

National Research Council of Italy

The logo consists of the letters 'DS@TMM' in a bold, blue, sans-serif font. The '@' symbol is stylized as a series of three concentric, overlapping curved lines that form a partial circle around the letter 'T'. The logo is centered horizontally and overlaid on a background of colorful, flowing, ethereal shapes in shades of green, yellow, orange, red, and purple.

Department of Chemical Sciences and
Materials Technologies

Director: Prof. Lidia Armelao



DSCTM carries out strategic and applied research in every field of chemistry, molecular sciences and advanced materials playing a key role in promoting, coordinating and designing a wide range of interdisciplinary projects. Scientific excellence, size and capacity for collaborative research at both national and international levels, make DSCTM one of the most important Italian scientific centers for chemical

sciences and materials technology. The Department activities tackle primary scientific and social challenges that distinguish the first part of the 21st century: the health, care and well-being of people throughout their lives, the design of new materials and the exploitation of renewable energy resources, the development of green and sustainable solutions to build economic growth according to the principles of circular economy.



Inspired by the Sustainable Development Goals of Agenda 2030, aim of DSCTM is to promote prosperity while protecting the planet, and to address a range of social needs including health and job opportunities, while facing climate change and environmental preservation.

DSCTM, with 11 research Institutes and about 1000 researchers, technologists and technicians, is able to develop multidisciplinary coordinated projects, combining blue-sky scientific research with technology transfer and process innovation.

SUSTAINABLE DEVELOPMENT GOALS



Research Areas

GREEN CHEMISTRY

CHEMISTRY FOR LIFE SCIENCES

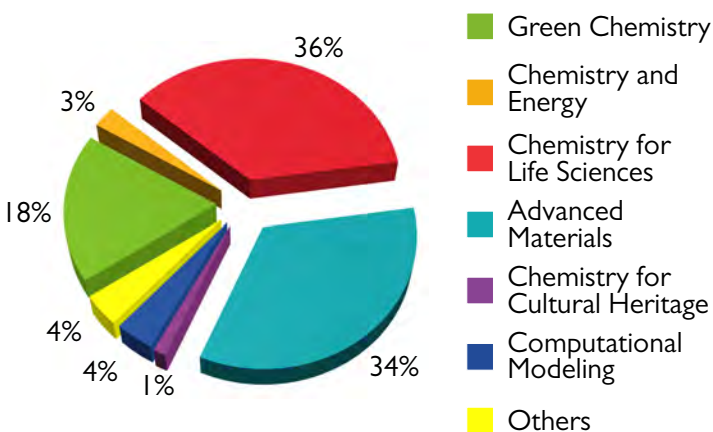
CULTURAL HERITAGE

CHEMISTRY AND ENERGY

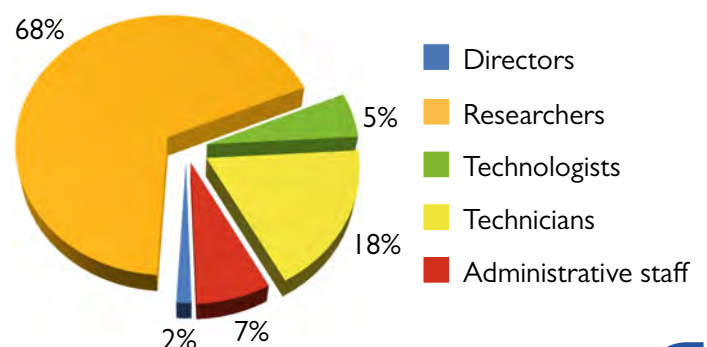
ADVANCED MATERIALS

COMPUTATIONAL MODELING

Patents



Human Resources



11 institutes are within the department (IC - Institute of Crystallography; ICB - Institute of Molecular Chemistry; ICCOM - Institute of Chemistry of Organometallic Compound; ICMATE - Institute of Condensed Matter Chemistry and Technologies for Energy; IPCB - Institute of Polymers, Composites and Biomaterials; IPCF - Institute of Chemical and Physical Processes; ISMN - Institute of Nanostructured

Materials; ISOF - Institute of Organic Synthesis and Photoreactivity; ISTECC - Institute of Science and Technology for Ceramics; ITM - Institute on Membrane Technology; SCITEC - Institute of Chemical Sciences and Technologies). These institutes, spread all over the whole country, carry out advanced research activity and are distinguished for competences, experimental facilities and the excellence of its researchers.





