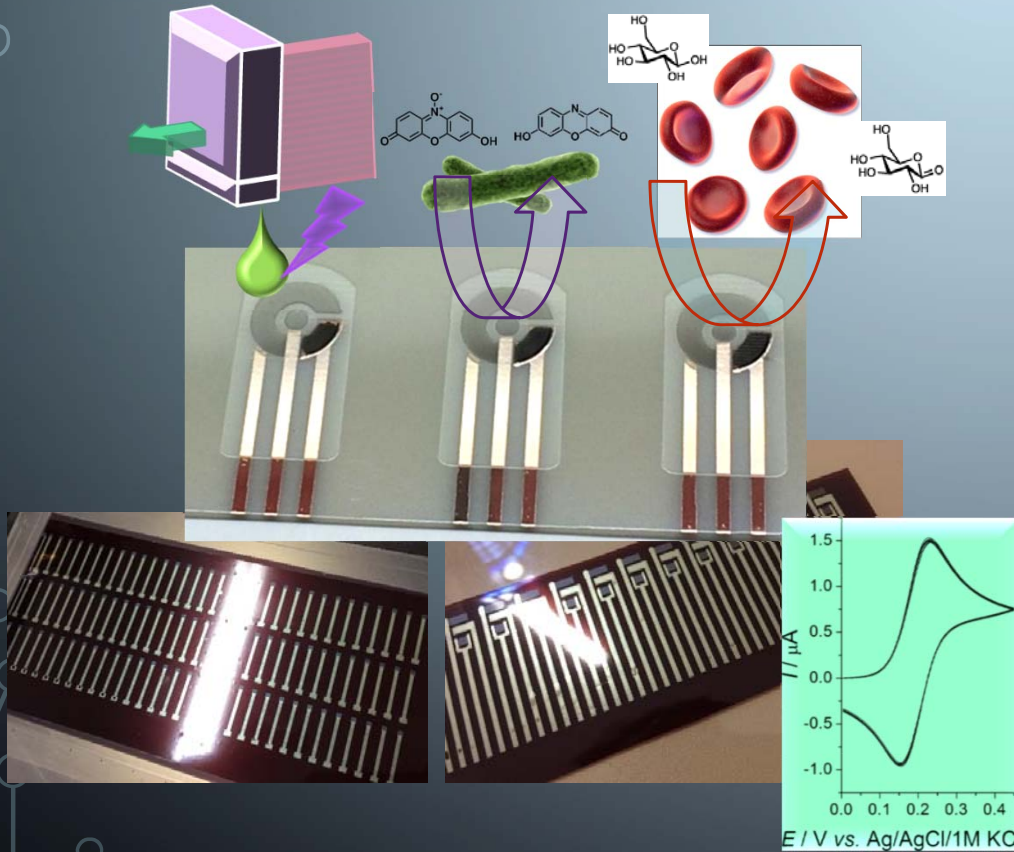
Sensori tessili indossabili: determinazione analiti di interesse biologico in campo medico e sportivo

TEMA DI RICERCA : SENSORI INKJET PRINTED

di tipo amperometrico e potenziometrico

Produzione dei sensori

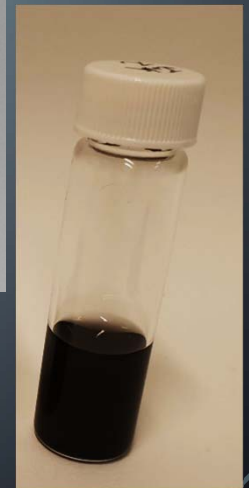
Biosensori elettroanalitici



Stampante a getto
d'inchiostro nel laboratorio



Goccioline
espulse



Inchiostro
preparato
nel
laboratorio

TEMA DI RICERCA : MICROSCOPIA A SCANSIONE ELETTOCHIMICA

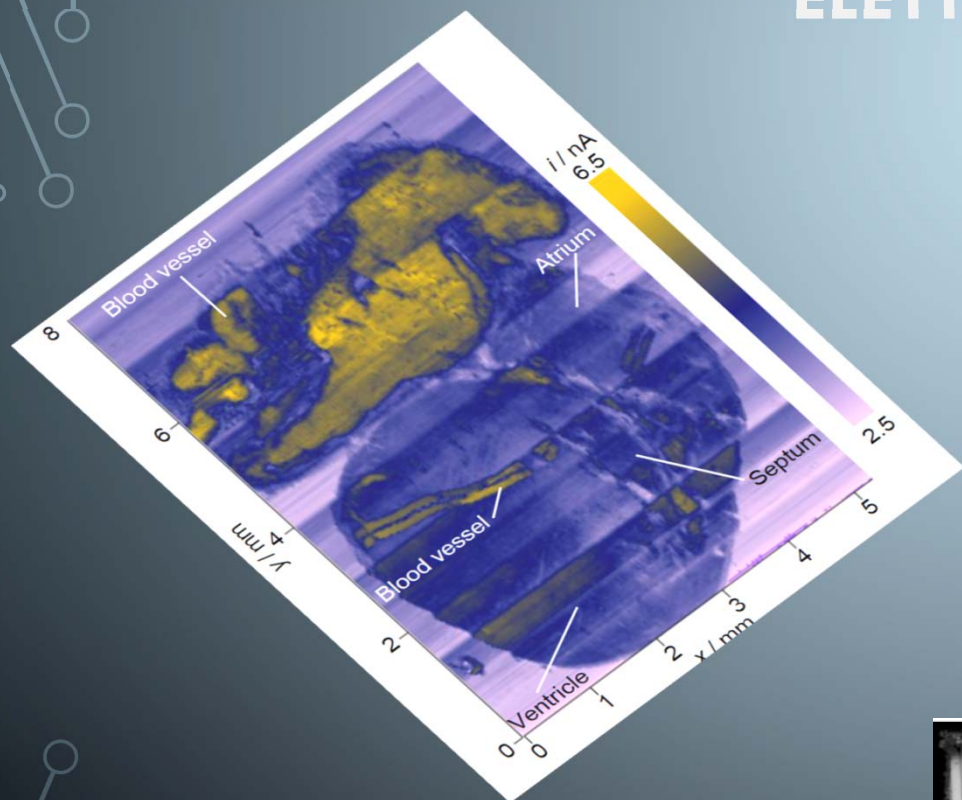
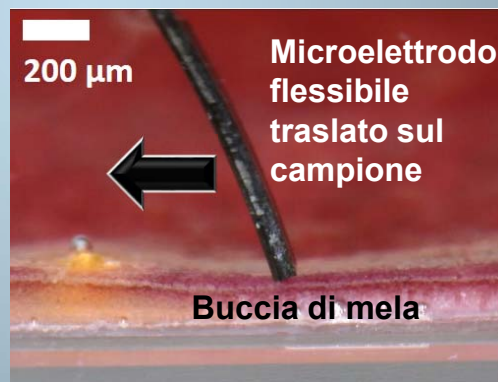


Immagine ottenuta con la microscopia elettrochimica: Distribuzione delle proteine nei tessuti biologici

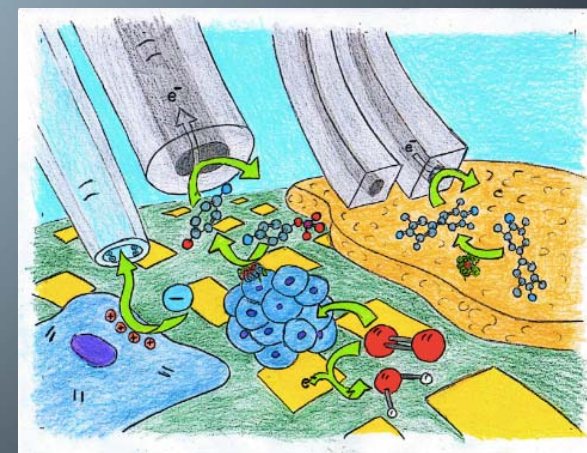


Microelettrodo flessibile su una buccia di mela per rilevare la distribuzione di antiossidanti



Microelettrodo di carbonio flessibile (Sezione trasversale)

Microscopia a scansione elettrochimica per studi sul cancro



Micro e nanoelettrodi

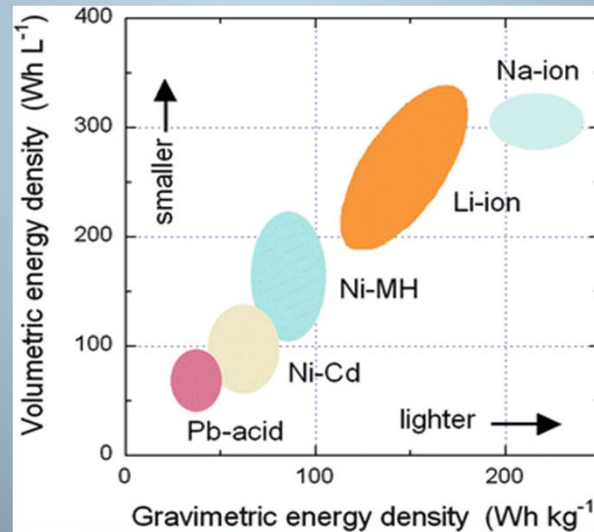
TEMA DI RICERCA : BATTERIE & SPETTROSCOPIA A RAGGI X

Team:

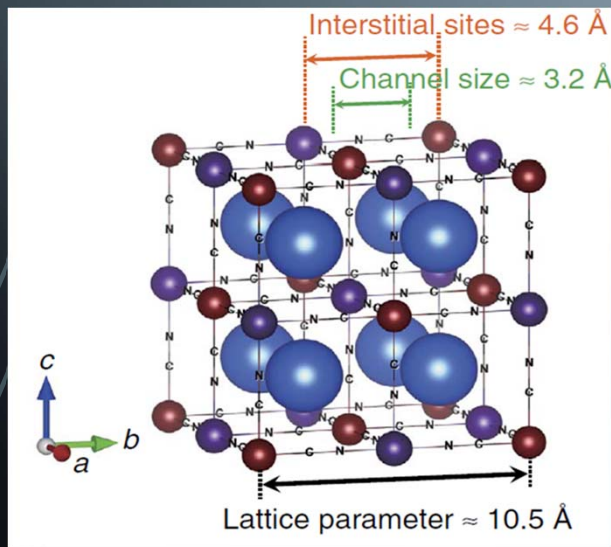
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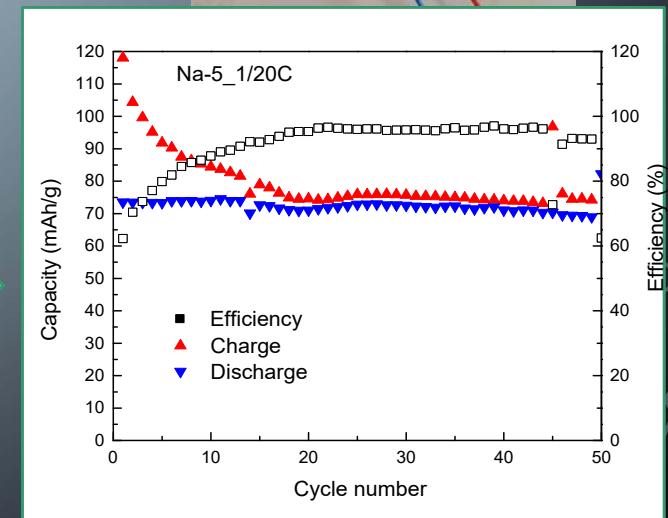
Sviluppo e caratterizzazione batterie Na-ion, K-ion, Zn-ion:



Sintesi di analoghi del Blu di Prussia come materiale elettrodico



Coin Cell

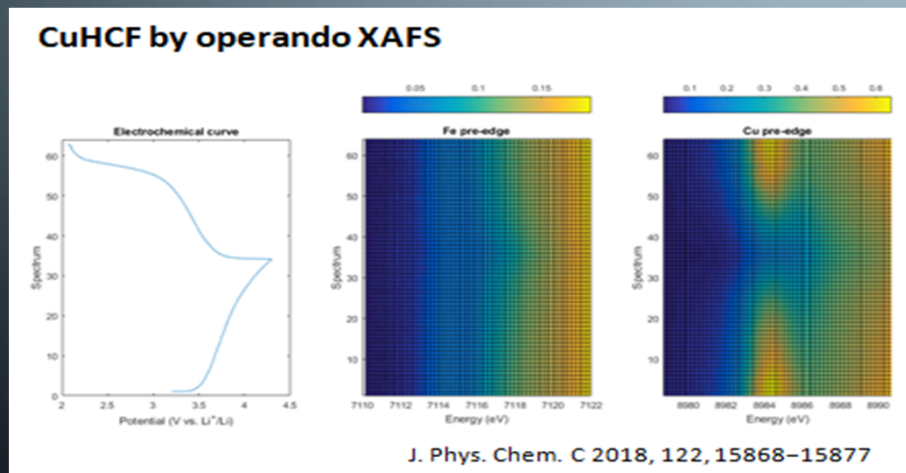


Prove di stabilità

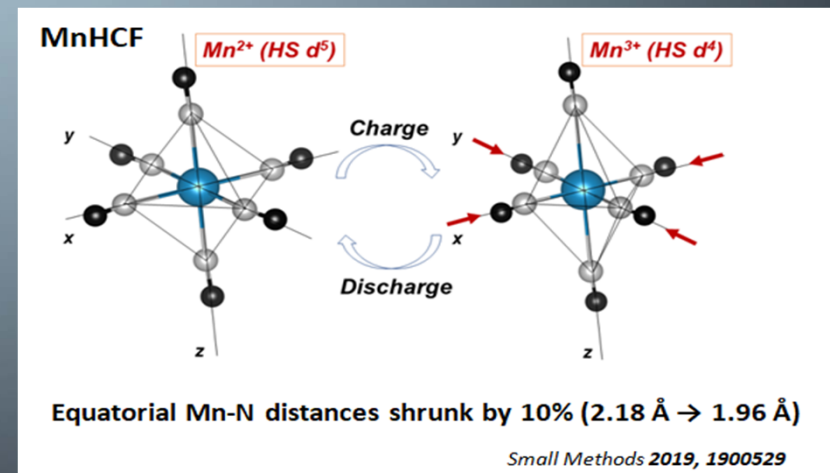
TEMA DI RICERCA : BATTERIE & SPETTROSCOPIA A RAGGI X

Tecniche a raggi X:

- 1) X-ray absorption spectroscopy (XAS)
- 2) Synchrotron X-Ray Powder diffraction (XRPD)
- 3) X-ray fluorescence (XRF)
- 4) X-ray photoelectron spectroscopy (XPS)



Identificazione dell'attività elettrochimica dei metalli



Quantificazione effetto Jahn-Teller

DYHWH#G X E E I#R #Q H#R OHWH#D SHUH#G I#S Ñ B

CONTATTATECI!

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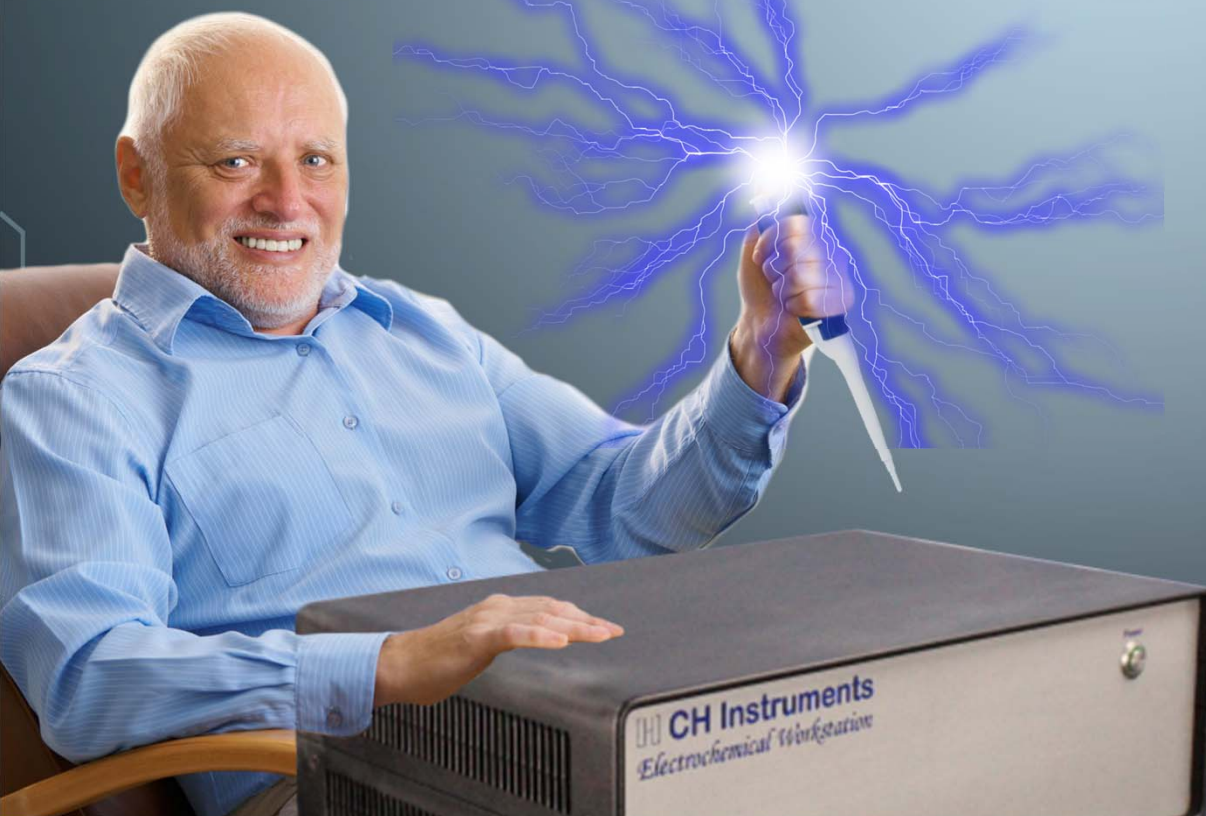
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Ivano Vassura

Fabrizio Passarini

Daniele Cespi

Luca Ciacci

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Massimiliano Boccarossa

Gianluca Torta

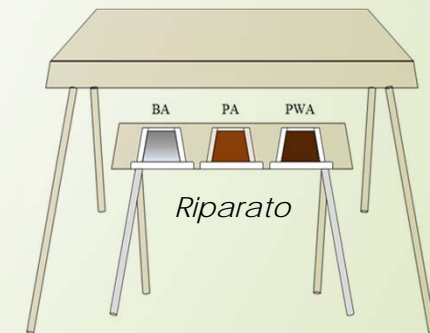
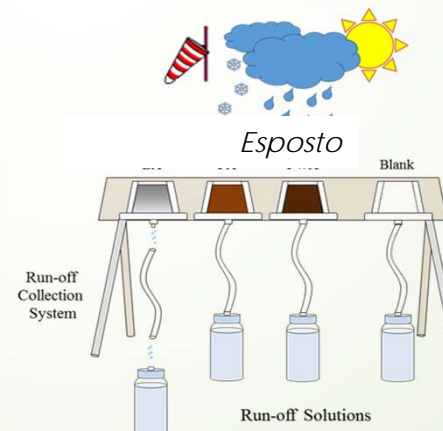
Linea di Ricerca: Ambiente e Beni Culturali

rif. Prof. Elena Bernardi: elena.bernardi@unibo.it

cecilia.velino2@unibo.it

Studio dell'influenza dell'ambiente sul degrado di materiali e sui prodotti protettivi utilizzati per applicazioni architettoniche, artistiche o industriali per:

- comprendere i meccanismi di degrado
- sviluppare adeguate strategie di protezione
- valutare prestazioni/durabilità di nuovi materiali



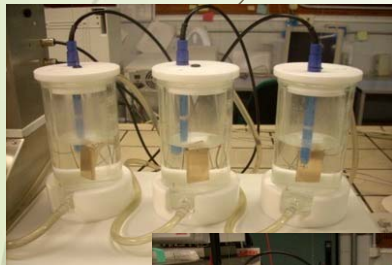
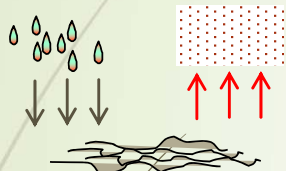
✓ Stazione di esposizione outdoor - Rimini

✓ Laboratorio per Invecchiamenti Accelerati - Bologna

Studio dei meccanismi di degrado e di efficienza/durabilità di prodotti protettivi o nuovi materiali attraverso simulazione di diverse condizioni di esposizione e livelli di inquinamento:

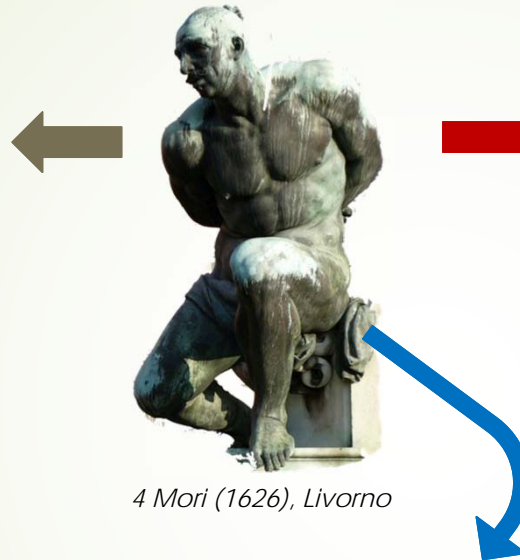
WET&DRY TEST

Test per immersioni alternate
Simula esposizione in condizioni
RIPARATE DALLA PIOGGIA BATTENTE



Wet

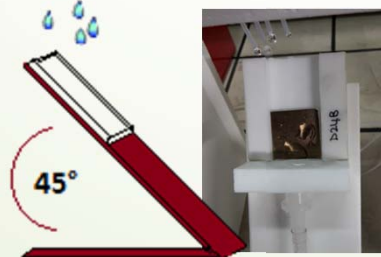
Dry



4 Mori (1626), Livorno

DROPPING TEST

Simula esposizione in condizioni di
PIOGGIA BATTENTE



TEST IN CAMERA CLIMATICA

Simula esposizione in
condizioni di
T, RH%, IRRAGGIAMENTO UV
variabili



Ambienti di invecchiamento:

- Condizioni di invecchiamento definite sulla base di dati ambientali.
- Piogge e particolato atmosferico riprodotti in laboratorio o campionati in ambiente

Pianificazione dei test effettuata, ove opportuno, anche attraverso DoE

Caratterizzazione di:

- Materiali invecchiati
- Ambiente di invecchiamento

Esempi di alcuni materiali indagati:

- Metalli e Leghe (bronzo, weathering steel, Al)
- Materiali lapidei (pietre e terrecotte)
- Materiali polimerici (resine per integrazioni)



PROTECTION & CONSERVATION
of Heritage airCRAFT

✓ Strumentazione utilizzata

TECNICHE MICROSCOPICHE

- Microscopia ottica
- Microscopia elettronica
 - SEM/FEG
 - SEM/EDS

TECNICHE SPETTROSCOPICHE:

- Assorbimento atomico (AAS)
- Emissione atomica al plasma (MP-AES)
- IR
- Raman



TECNICHE CROMATOGRAFICHE

- Cromatografia ionica (IC)
- Cromatografia liquida (HPLC)



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rif. Prof. Ivano Vassura: ivano.vassura@unibo.it

Tecnopolo di Rimini – attività di Ricerca Gruppo Ambiente

La chimica in un'economia circolare



• Analizzare il ciclo di vita delle risorse nei sistemi antropici

Quanta materia è disponibile per riuso, recupero e riciclo?
Dove si trova?

• Stimare l'impatto ambientale di prodotti e processi

Qual è la soluzione più sostenibile?



