



**Università
di Genova**



Scientific and Technological Activities at the Department of Chemistry and Industrial Chemistry, University of Genova

Next frontier of international collaborations in science and technology

February 25, 2021

Shibaura Institute of Technology

Luca Banfi - Director - Department of Chemistry and industrial Chemistry



**Università
di Genova**

**DCCI DIPARTIMENTO
DI CHIMICA E CHIMICA INDUSTRIALE**

University of Genova: some Figures



Università
di **Genova**

- Students (Bachelor and Master): 31.411
- Students (Ph.D.): 1003
- Teaching Staff: 1265
- Administrative and technical staff: 1244
- 22 departments coordinated by 5 Schools (Umanities, Social Sciences, Polytechnic, Medical-Pharmaceutical, Natural Physical and Mathematical Sciences)
- 11 areas: Literature and Philosophy, Foreign Languages and Literatures, Education Sciences, Law, Political Sciences, Economy, Architecture and Design, Engineering, Mathematical, Physical and Natural Sciences, Medicine and Surgery, Pharmacy
- A generalist university (only veterinary and agrarian sciences not present)



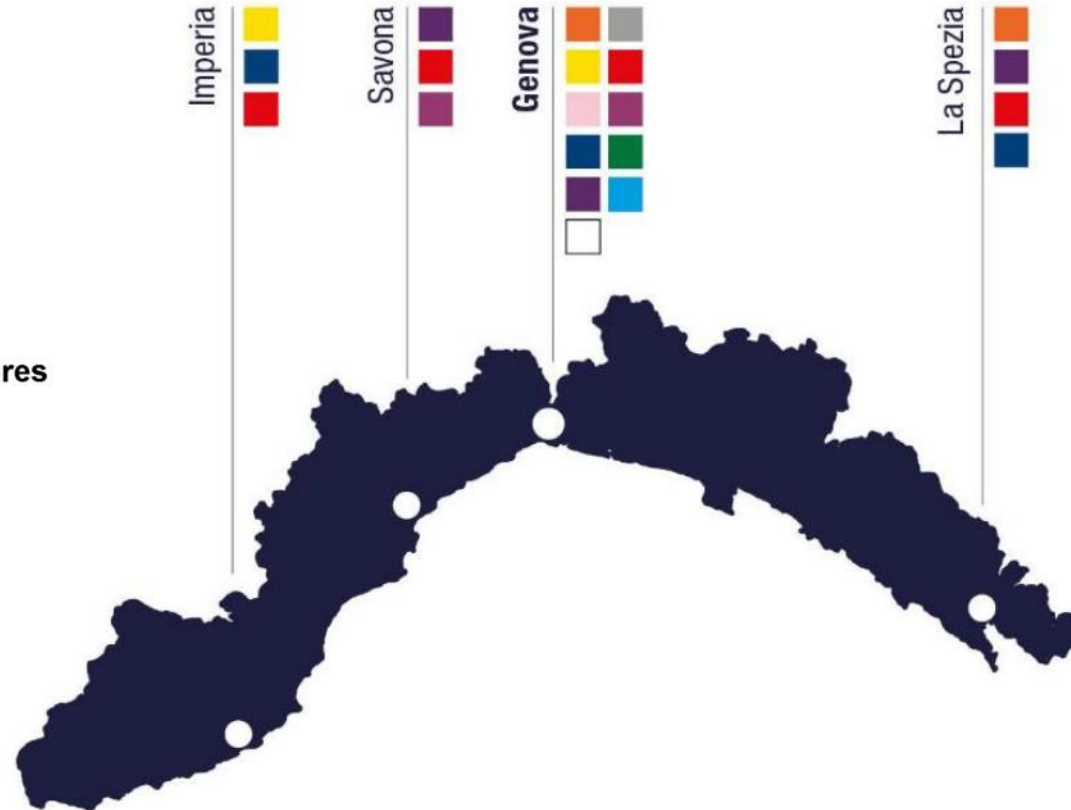
University of Genova: sites

- UniGE is the only one University in Liguria Region and has campuses in all four district capitals



Università
di **Genova**

- Architecture and Design
- Economy
- Pharmacy
- Law
- Engineering
- Literature and Philosophy
- Foreign Languages and Literatures
- Medicine and Surgery
- Education Sciences
- Mat., Phys., Nat. Sciences
- Political Sciences



University of Genova: some Figures



**Università
di Genova**

- Bachelor courses (3 years): 61
- Master courses (2 years): 60
- Single Cycle Master Courses (5 or 6 years): 7
- International courses (fully given in english): 16
- International students: 3148 (more than 10%).
- International Ph.D. students: 16.6%



University of Genova: International Courses



Università
di Genova

MASTER

- Computer Engineering
- Energy Engineering
- Engineering for Building Retrofitting
- Engineering for Natural Risk Management
- Engineering Technology for Strategy and Security
- Environmental Engineering
- Internet And Multimedia Engineering
- Robotics Engineering
- Safety Engineering for Transport, Logistics and Production
- Yacht Design

BACHELOR

- Maritime Science and Technology

MASTER

- Computer Science
- Hydrography and Oceanography
- Surface, Electro, Radiation, and Photo-Chemistry (not all in Genova)
- **Medical-pharmaceutical Biotechnology**
- International Relations

University of Genova: Strategical Centers



Università
di Genova

The Center for the Sea

The Center for the Sea was founded in 2019 in order to connect several teaching, research and third mission activities related to the sea.

Now it involves about 400 professors or researchers and coordinates 5 bachelor and 8 master courses.

This represents the widest and most comprehensive offer among all Italian universities on sea-related themes.

Finally, Sciences and Technologies for the Sea, a new Ph.D. course (with about 20 students per year) was activated.

The Center for Security, Risk and Vulnerability

This is the second strategical centre, recently created. It will put together knowledge from different areas, such as Engineering, science, but also Law, Economy, and Political Sciences



University of Genova: Research



**Università
di Genova**

- Average rank position of UniGE in the world (according to the 10 main agencies): 356
- Annual number of publications: about 10.000
- Competitive research projects (national, international) funded in 2020: 77
- "Excellence Departments": 2
(Department of Physics and Department of Neurosciences)



❖ 50 teaching staff.

- 9 Full Professors.
- 17 Associate Professors.
- 13 tenured Assistant Professors.
- 11 tenure-track Assistant Professors (7 at first level and 4 at second level).

❖ **Distribution between the various disciplines:**

- Analytical and Environmental Chemistry: 7.
- Physical Chemistry: 9.
- General and Inorganic Chemistry: 10.
- Industrial and Polymer Chemistry: 9.
- Organic Chemistry: 9,
- Metallurgy: 2.
- Chemical Plants and Processes: 4.

❖ 26 personnel units: 18 technicians and 8 administrative staff



UniGe | DCCI Courses

- ❖ **4 degree courses.** Overall about 470 students.
 - Bachelor course in Chemistry and Chemical Technologies.
 - Master course in Chemical Sciences.
 - Master course in Industrial Chemistry.
 - Master course in Science and Technology of Materials.
- ❖ **Doctorate in Science and Technology of Chemistry and Materials.** About 90 students (30 new students each year).