Institute of Crystallography

Director: **Dr. CINZIA GIANNINI**



The Institute of Crystallography (IC), officially active since 2002, with headquarters in the CNR Research Area in Bari, is also in Trieste (Elettra synchrotron in the Science Park Area of Basovizza), Como (Department of Science and High Technology of the University of Insubria), Rome-Monterotondo (Research Area of Rome I, Montelibretti), Caserta (Vanvitelli University, Department of Phar-

macy), Catania (Research Area of Catania). The IC, through the Trieste unit, co-manages (50%) the X-Ray Diffraction I (XRDI) beamline at the Elettra synchrotron, for macromolecular crystallography and material science studies.



What We Are Doing

The Institute of Crystallography operates at international levels of excellence in three main application areas: Health, Materials, Environment in a systemic approach (one-health oriented). Precisely, it deals with research in the field of chemistry, physics, structural and functional biology, with studies in human and animal health, in the health of ecosystems, and in new materials with applications in energy, environment, medicine, covering the following list of activities:

Development of innovative, theoretical, computational, and experimental crystallographic methodologies, and their applications for the study of crystalline and non-crystalline matter through X-rays, electrons, and neutrons.

Development of instrumentation, methods, and dedicated set-up for experimental applications of X-ray scattering from conventional sources, synchrotron, and neutron light.

Structural and microstructural studies of nanomaterials and biomaterials of scientific and technological interest.

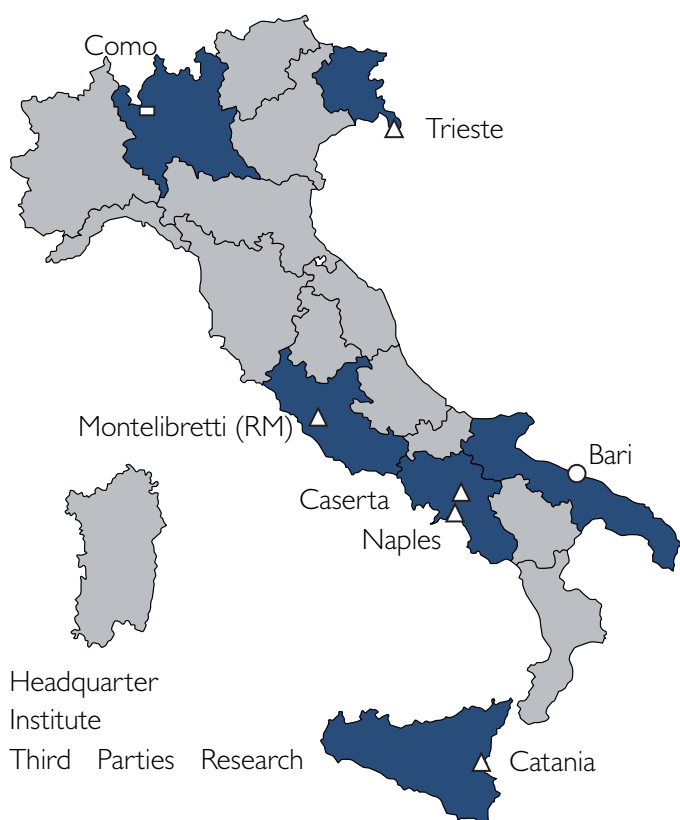
Synthesis and study (also predictive computing, AI based) of the structure-activity-function relationships of inorganic, organic, bioinorganic, and pharmaceutical compounds.

Molecular design, synthesis, production, crystallization, structural and functional characterization of biomolecules, in solid or liquid phase, also in interaction with ligands and / or metals, for biotechnological and / or pharmaceutical applications.

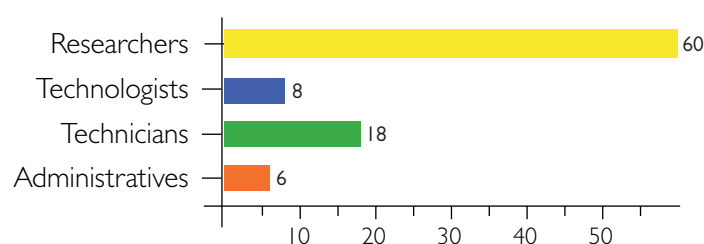
Studies of processes and products of biotechnological interest and development of innovative biosensors and sensors.