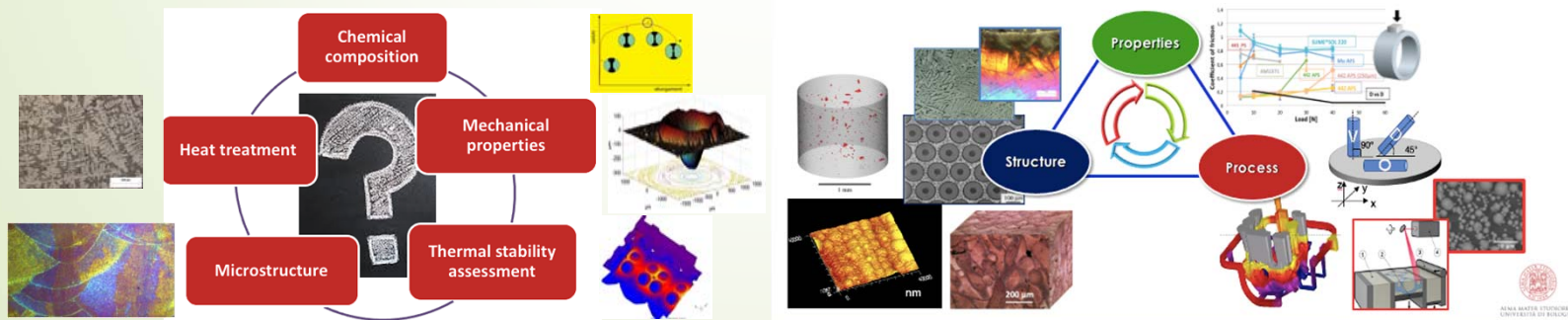
Il controllo degli inquinanti ambientali

- Monitoraggio in comparti ambientali (aria, acqua, suolo)
- Studio delle emissioni di contaminanti emergenti e non da impianti di depurazione acque
- Microplastiche nell'ambiente: tecniche di determinazione tramite pirolisi analitica

rif. Prof. Ivano Vassura: ivano.vassura@unibo.it

Argomenti di tesi (Gruppo Metallurgia, Dip. DIN)

- Studio **microstrutturale** e **meccanico** (prove di trazione, durezza, fatica, attrito ed usura) di materiali metallici (massivi, modificati superficialmente o compositi):
 - **prodotti mediante tecnologie additive** (*additive manufacturing*, noto anche come stampa 3D)
 - sviluppati in ottica di **alleggerimento strutturale veicoli** (riduzione consumo energetico ed emissioni CO₂)
 - per **limitazione consumo materie prime critiche**



Progetti recenti e in corso

- **NEWMAN** (EIT KIC Raw Materials, KAVA 6 - Upscaling projects 2020: «Nickel frEe poWders for high perforMAnce compoNents» 2020-21)
- **ACMEC** (POR-FESR «Additive manufacturing and Cyber-physical technologies for MEChatronics of the future» 2019-21)
- **RIMMEL** (POR-FESR «Multifunctional and multiscale coatings for mechanical components produced by additive manufacturing» 2019-21)
- **PAR-ENEA** (Italian National Agency for New Technologies, Energy & Sustainable Economic Development «Tribological study of alloys for the electrical system produced by additive manufacturing» 2020-21)
- **PROCRAFT** (JPI-CH «PROtection and conservation of Heritage AirCRAFT» 2020-23)



EIT RawMaterials is supported by the EIT, a body of the European Union



Regione Emilia-Romagna



The JPI Cultural Heritage project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 699523

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Giuseppe Fornasari
Patricia Benito Martin
Nikolaos Dimitratos
Tommaso Tabanelli
Andrea Fasolini

Dottorandi/Assegnisti/Borsisti

Gabriele Galletti
Alessandro Allegri
Eleonora Tosi Brandi
Anna Gagliardi
Ilenia Giarnieri
Alessandro Manna
Claudio Monaco
Ludovica Conte
Alessia Ventimiglia
Alessandro Allegri
Riccardo Bacchiocchi
Federico Bugli
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Francesca Liuzzi
Liu Weifeng
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CATALYSIS FOR RENEWABLES AND INNOVATIVE PROCESSES «CARE IN PROCESS»

Alessandro Allegri

Gabriele Galletti



WHO WE ARE

Prof.ssa Stefania Albonetti

Prof. Francesco Basile

Prof.ssa Patricia Benito

Prof. Fabrizio Cavani

Prof. Nikolaos Dimitratos

Prof. Giuseppe Fornasari

Prof Carlo Lucarelli (UnInsubria)

Dott. Andrea Fasolini

Dott. Tommaso Tabanelli

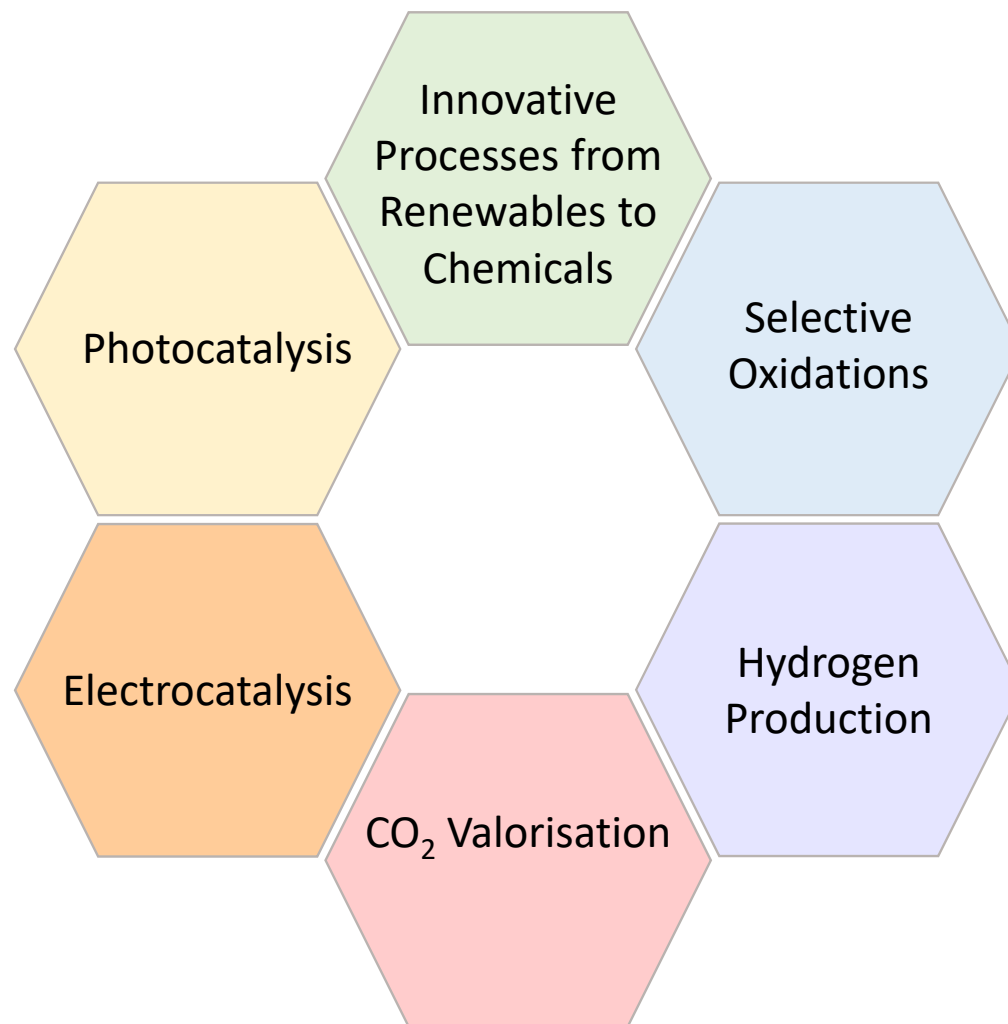
4 Research Fellows

12 PhD Students

3 Post-Doctorate
Research Fellows

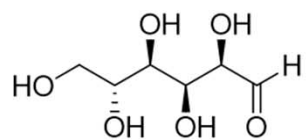


RESEARCH LINES

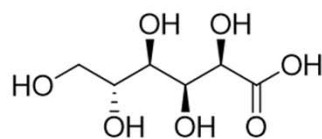


RESEARCH LINES

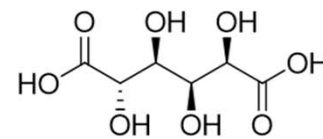
Innovative
Processes from
Renewables to
Chemicals



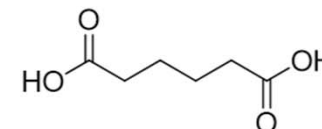
D-Glucose



D-Gluconic acid

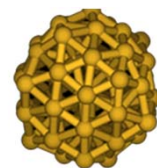


D-Gluconic acid

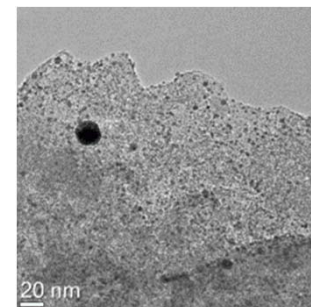


Biobased Adipic acid

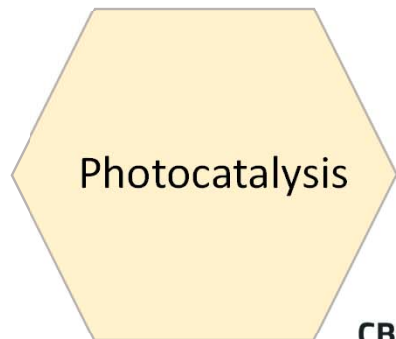
→ **Nylon**



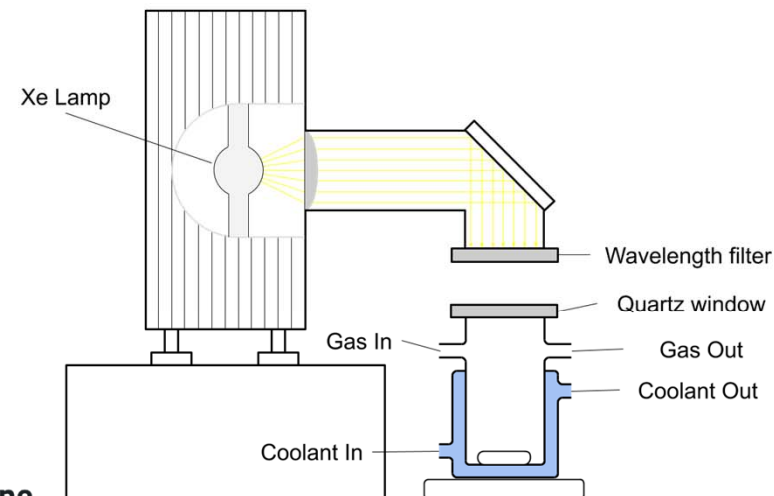
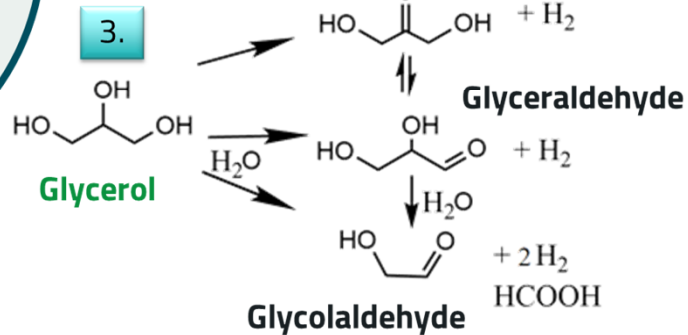
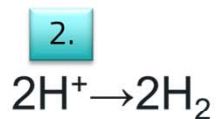
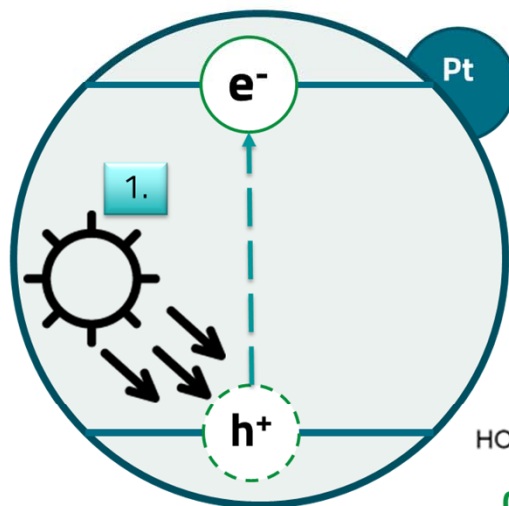
Catalyst: Au/C