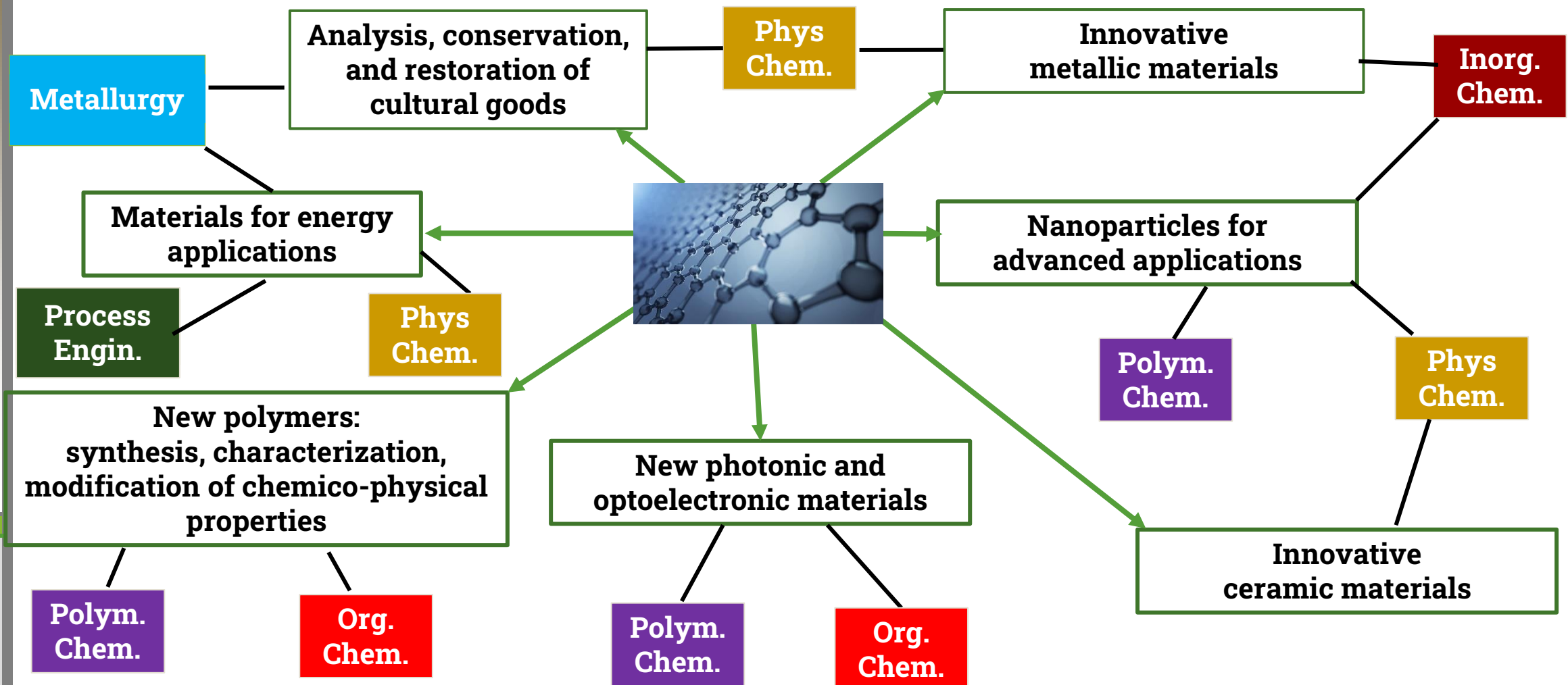
In collaboration with the Departments of Pharmacy, Physics, Chemical Engineering and with the Italian Institute of Technology.



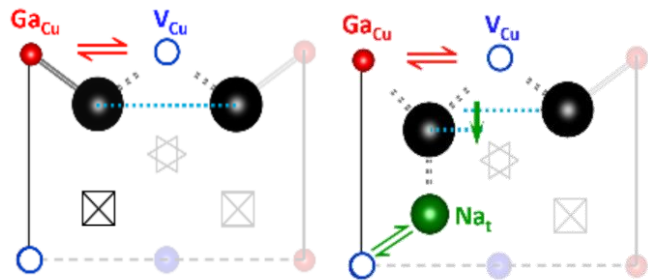
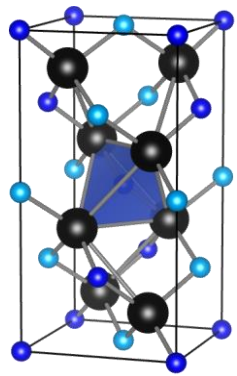
Research mainly focusing on 3 research objectives

- **Materials Chemistry**
- **Environment and Sustainable Development**
- **Bioeconomy and the Circular Economy**

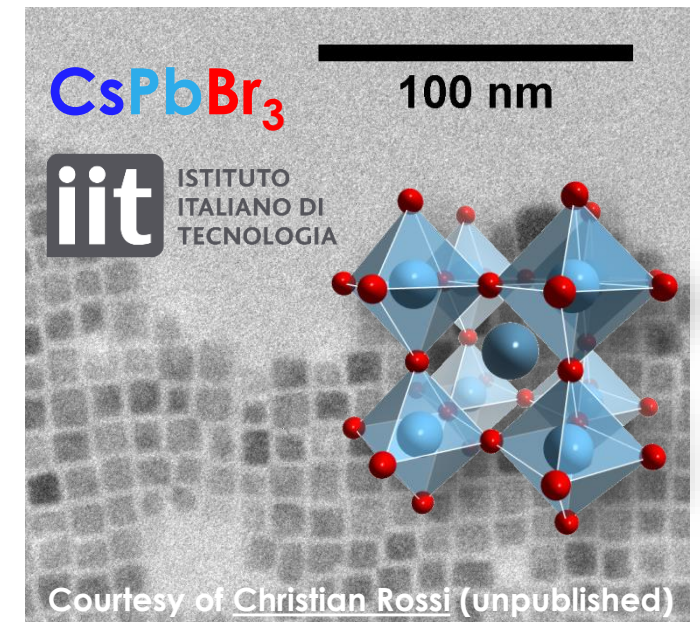
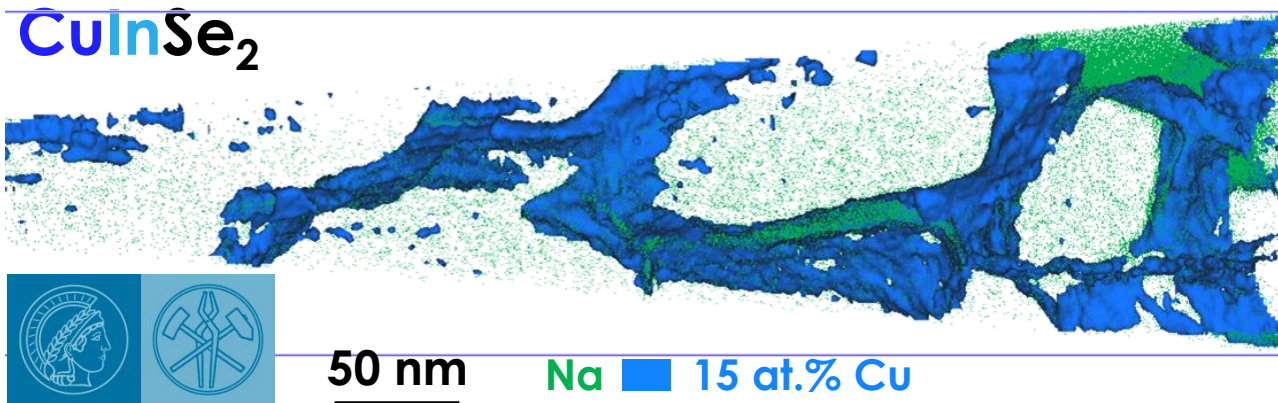
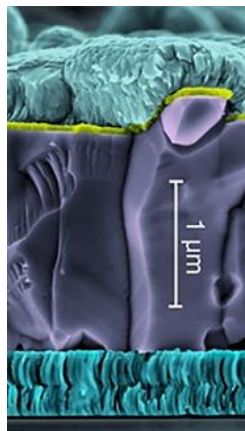