Development of imaging approaches for multidisciplinary research.

SOFTWARE/KNOW-HOW
IC develops and distributes innovative crystallographic software for structure solution to academic institutions and companies. IC has two know-how non-exclusive license agreements with RIGAKU for commercialization of EXPO and SIR packages, with recognition to CNR of royalties.



Human Resources





ITACA-SB Infrastructure:
 UP: XEUSS3.0 HR BioSAXS Laboratory,
 contact: cinzia.giannini@cnr.it
 DOWN-LEFT: HPC HERMES Laboratory,
 contact: domenico.alberga@cnr.it
 DOWN-RIGHT: CRYO-EM Laboratory,
 contact: giancarlo.tria@cnr.it



Elettra Infrastructure:
 X-Ray Diffraction I (XRD1) beamline at the
 Elettra synchrotron,
 contact: luisa.barba@cnr.it



Some of the computational tools available
 for structural investigations of biomolecules
 and materials. Entire list at: <https://www.ic.cnr.it/software/>

Our Projects

BIOACTIVE PEPTIDES (BPS)

short amino acid sequences with high selectivity, biocompatibility, and low toxicity— are increasingly important in therapeutics, nutrition, and biotechnology. Despite more than 80 peptide drugs in use and a rapidly expanding global market, their development remains limited by poor stability, low oral bioavailability, and challenges in purification. Traditional chromatographic separation is effective but resource-intensive, whereas crystallization offers a sustainable, scalable alternative capable of producing highly pure materials with controlled physical properties. However, peptide crystallization is hindered by conformational flexibility, structural heterogeneity and low crystallization propensity. Recent advances in crystallization strategies, including the use of soft and hard templates, present promising solutions. Structural characterization via SCXRD and PXRD, supported by synchrotron radiation and tailored phasing strategies, is essential for resolving complex peptide architectures. This proposal is a bilateral collaboration between Imperial College London (Royal Society-UK) and Institute of Crystallography (CNR-IT), integrating complementary expertise in peptide synthesis, crystallization technologies, and advanced X-ray methodologies to enable efficient, sustainable BP purification and structure determination.



Project Manager

DR. B. CARROZZINI

POTENTIATING THE ITALIAN CAPACITY FOR STRUCTURAL BIOLOGY SERVICES IN INSTRUCT-ERIC

The main objective of the ITACA.SB IR (Potentiating the Italian Capacity for Structural Biology Services in Instruct-ERIC) is to strengthen Italy's capacity in the strategic field of structural biology. Through the creation of a dedicated research infrastructure, ITACA.SB provides the Italian and international scientific community with the tools and expertise required to study (macro)molecules at various levels of complexity and their mechanisms of action. Consequently, the project consolidates Italy's role within the European Instruct-ERIC network with an immediate impact, increasing the quality and visibility of Italian research while aligning the country with international advancements in structural biology and modern technology.

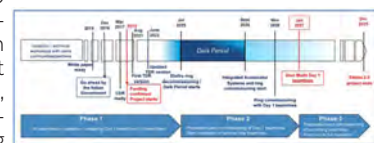
With the acquisition of high-tech instrumentation (CryoEM, BioSAXS, High-Throughput Crystallization platforms, etc.; see www.itaca-sb.it), the project aims to stimulate innovation and technology transfer by bridging the gap between research and industry. This is particularly relevant to the biotechnology and pharmaceutical sectors, fostering the development of new products such as drugs, diagnostics, nutraceuticals, and functional foods. Furthermore, ITACA.SB aims to contribute significantly to societal development through the continuous training of researchers from both academia and industry, equipping them with the diverse skills essential for their future careers.



Project Manager
 DR. M. SAVIANO

ELETTRA 2.0

The new infrastructure, Elettra 2.0, realized through a public investment of nearly 200 million euros, is based on a fourth-generation storage ring. It will provide a substantial improvement in performance in terms of beam stability, brilliance, coherence, and photon beam precision. Commissioning of the new light source is scheduled for 2026, with the first external users expected in early 2027. The new machine will deliver a more stable, focused, and coherent photon beam, with energies up to 120 keV, to a maximum of 32 experimental stations. Of these, 20 will be reconfigured from the 28 beamlines previously operating at Elettra. Among them is XRD1, the beamline co-managed by our institute. XRD1 will be dedicated to hard X-ray diffraction on single crystals, powders, and thin films or surfaces, with a strong emphasis on in situ and operando experiments.