RESEARCH LINES



CB
VB

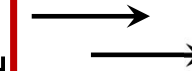
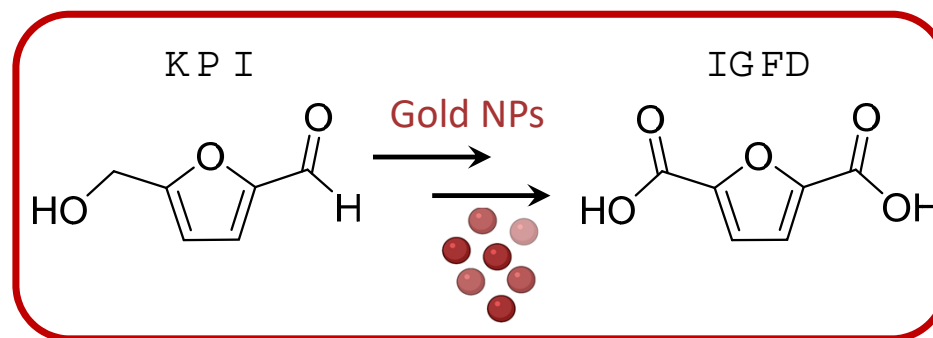
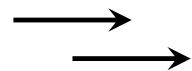


1. Renewable Energy Source
2. Hydrogen production
3. Valorization of **glycerol** towards production of chemicals

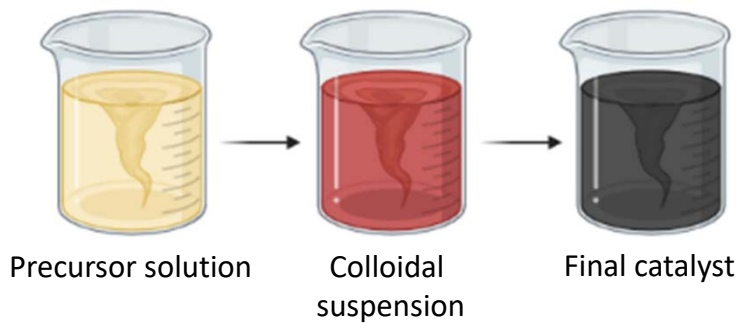
RESEARCH LINES

Selective Oxidations

El rp dvvhv



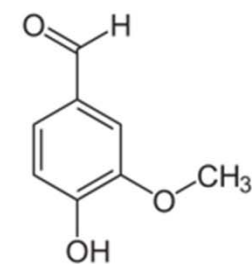
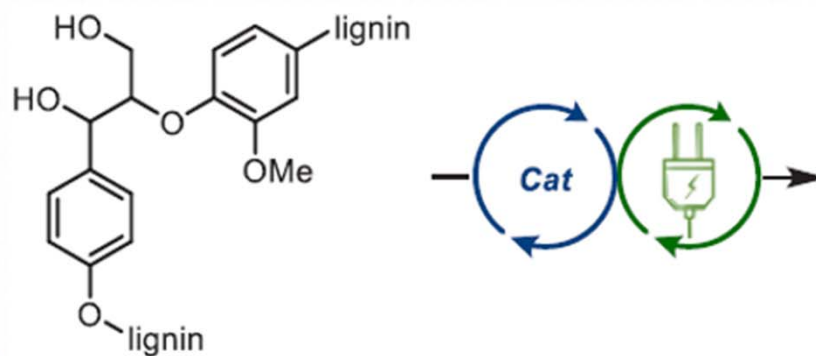
SHI



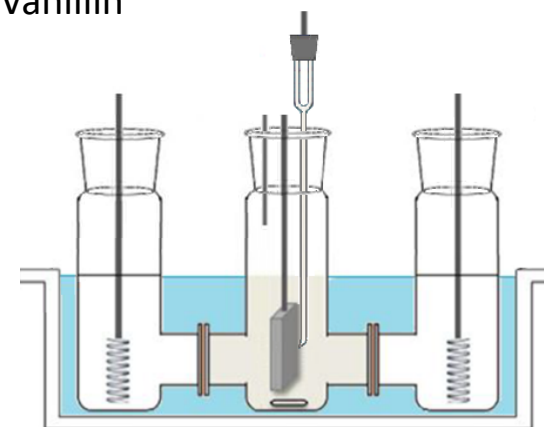
Post-reaction solutions

Electrocatalysis

RESEARCH LINES

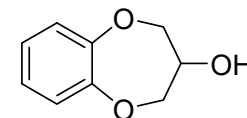
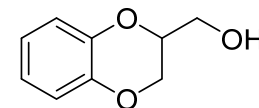
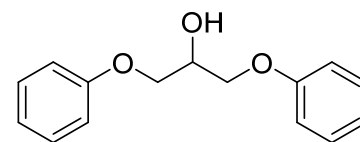
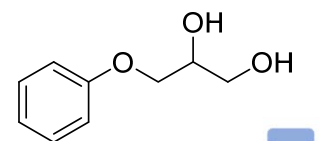
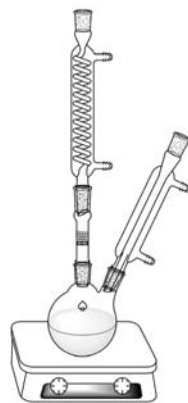
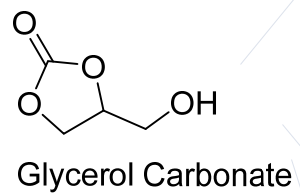
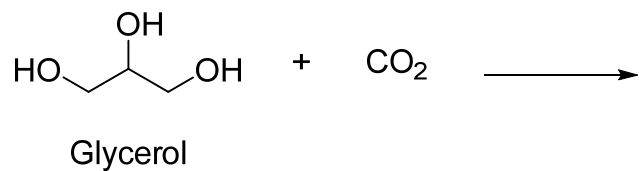


Vanillin



RESEARCH LINES

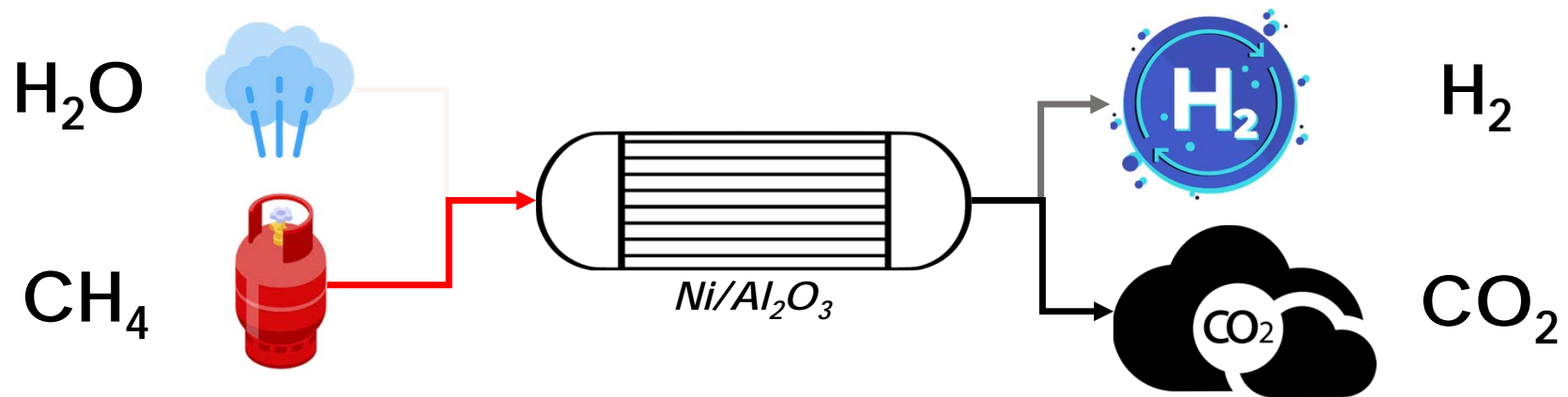
CO₂
Valorisation



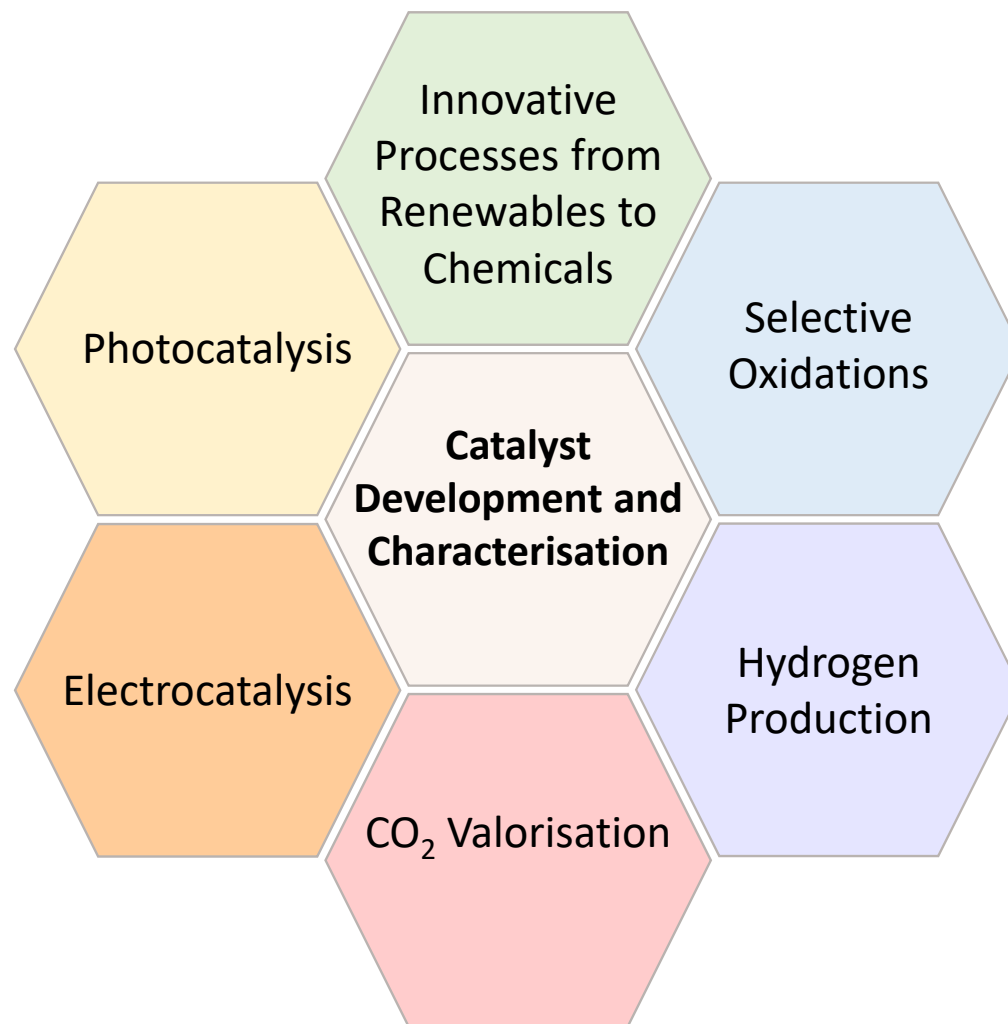
RESEARCH LINES

Hydrogen
Production

Methane Steam Reforming



RESEARCH LINES



GENERAL APPROACH

Catalyst Preparation

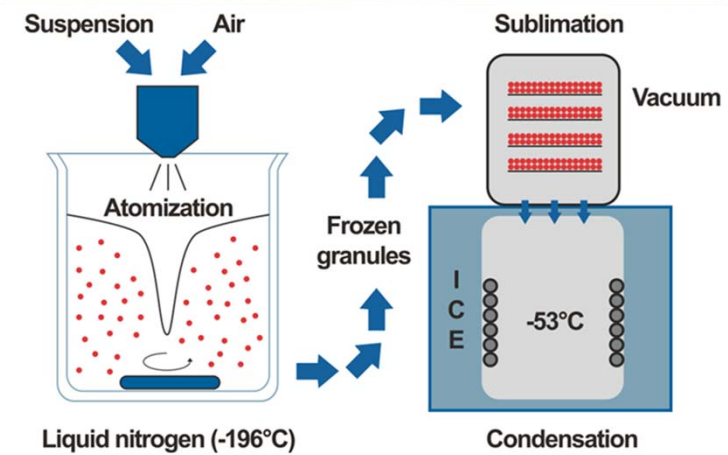
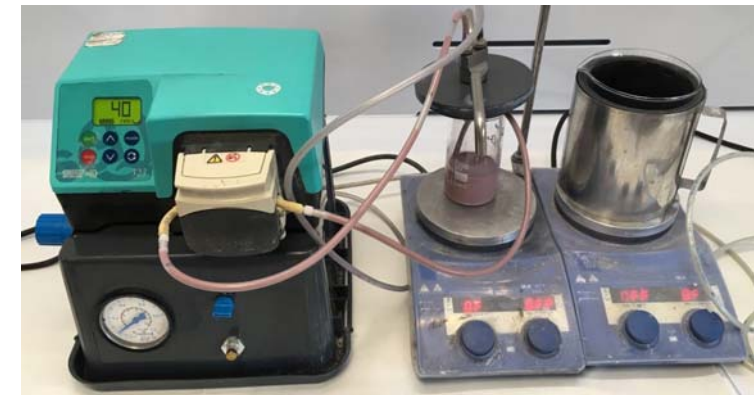
(Co-)Precipitation