Inorganic semiconductors for Photovoltaic applications



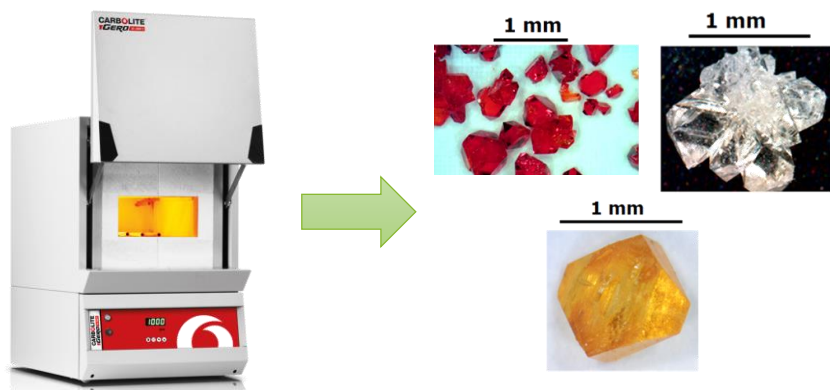
- **Combinatorial extrinsic doping** of chalcogenides [1-2]
- **Exotic dopant-induced atomic diffusion** effects [3]
- Synthetic and electrochemical strategies in **liquid ammonia**
- Chemical protection of lead halide **perovskite quantum dots**



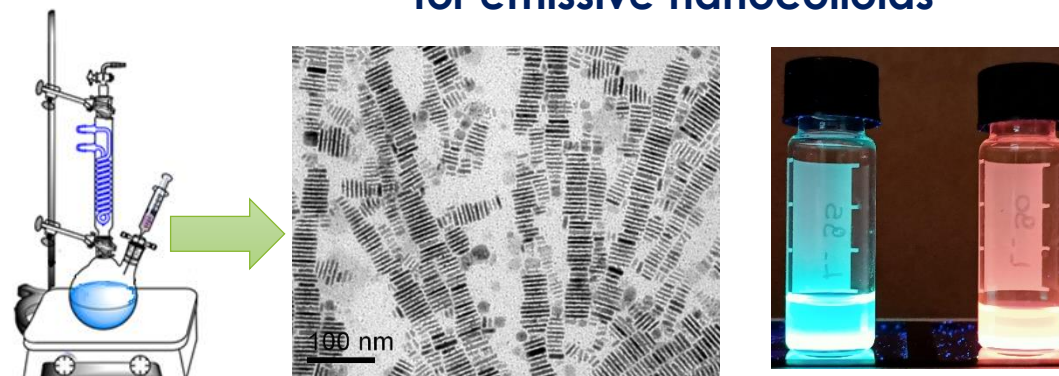
- [1] [Diego Colombara, T. Schwarz et al., Nature Communications 9, Article number: 826 \(2018\).](#)
- [2] [Diego Colombara, H. Elanzeery et al., Nature Communications 11, Article number: 3634 \(2020\).](#)
- [3] [Diego Colombara, Physical Review Materials 3, 054602 \(2019\).](#)

(Nano)perovskites for optoelectronics

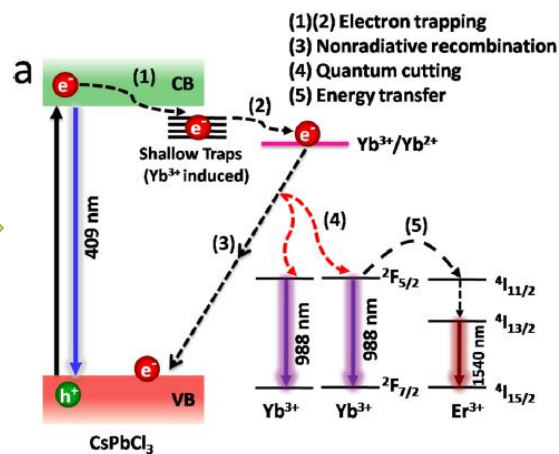
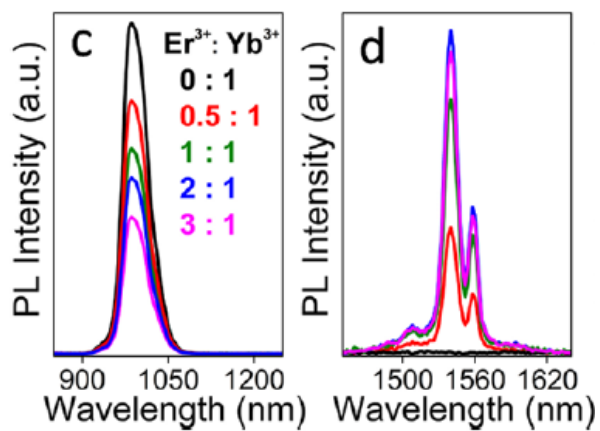
Halide-based perovskites single crystals



Development of new synthetic strategies for emissive nanocolloids



F. Locardi et al., JACS, 2018, 140, 12989-12995



Understanding the structure – property relationships

F. Locardi et al., ACS Energy Lett. 2019, 4, 1976-1982

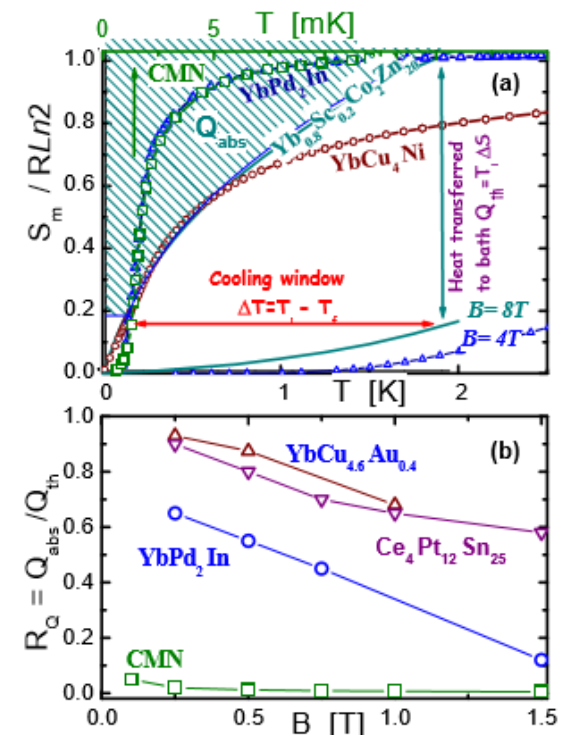
New Cryogen-free coolers



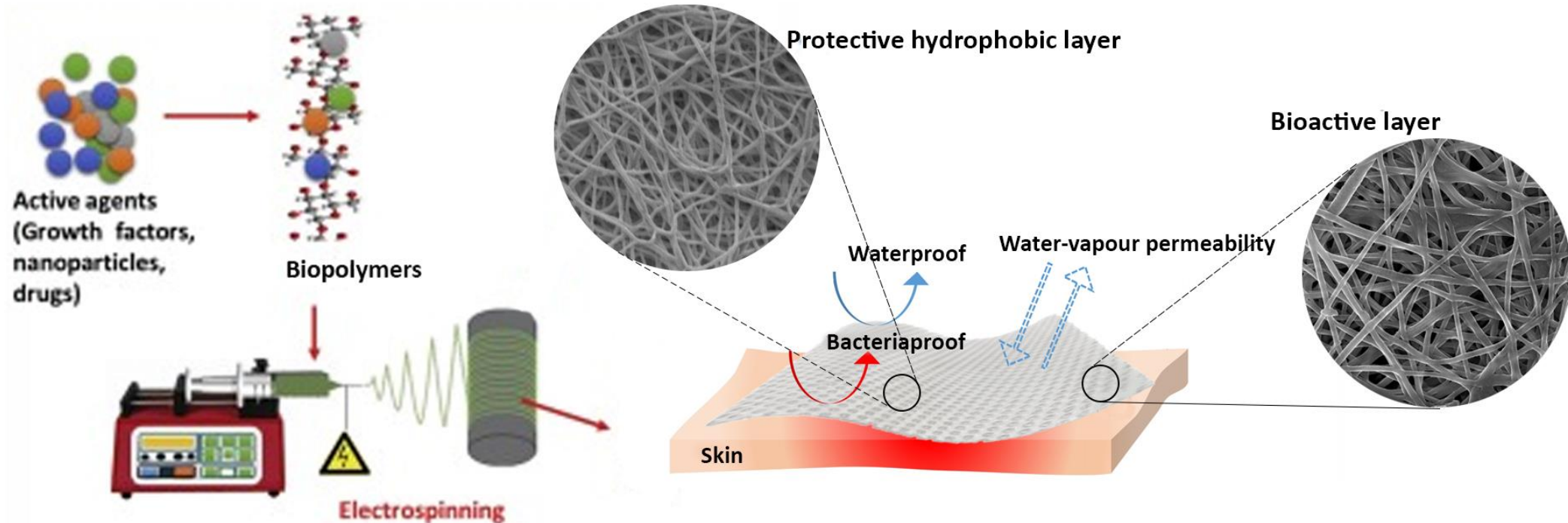
Aiming at improving the performances of current ADR paramagnetic salts for adiabatic refrigeration processes in the sub-Kelvin range, we obtained strong enhancement of MCE in certain intermetallic compounds exploiting strong correlation between electrons (SCES). Therefore we succeeded in producing metals able to achieve efficient magnetic cooling with a good performance and high thermal conductance

SCES/group Mauro Giovannini, Dip. Chimica Uni. Genova
mauro.giovannini@unige.it

Very low-T coolers ($T < 1\text{K}$) are essential for future space missions. A large effort is required to develop closed-loop, space qualified coolers (especially cryogen free such as ADR), offering reliable performance and long lifetime.



Biomimetic electrospun wound healing patches

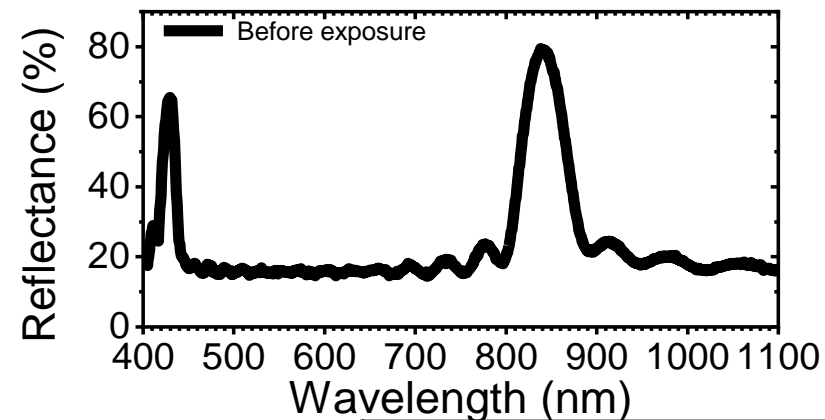
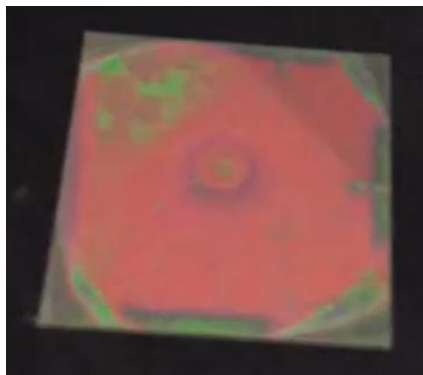
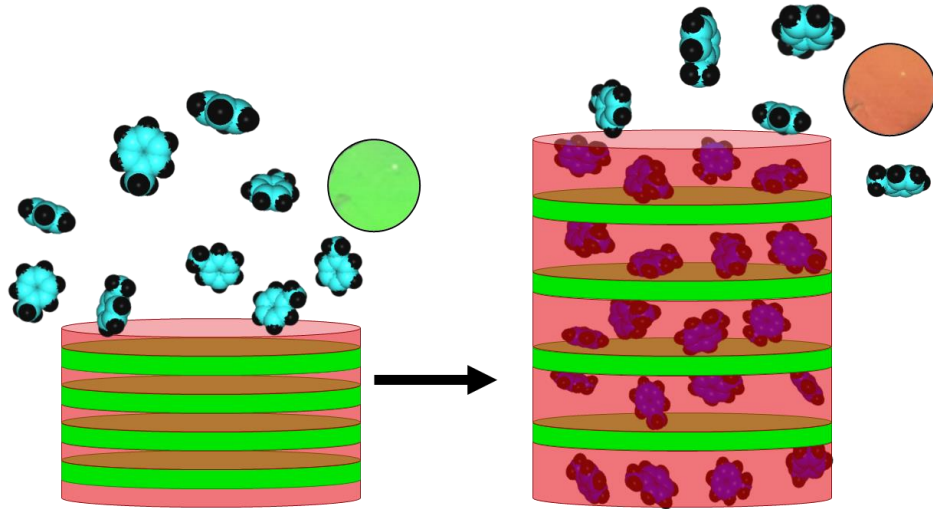


A. Dodero, M. Alloisio, S. Vicini, M. Castellano, *Carbohydr. Polym.* **2020**, 227, 115371.

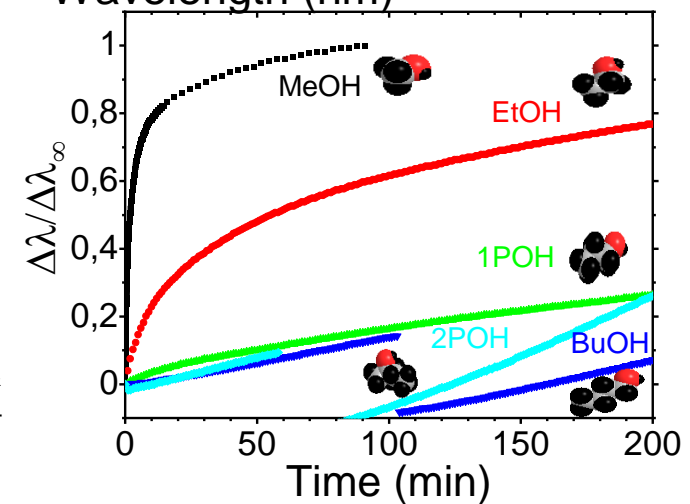
A. Dodero, S. Scarfi, M. Pozzolini, S. Vicini, M. Alloisio, M. Castellano, *ACS Appl. Mater. Interfaces* **2020**, 12, 3371.