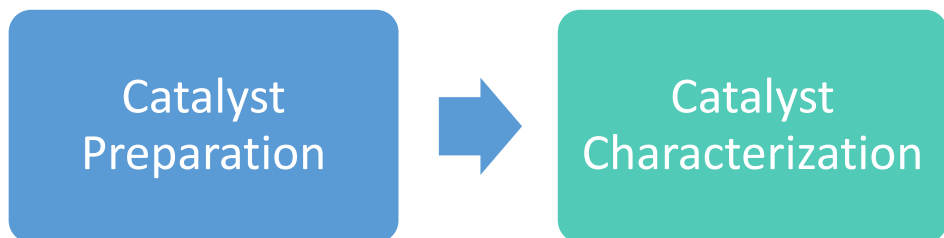
Sol Immobilization
Incipient Wetness Impregnation



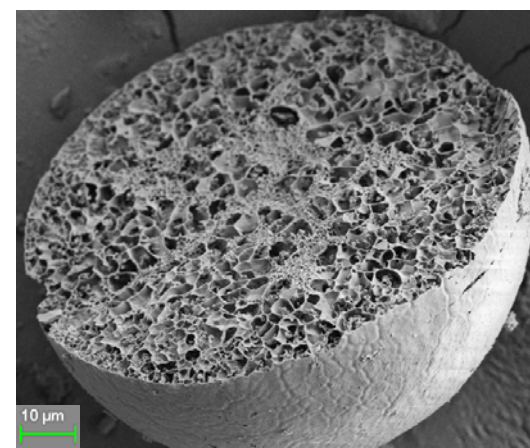
Spray-Freeze Drying



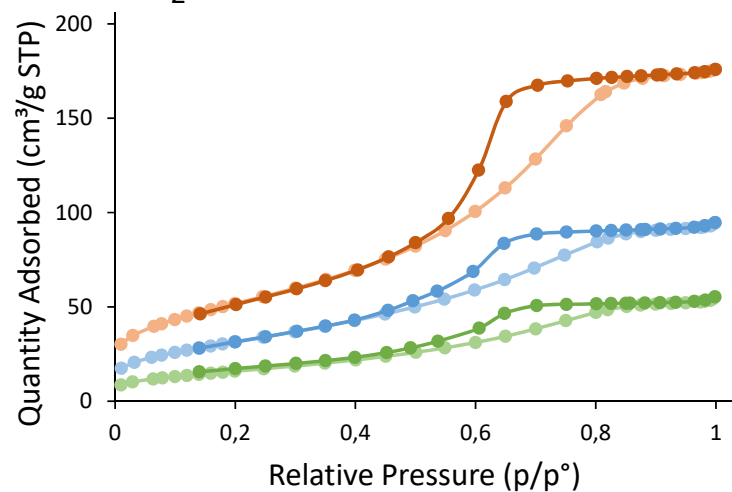
GENERAL APPROACH



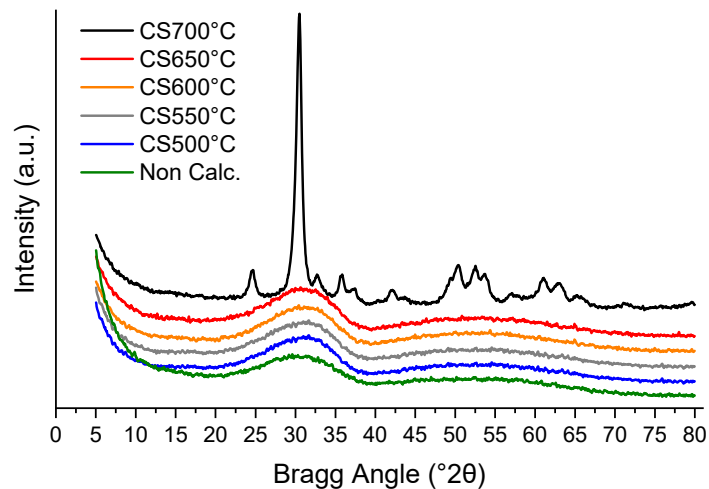
SEM



N₂ Adsorption-Desorption



XRD

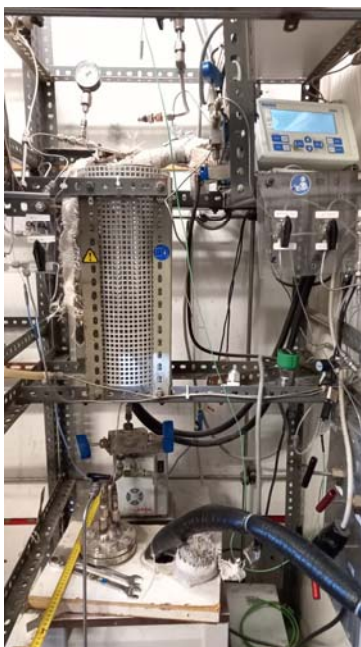


...and others like:
XRF, TPD-R-O,
(DR)UV-Vis, etc.

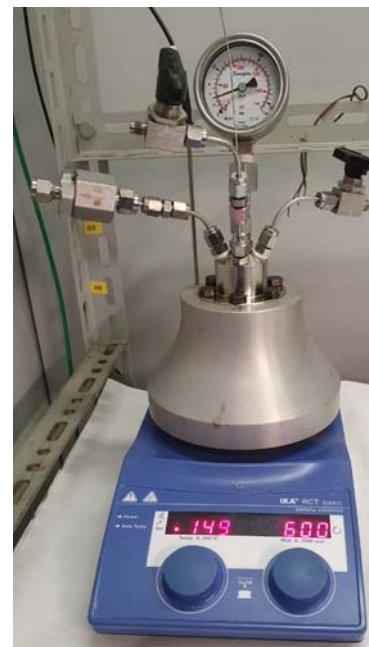
GENERAL APPROACH



Gas Phase
Continuous Flow Reaction



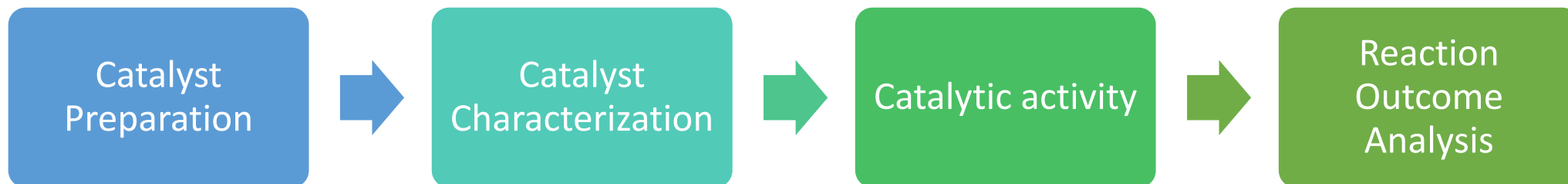
Liquid Phase
Batch Reaction



Liquid Phase
Continuous Flow Reaction



GENERAL APPROACH



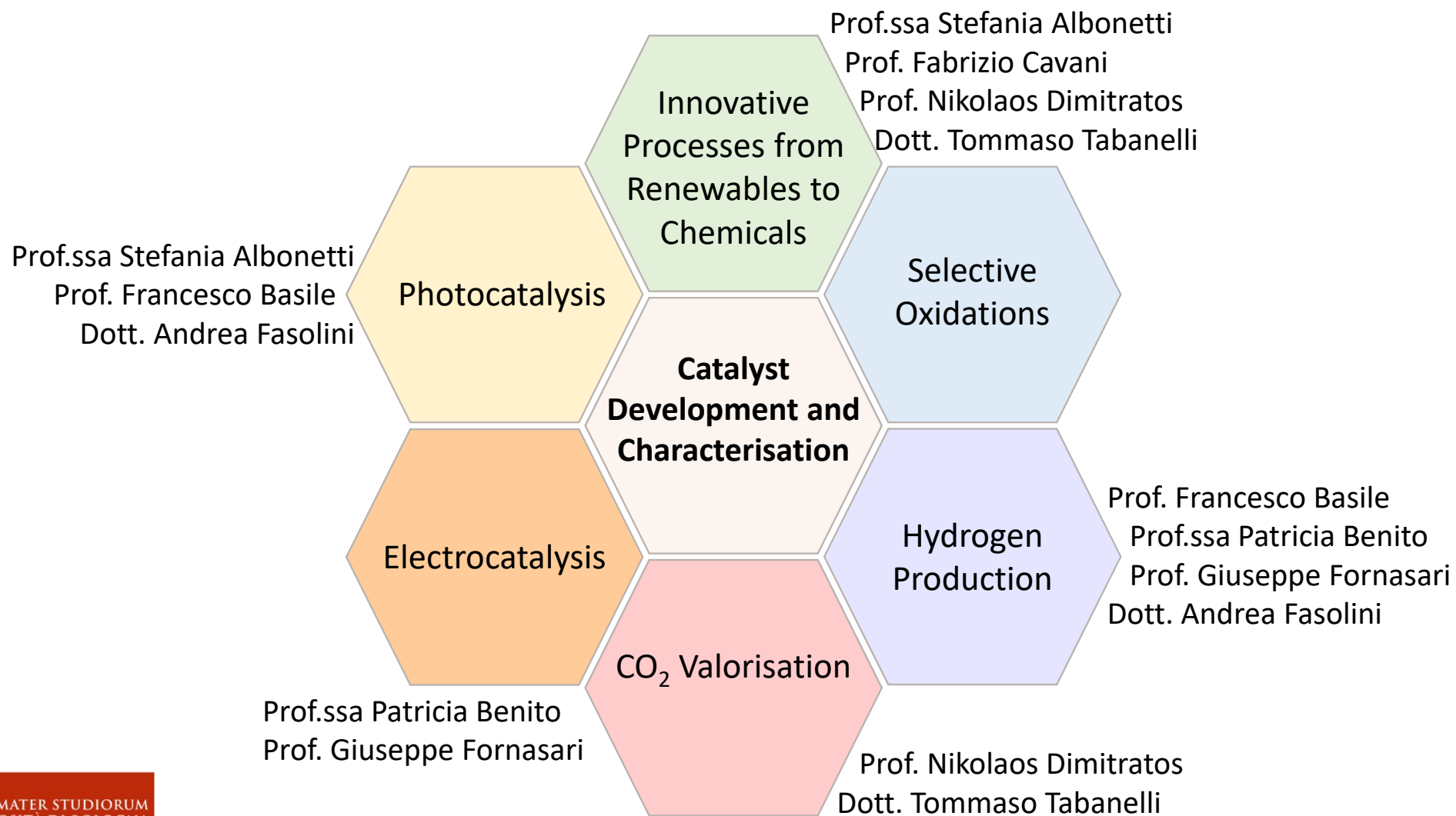
Gas Chromatography
(GC)



High-Pressure
Liquid Chromatography
(HPLC)



RESEARCH LINES



CATALYSIS FOR RENEWABLES AND INNOVATIVE PROCESSES «CARE IN PROCESS»

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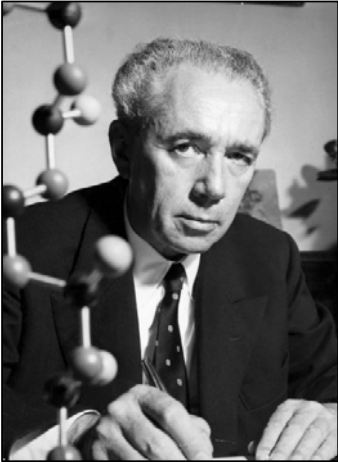
Giulia Vigarani

Luca Mugnaini

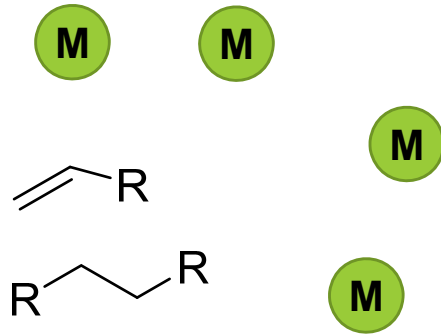
Filippo Valorosi

Paola Natali

Gruppo Polimeri



Cosa sono i polimeri?



- Packaging
- Automotive and Transportation
- Building and Construction
- Electrical and Electronics
- Medical
- Other End-user Industries
- Sports and Leisure



Gruppo di Ricerca di Polimeri Caretti-Toselli



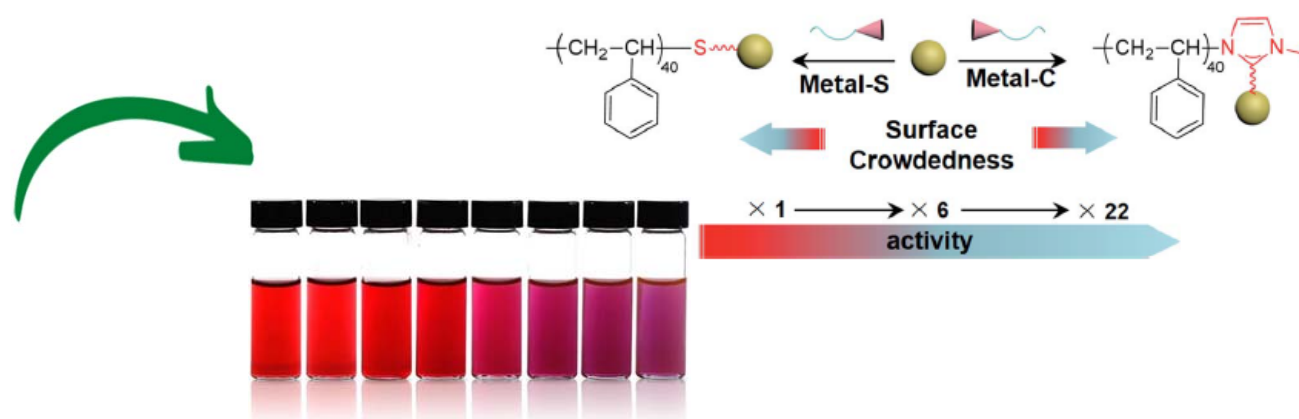
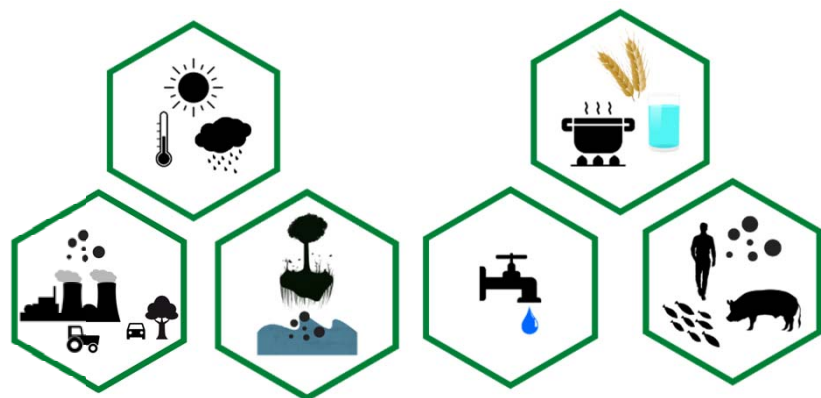
❖ Prof. Daniele Caretti
daniele.caretti@unibo.it

❖ Prof. Maurizio Toselli
maurizio.toselli@unibo.it

❖ PhD student:
Francesco Prandi (UNIBO-SACMI)
francesco.prandi3@unibo.it

Stefano Scurti
stefano.scurti2@unibo.it

Sintesi di nano-materiali ibridi (metallo-polimero) per il trattamento delle acque



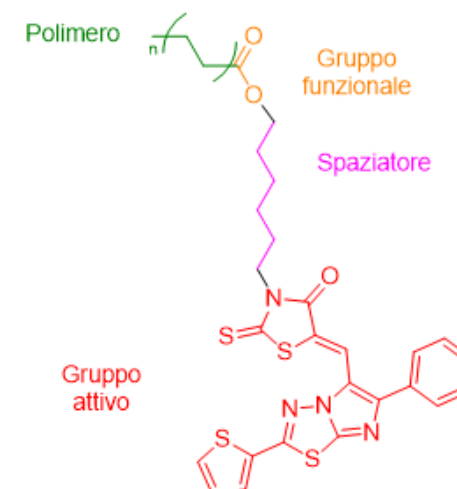
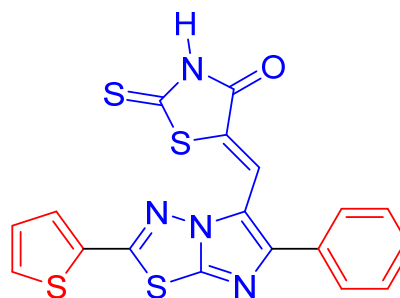
- ❖ Sintesi dei monomeri e dei polimeri (NMR, IR, analisi termiche)
- ❖ Preparazione dei nanomateriali (sintesi inorganica)
- ❖ Valutazione delle proprietà nella rimozione/conversione catalitica degli inquinanti

Prof. Daniele Caretti
Daniele.caretti@unibo.it

Polimeri funzionali per applicazioni nell'opto-elettronica



Donatore-Acettore-Donatore



- ❖ Sintesi dei monomeri e dei polimeri (NMR, IR, analisi termiche)
- ❖ Valutazione delle proprietà ottiche non lineari

PETALS (PRIN 2021)

UPO
UNIVERSITÀ DEL PIEMONTE ORIENTALE


UNIVERSITÀ DEGLI STUDI
DI GENOVA

Prof. Daniele Caretti
Daniele.caretti@unibo.it

Sviluppo di packaging a base di cellulosa mediante la sintesi di additivi idrofobizzanti:

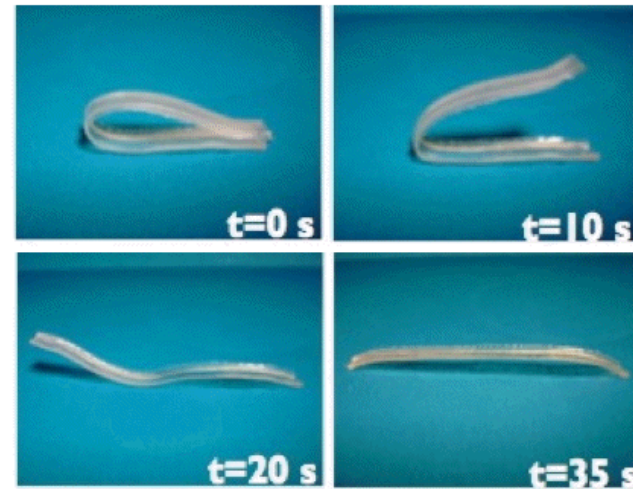
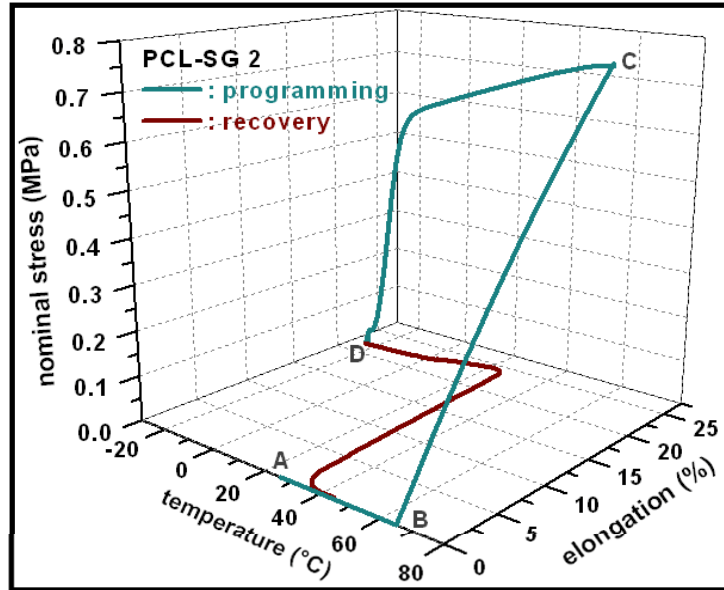


- ❖ Valutazione ed eventuale pretrattamento del materiale celluloso di partenza
- ❖ Sintesi dell'additivo idrofobizzante e modifica della cellulosa
- ❖ Produzione di campioni mediante stampaggio a compressione
- ❖ Determinazione delle proprietà meccaniche, termiche, ecc. del provino ottenuto

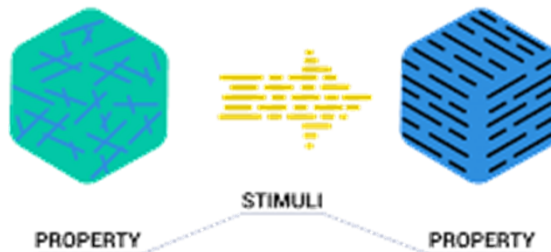


Prof. Daniele Caretti
Daniele.caretti@unibo.it

Polimeri a memoria di forma e stimoli responsive

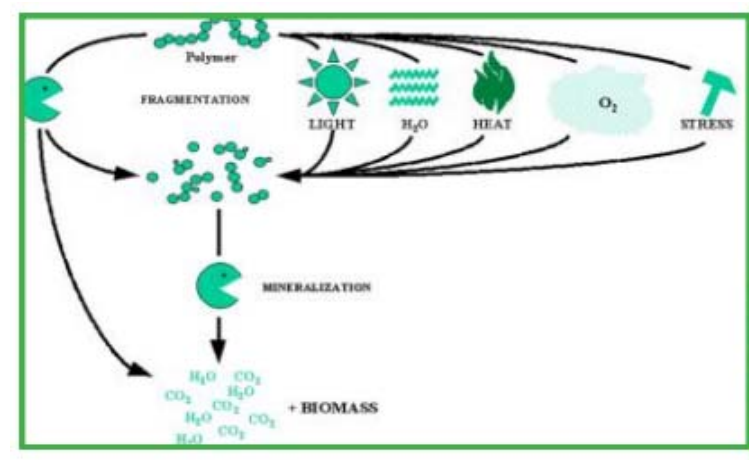
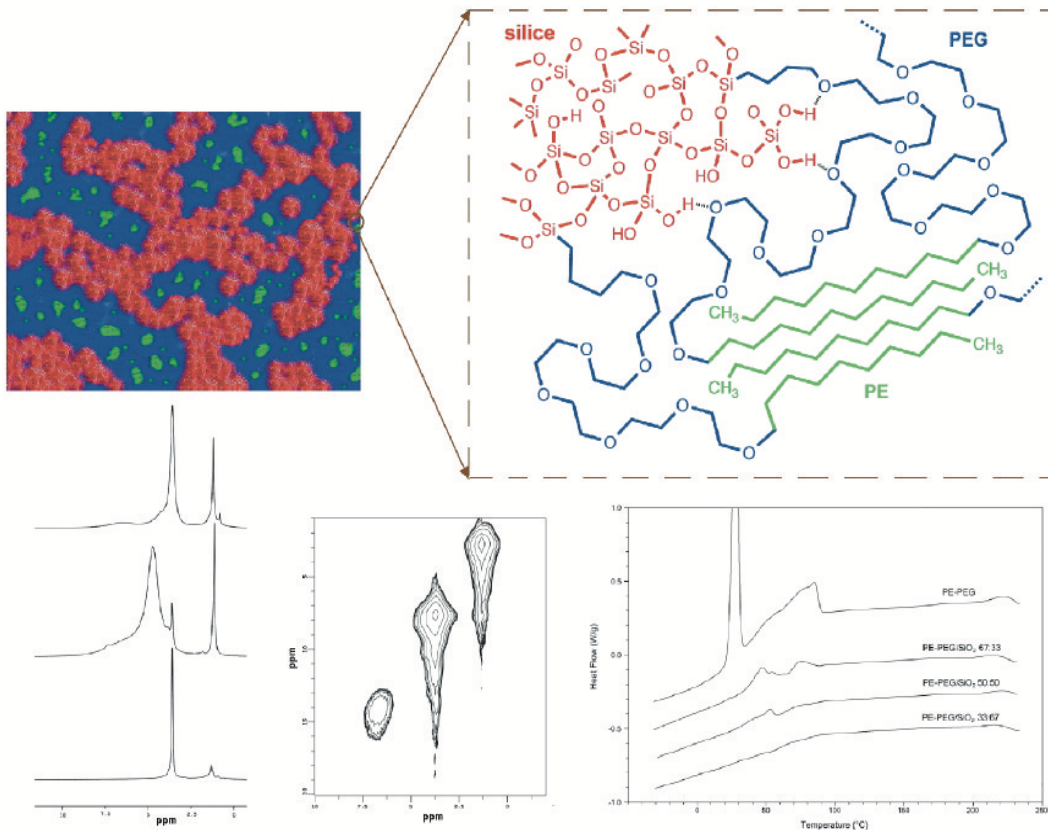