A. Dodero, M. Alloisio, M. Castellano, S. Vicini, *ACS Appl. Mater. Interfaces* **2020**, 12, 31162.

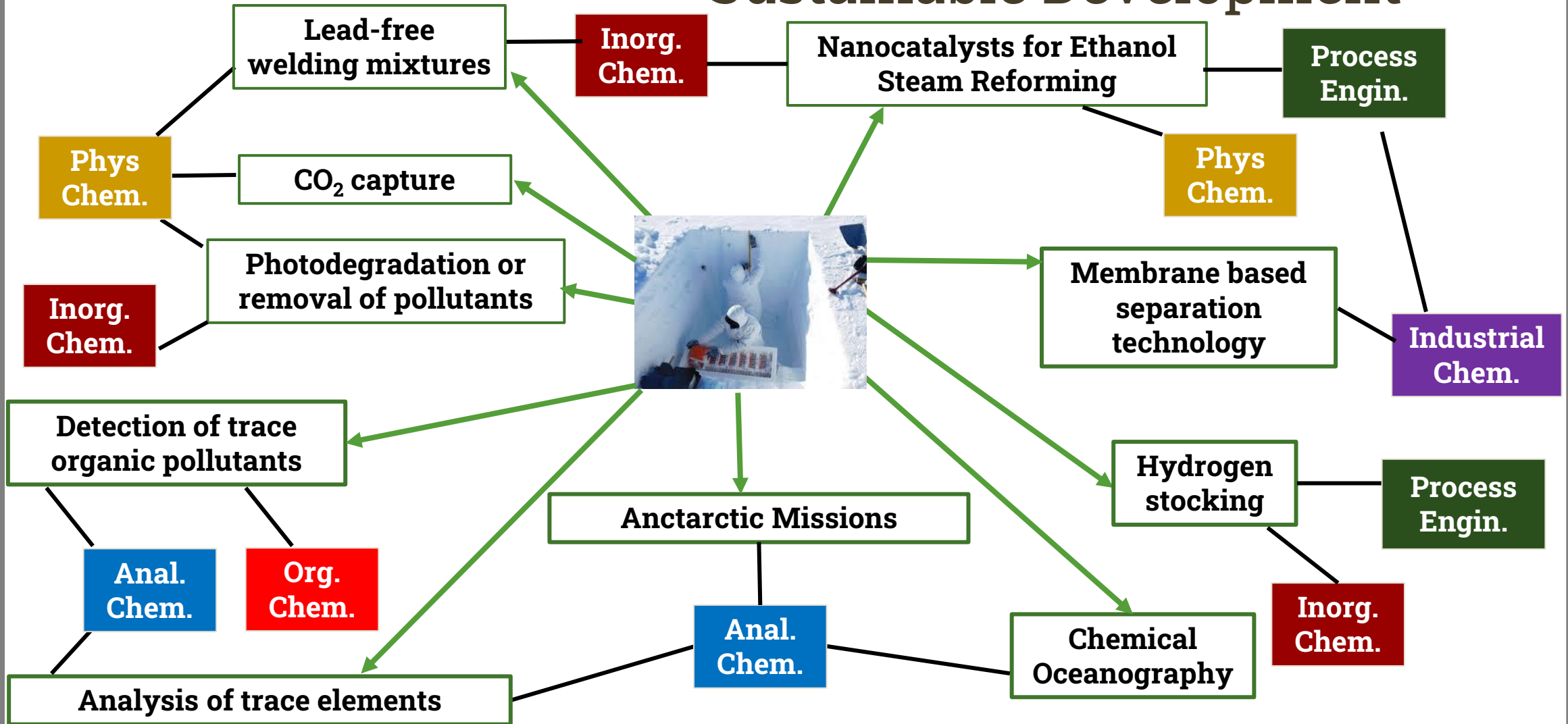
Polymer Photonic Crystal Sensors



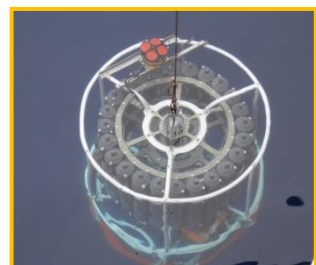
$$\frac{\Delta\lambda(t)}{\Delta\lambda(\infty)} \sim \frac{2}{d} \sqrt{\frac{D_{eff}}{\pi}} \sqrt{t}$$



P. Giusto et al., *ACS Omega* 3, 7517 (18). P. Lova et al., *ACS Applied Materials & Interfaces*, **2019**, 11, 16872. P. Lova et al., *ACS Applied Polymer Materials*, **2020**, 2, 563-568. H. Megahd et al., *Adv. Funct. Mater.* **2020**, 2009626. H. Megahd et al., *Adv. Optical Mater.* **2021**, 2002006.



Italian National Program of Research in Antarctica



Focus on Environment and Sustainable Development



- In-field and laboratory work since 1988
 - ✓ Chemical contamination of the polar regions
 - ✓ Marine and atmospheric chemistry
 - ✓ Chemical oceanography
 - ✓ Analytical methods and technologies
 - ✓ Antarctic Environmental Specimen Bank
- 30 Expeditions; 20 projects; 2M€; 100 publications (*)
(*) rough estimates related to the research groups at DCCI
- Multidisciplinary approach and international cooperation

An eco-friendly process for zerovalent bismuth nanoparticles synthesis

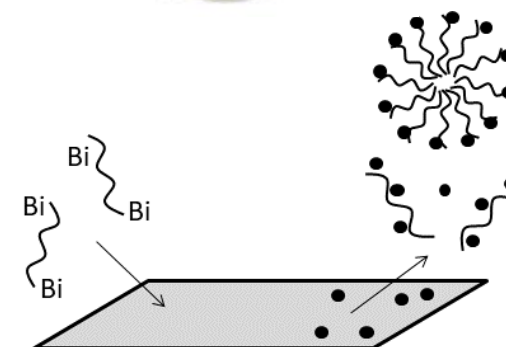
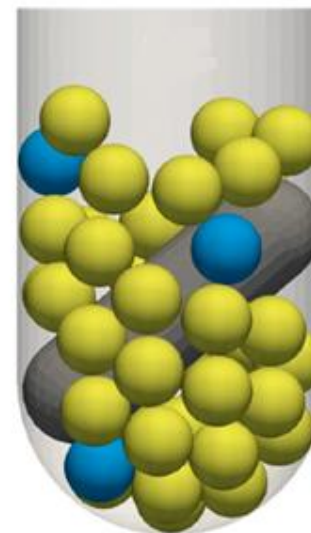
A two-pot bismuth nanoparticle synthesis based on a combination of a bottom-up process and a disaggregation technique.

First step: a cementation process with aluminium as sacrificial metal

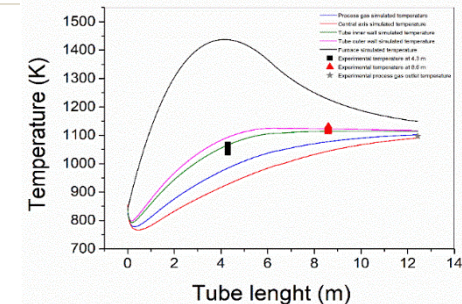
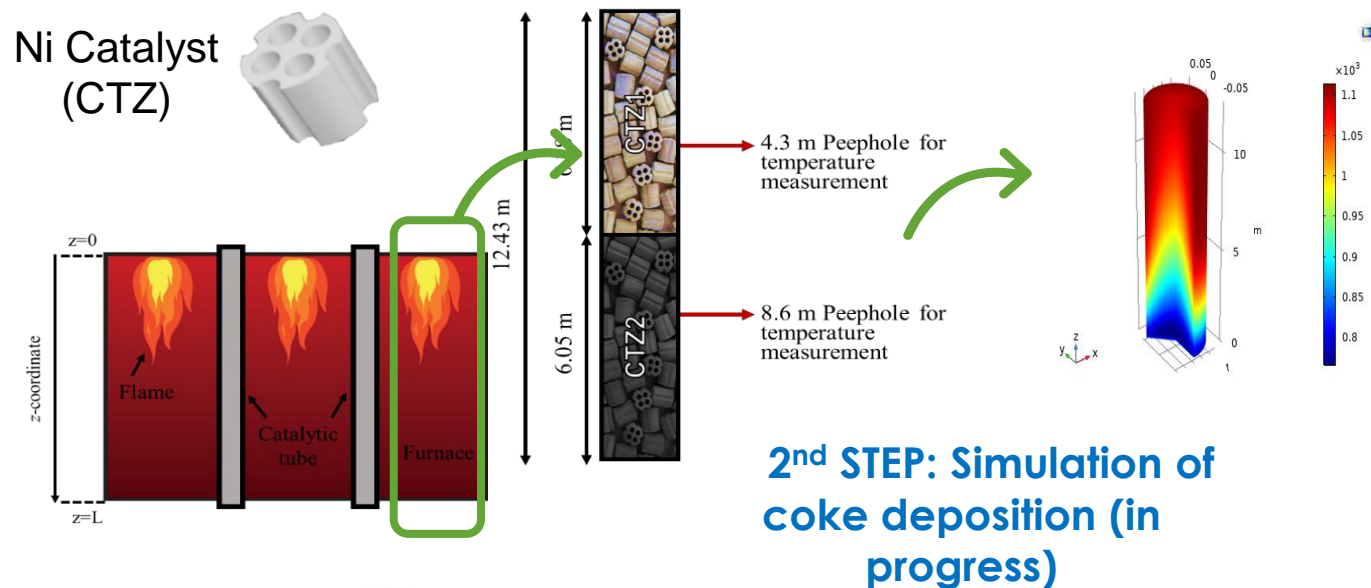
Second step: a wet bead-milling process in propylene glycol .

ADVANTAGES:

- 1) **Reagents substitution.** obtainment of metallic bismuth at the end of the cementation step without further purification treatments.
- 2) **Avoidance of use of toxic reductants** in view of a cleaner production and sustainability.
- 3) **Energy savings.** All stages carried out at room temperature



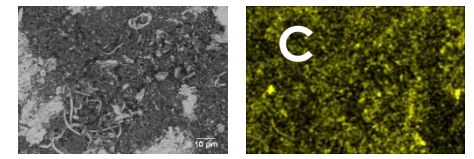
Improvements of steam methane reforming (SMR) reactors for hydrogen production



1st STEP: Simulation of SMR reactor & model validation (completed)

2nd STEP: Simulation of coke deposition (in progress)

3rd STEP: Development of FDI tool for early detection of coke deposition, based on machine learning (in progress)

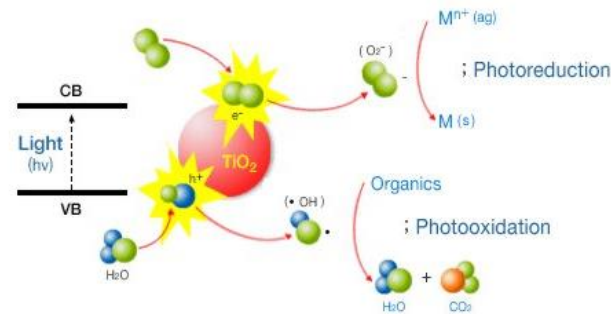


Project POR FSE Liguria Region 2014-20
RLOF18ASSRIC/30/1

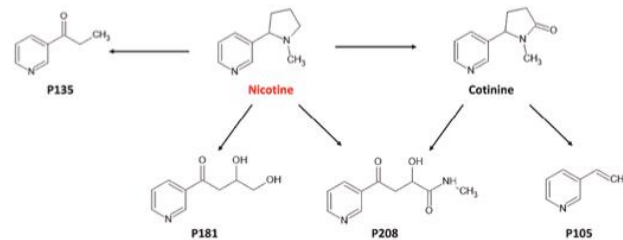
V. Tacchino, P. Costamagna, S. Rosellini, V. Mantelli, A. Servida, Multi-scale model of top fired steam methane reforming reactor, featuring effective furnace simulation, *Chemical Engineering Journal*, submitted.

Advanced Oxidation Processes for Environmental Applications

TiO₂-based photocatalytic processes

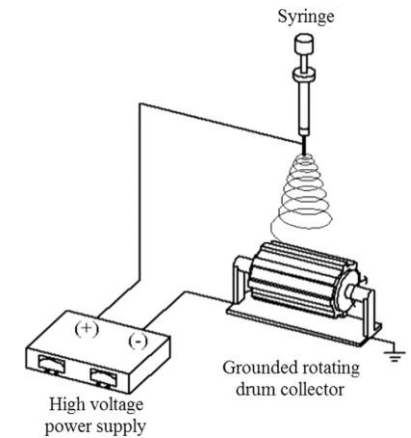
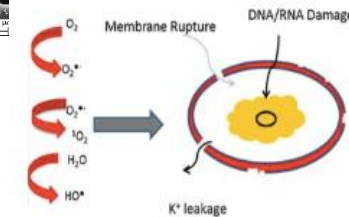
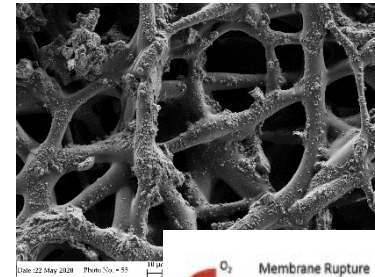