- ❖ Sintesi dei monomeri e dei polimeri (NMR, IR, analisi termiche)
- ❖ Valutazione delle proprietà del materiale



Prof. Maurizio Toselli
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Coating ibridi organici-inorganici



- ❖ Sintesi dei monomeri e dei polimeri (NMR, IR, analisi termiche)
- ❖ Preparazione dei coating ibridi
- ❖ Valutazione delle proprietà di resistenza alla luce UV

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Gruppo di Ricerca

Materiali polimerici e compositi (CHIMIND)



- ❖ Pro. Loris Giorgini
loris.giorgini@unibo.it

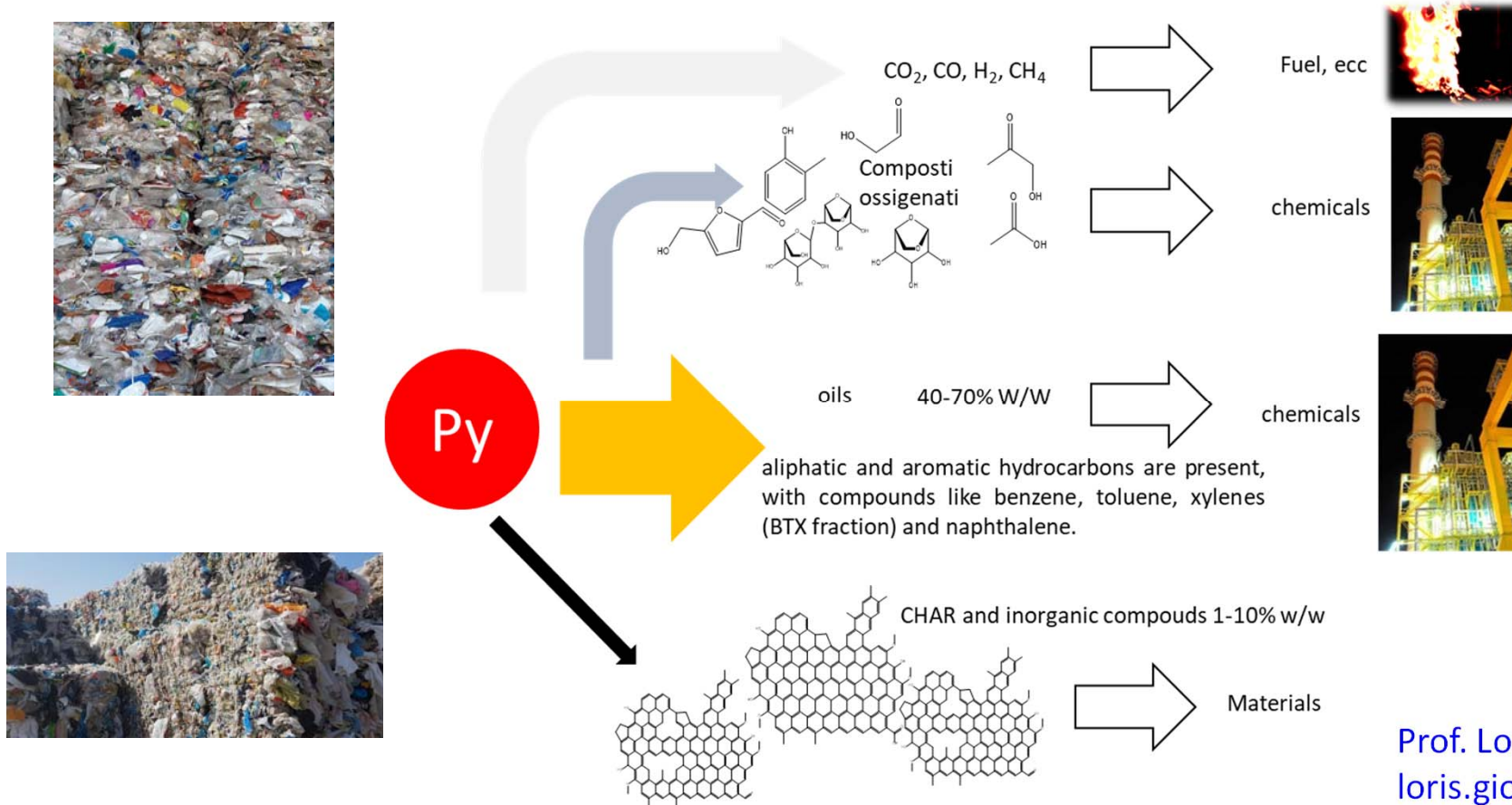
- ❖ Prof.ssa Tiziana Benelli
- ❖ Prof.ssa Laura Mazzocchetti

- ❖ 4 PhD student
- ❖ 2 Industrial PhD student
- ❖ 2 Assegnisti di ricerca

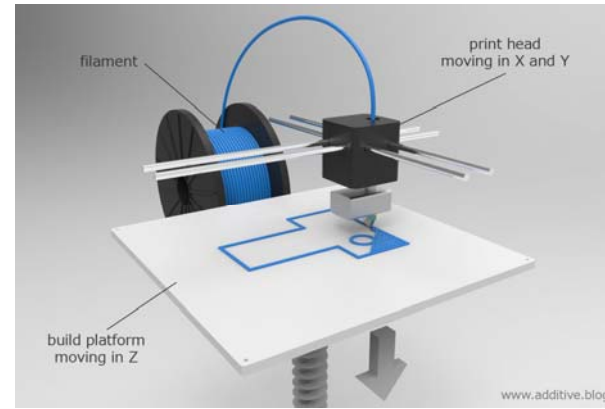
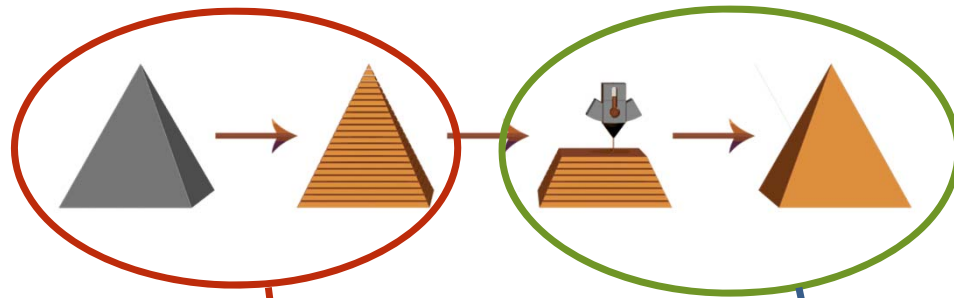
- ❖ 12 laureandi magistrale
- ❖ 3 laureandi triennale

PYROLYSIS of PLASMIX (mix of plastic materials e.g. Corepla)

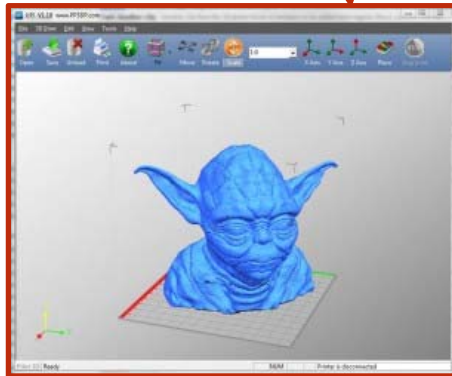
Our approaches for Recovery Carbon (C) weight % in oil



3D printing - Fused deposition modeling (FDM)

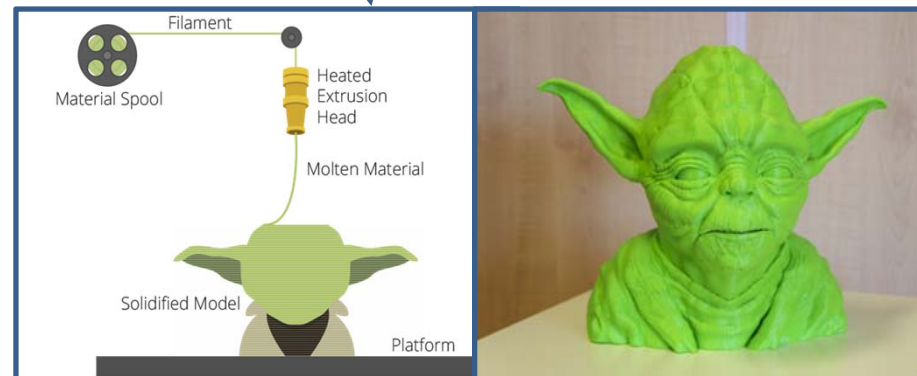


Progettazione



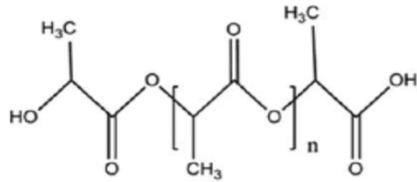
Disegno CAD

Stampa 3D



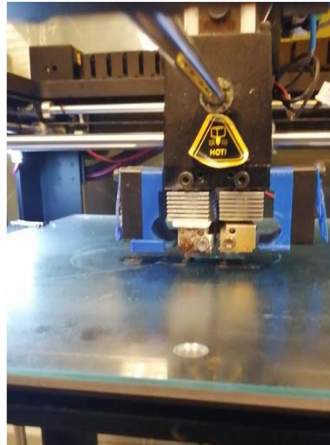
Prof. Loris Giorgini
loris.giorgini@unibo.it

Stampa 3D di compositi termoplastici



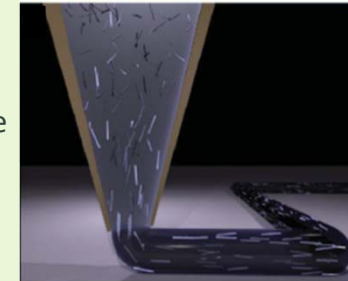
Polylactic acid (PLA)

vCF = fibre di carbonio vergini
rCF = fibre di carbonio riciclate



Stampa con fibre di carbonio corte

- Lunghezza fibre < 500 µm
- Allineamento delle fibre con il flusso



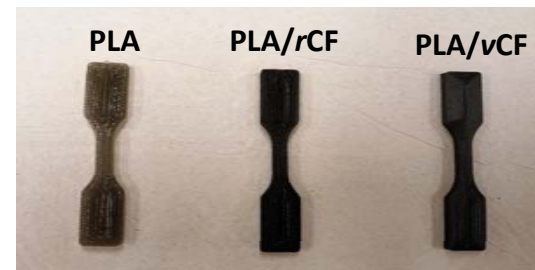
Analisi delle proprietà meccaniche su stampati:

- Analisi dinamico-meccanica (DMA)
- Test di trazione

Stampa 3D



Filamento di PLA puro
Filamento PLA/CF



In collaborazione con DIFA
e DISTAL

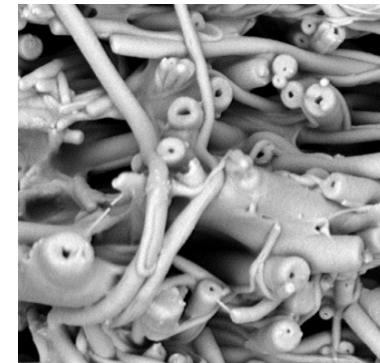
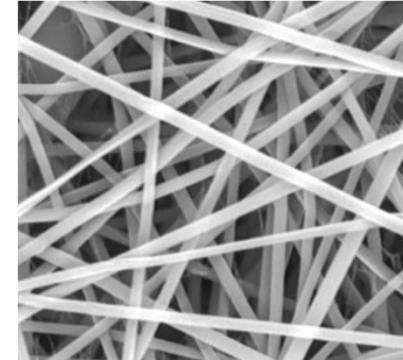
Prof. Loris Giorgini
loris.giorgini@unibo.it

Macchina per elettrofilatura



ruolo collettore
4 aghi
blocco aghi traslante

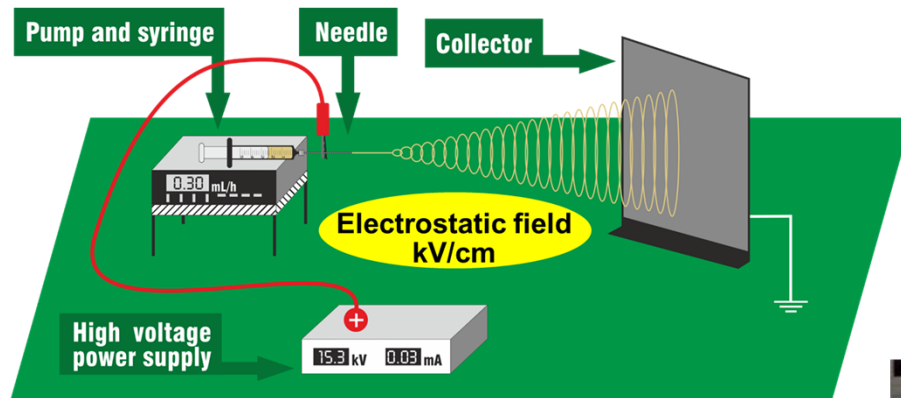
[In collaborazione con il DIN](#)
[Parte della tesi da svolgersi](#)
[presso il Lazzaretto](#)



Nanofibre
Core-shell

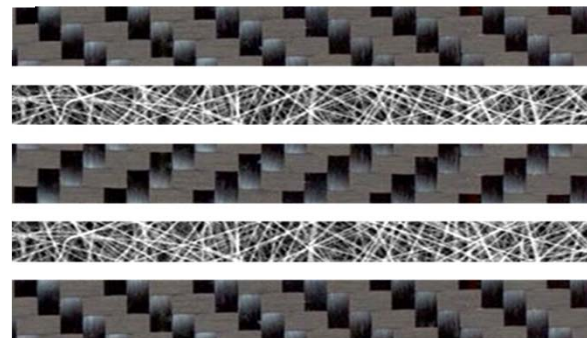
Laminati e nanofibre

Processo di elettrofilatura per la produzione di membrane nanofibrose



membrane nanofibrose intercalate tra le lamine di CFRP

PREVIENE LA DELAMINAZIONE



CFRP prepreg

Nano-mat

CFRP prepreg

Nano-mat

CFRP prepreg

La propagazione della cricca è ostacolata



Gruppo di Ricerca di Polimeri Lanzi - Salatelli



Prof. Massimiliano Lanzi
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Prof.ssa Elisabetta Salatelli
elisabetta.salatelli@unibo.it

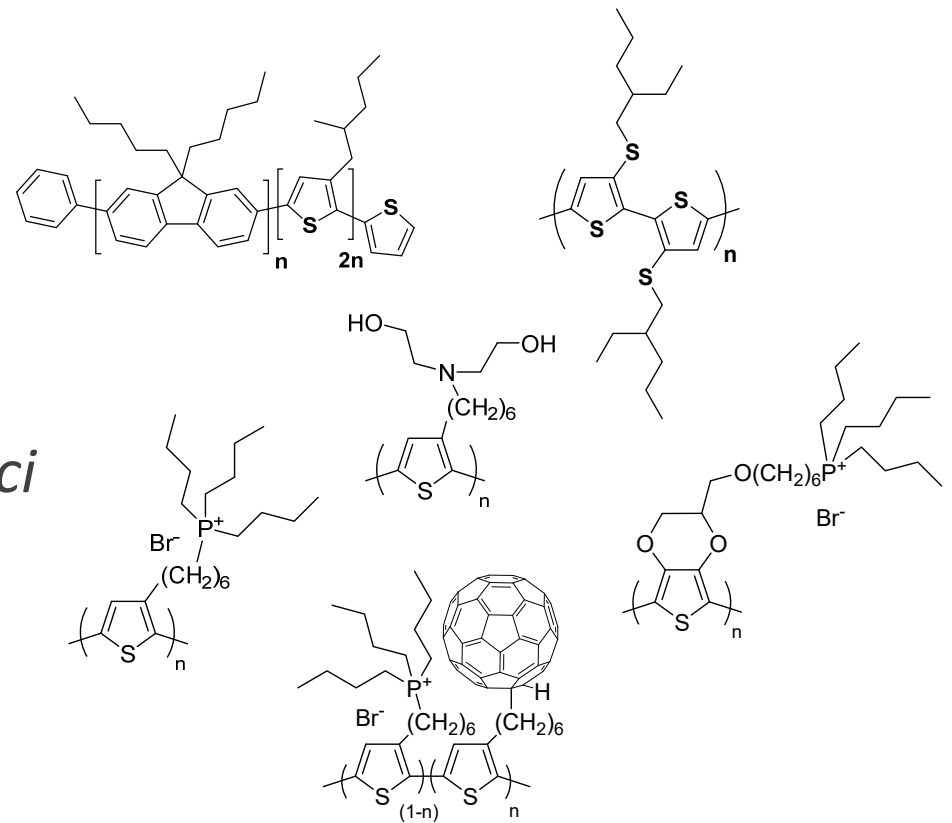
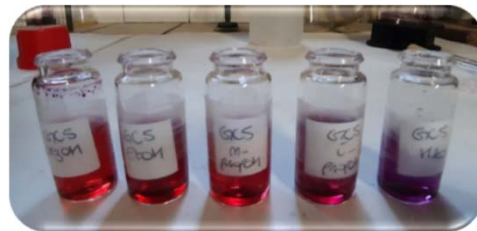
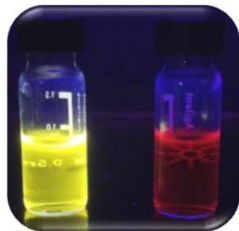
Dott.ssa Martina Marinelli
Assegnista di Ricerca

Dott.ssa Debora Quadretti
Dottoranda



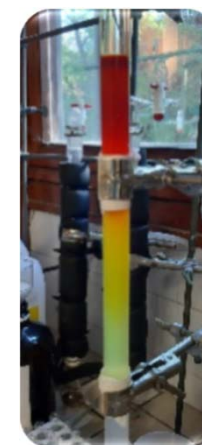
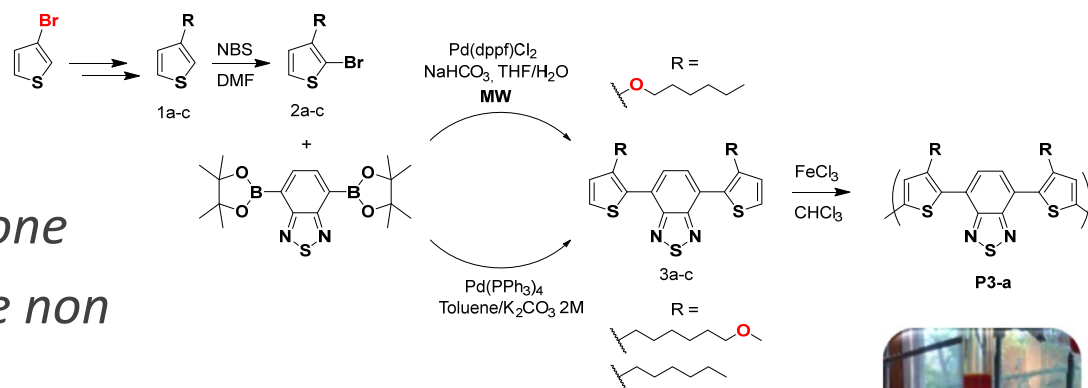
Temi di Ricerca

- ❖ *Sintesi di polimeri semiconduttori (in particolare politiofeni)*
- ❖ *Ottimizzazione delle sintesi*
- ❖ *Caratterizzazione dei materiali*
- ❖ *Applicazione in dispositivi fotovoltaici*



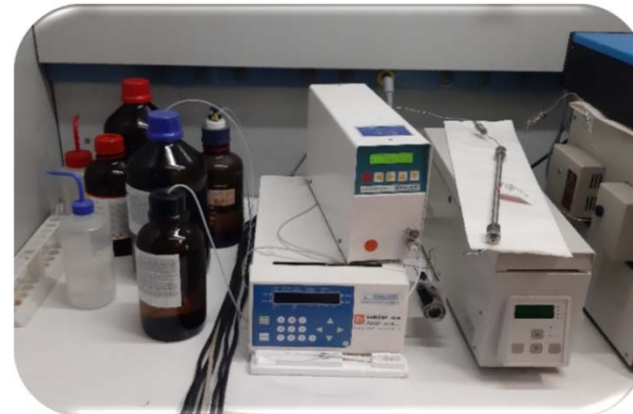
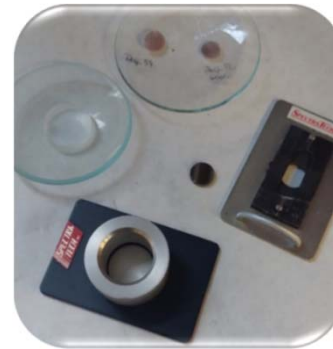
Sintesi

- ❖ Sintesi dei monomeri a partire da reagenti commerciali
- ❖ Utilizzo di diversi sistemi di reazione
- ❖ Polimerizzazioni regiospecifiche e non
- ❖ Varie tecniche di purificazione (cristallizzazione, colonna cromatografica, distillazione in vuoto)
- ❖ Identificazione dei prodotti



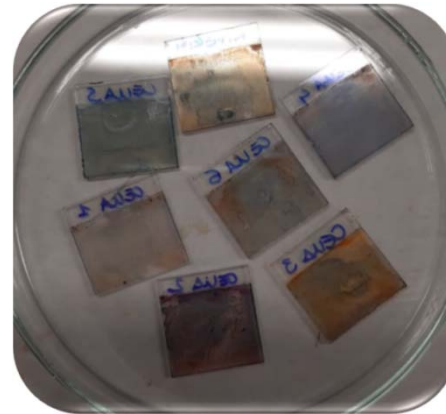
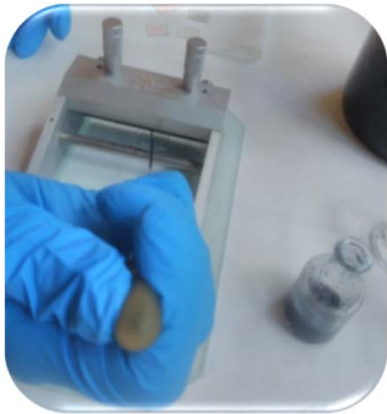
Caratterizzazione

- ❖ $^1\text{H-NMR}$, IR (identificazione)
- ❖ GPC (peso molecolare medio)
- ❖ UV-Vis (proprietà ottiche)
- ❖ TGA, DSC (proprietà termiche)



Realizzazione di celle solari

- ❖ *Il polimero sintetizzato viene testato come strato fotoattivo in un dispositivo fotovoltaico su piccola scala*



Contatti

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Chimica e Biotecnologia delle Fermentazioni

Docenti

Leonardo Setti

Alessandra Stefan

Alejandro Hochkoeppler

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Tirocini Esterni

Aziende

Reagens
BASF Italia S.p.a.
Bertelli
Lesepe S.r.l.
Dow Italia srl
L.A.V. SRL
KERAKOLL S.P.A.
ITALTECNO SRL
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Enti di ricerca

CNR - ISOF
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