Degradation of emerging pollutants



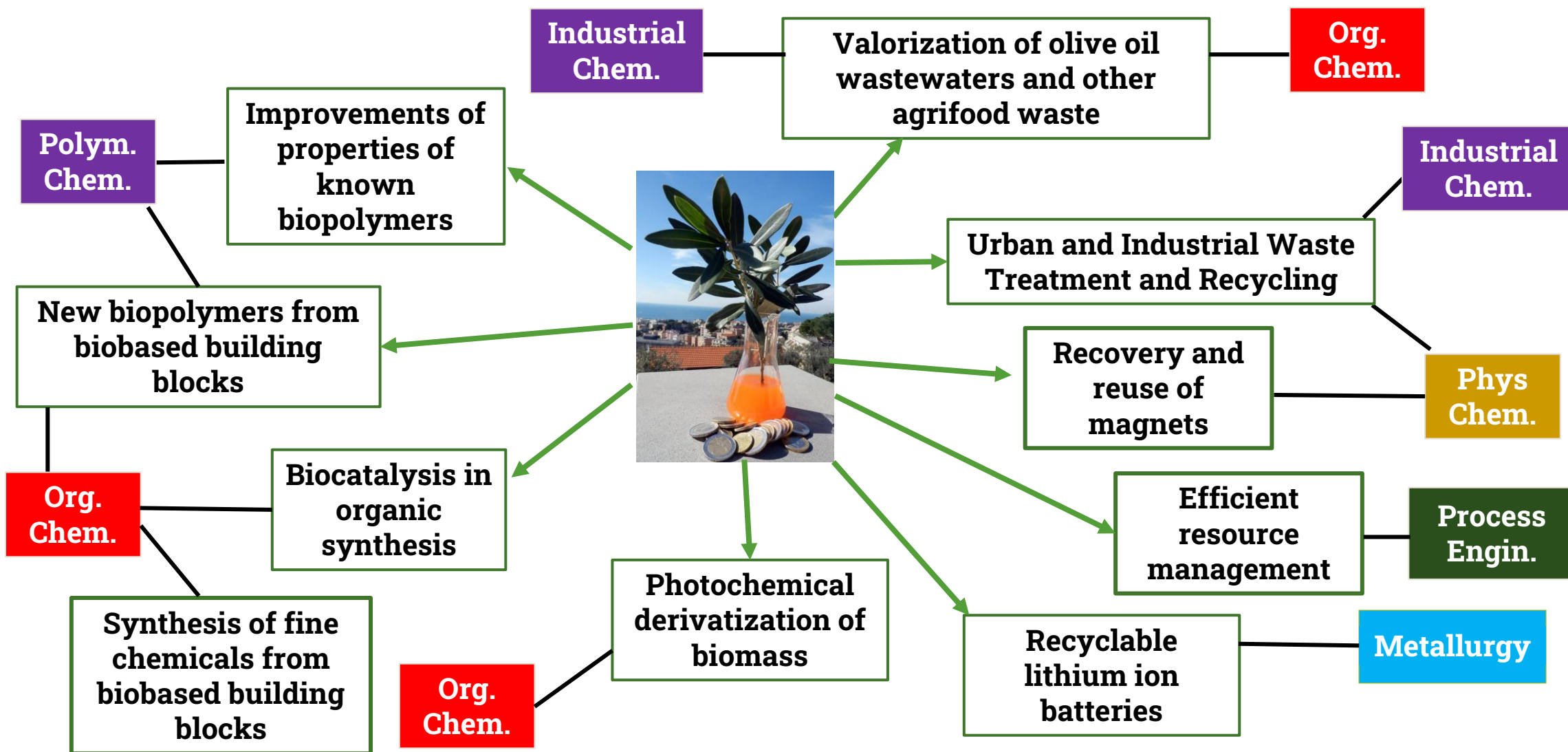
S. Alberti et al., Environ. Res. 194 (2021), 110695
 S. Alberti et al., J. Alloys Compd. 797 (2019), 820-825

Synthesis of membranes for antibacterial applications

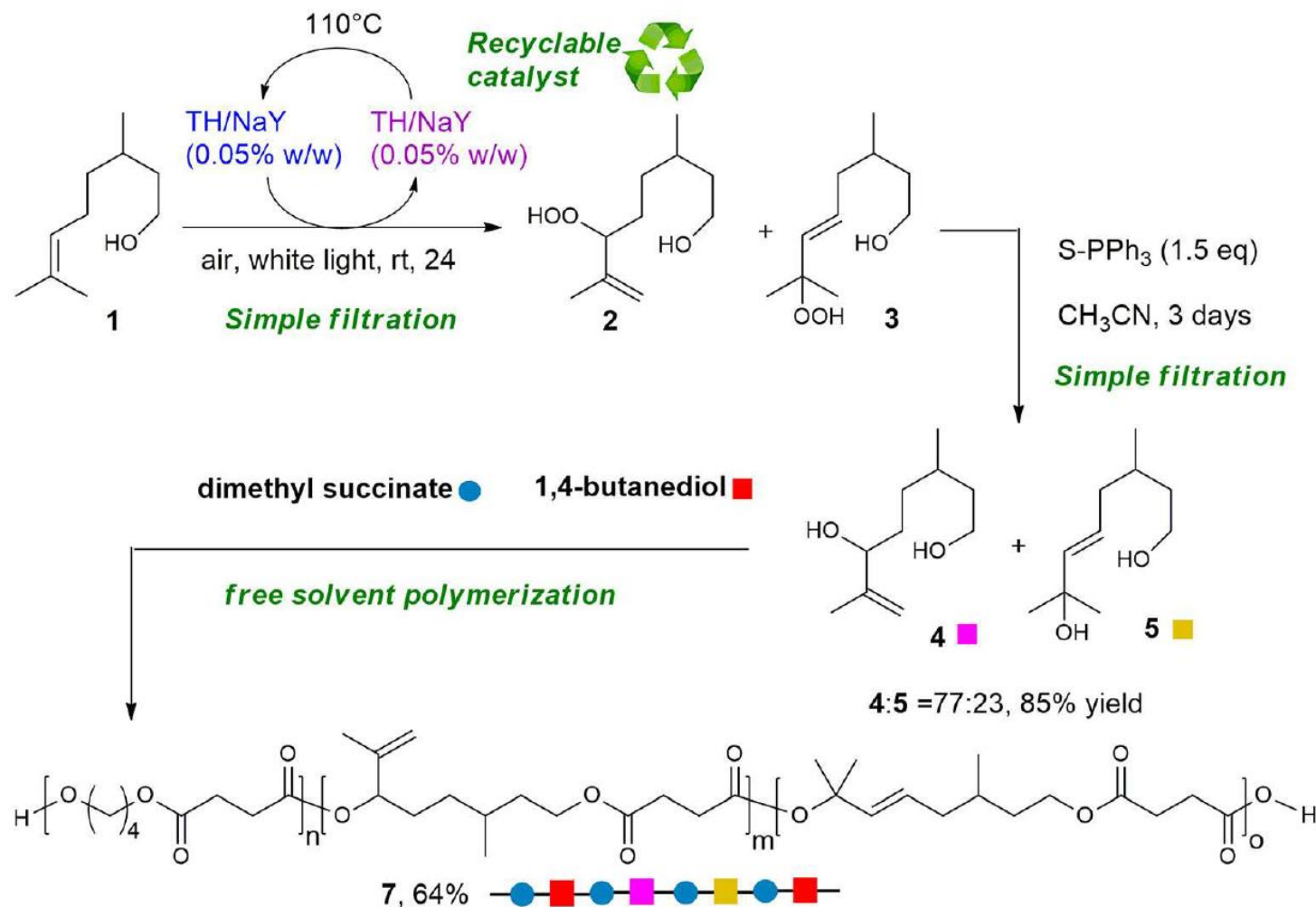


S. Alberti et al., J. Mater Sci. 54 (2019), 1665-1676



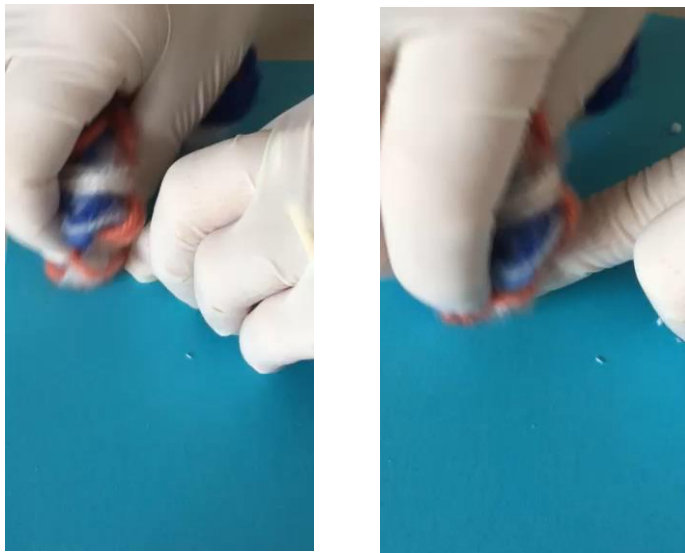


Light and air: the greenest chemical reagents

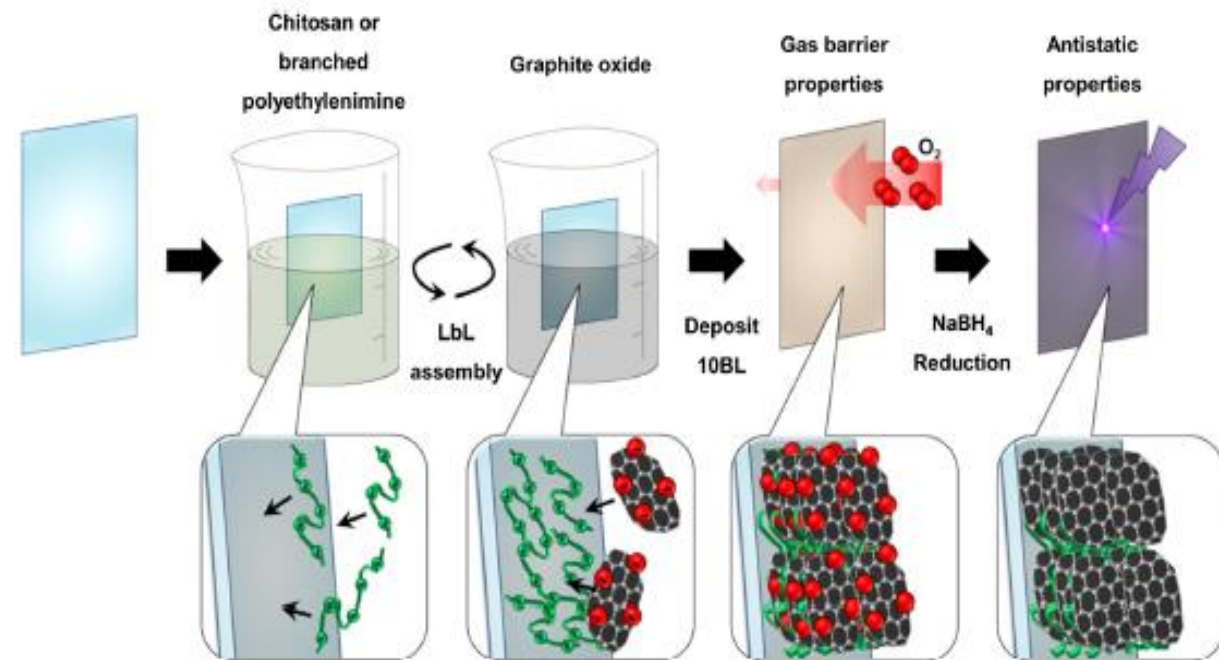


D. Lanteri, S. Quattrosoldi, M. Soccio, A. Basso, D. Cavallo, A. Munari, R. Riva, D. Lotti, L. Moni, *Frontiers in Chemistry*, **2020**, 8, art. 85.

Novel formulations based on bioplastic



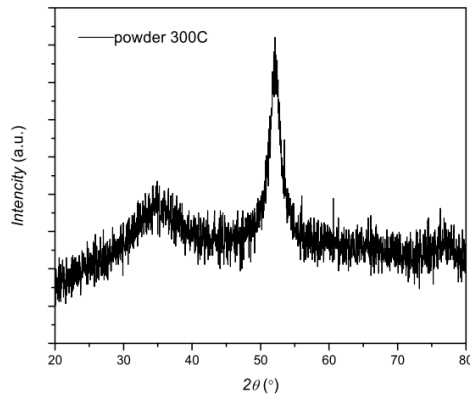
PLA films with good oxygen barrier and antistatic properties are developed by applying the Layer-by-Layer deposition of functional coatings



K. Li, A. Fina, D. Marrè, F. Carosio, O. Monticelli, *Applied Surface Science*, 2020, 522, 146471

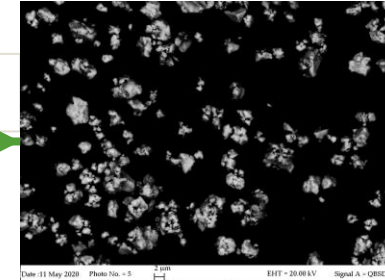
Recovery and reuse of End of Life NdFeB permanent magnets

From End of Life permanent magnets

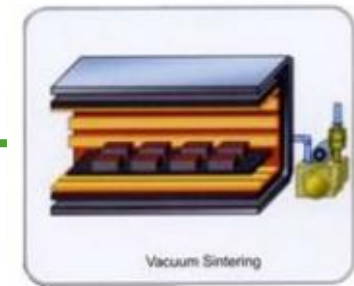


Controlled structure

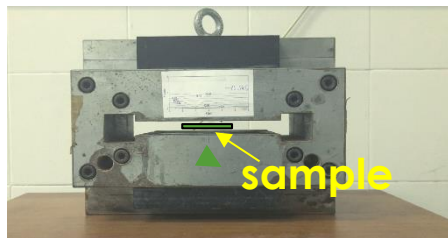
Controlled milling



Pressing and vacuum sintering



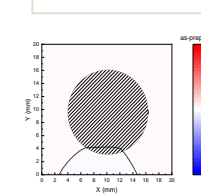
Magnetising



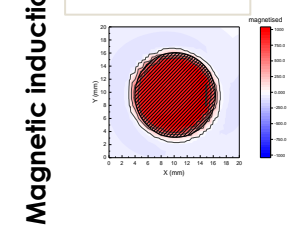
Quality control

Magnetic induction

before field



after field



New Magnets!

F.Canepa et al. "Magnetic and morphological characterization of NdFeB magnets with different quality grades at low temperature 5–300K" , JMMM 451, (2018), 549

A. Omelyanchik, G. Lamura, D. Peddis, F. Canepa, "Optimization of a NdFeB permanent magnet configuration for in-vivo drug delivery experiments" JMMM 521, (2021) 167491

UniGe | DCCI Research

Research mainly focusing on 3 research objectives

- **Materials Chemistry**
- **Environment and Sustainable Development**
- **Bioeconomy and the Circular Economy**

Thank you!!