The beamline will be equipped with a new wiggler source featuring a 1.8 T magnetic field, 9.6 mm period, 15 poles, and a 12 mm gap. This source will significantly enhance beamline performance not only thanks to the improved machine parameters of Elettra 2.0, but also due to its more compact and modern design, which reduces the apparent source size while improving beam homogeneity. As a result, an increase of approximately one order of magnitude in brilliance at the experimental station is expected. This will enable measurements on smaller organic and inorganic crystals, non-ambient experiments on highly disordered materials, access to near-monolayer sensitivity in grazing-incidence X-ray diffraction (GIXRD), and the routine execution of in situ and operando diffraction experiments.

Project Manager
 DR. L. BARBA

Excellence of the Institute

The main and promising research lines cover the following relevant scientific area: Crystallographic methods. IC is one of the world leaders in the development of innovative crystallographic methods. The developed packages for structural resolution (SIR, EXPO), crystalline phase identification (QUALX), X-ray scanning microscopy (SUNBIM), multivariate analysis of unidimensional profiles (ROOTPROF), for searching and analyzing crystal-chemical information (OCHEMDB), for nanomaterials characterization with total scattering methods (DEBUSSY) are well known in the international scenario and downloaded by hundreds of thousands of users worldwide. Structural Chemistry. More promising research on new ligands is performed by X-ray powder and single crystal diffraction with

application in medicinal chemistry, cultural heritage materials and minerals. Material Science. IC offers excellent scientific competences and state-of-the-art instrumentation to image structure and morphology of smart nano/bio/materials at the nano and atomic scale, encompassing diverse disciplines.

Biotechnology for agri-food field. Biosensors are developed to detect environmental pollutants, and address food quality and safety issues.

Structural Biology. High impact research is in progress on proteins or oligonucleotides and their complexes with biological molecules, with the aim to drive the design of new molecules with application in early diagnosis and in therapy.

Website: <http://www.ic.cnr.it>

Address: via Amendola, 122/O

70126 - Bari - Italy

Tel: +39 080 5929142 - Fax: +39 080 5929170





Institute of Biomolecular Chemistry

Director: **Prof. ANGELO FONTANA**



The Institute of Biomolecular Chemistry (ICB) fosters the chemical study in any sector of life science and sustainable use of natural resources, occupying a multi-disciplinary area in which the methods and approaches

of organic and bio-organic chemistry are applied to biology, medicine, and environmental protection. The mission of the Institute concerns the research and development of chemical reactions and organic molecules of interest in biology and sustainability, intending to understand their function and explore their applications. The ICB was born on 15th February 2002 from the union of 3 former Institutes and 3 Centers of CNR but the original core dates back to the late sixties. In the present form, the Institute is composed of more than 100 units of personnel distributed in four sites including the institutional headquarters in Pozzuoli at the north of Naples and 3 branches in Catania, Padua, and Sassari.

The Institute promotes basic and applied research through national and international projects with public and private collaborators in favor of scientific and social progress in human well-being (therapeutics, diagnostics, food ingredients, nutraceuticals, and cosmeceuticals), bio-based and eco-friendly technology, green chemistry, marine and extreme environment exploration. The ICB also offers research infrastructures for the analysis of single metabolites (marker analysis) and molecular pools (metabolomics, glycomics and lipidomics), the structural characterization of small molecules, the identification of biological and pharmacological properties, the study of the mechanism of action of bioactive compounds, the synthesis and functionalization of organic chemicals, the extraction and purification of natural molecules, fermentation and biomass production.

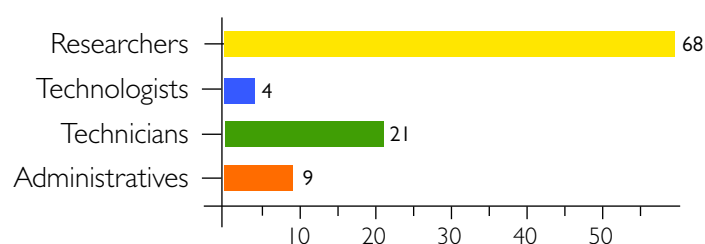


What We Are Doing

The ICB copes with R&D in the bio-medical, agro-food, biotechnology, and green-economy sectors by virtue of experience in chemical synthesis, supramolecular chemistry, pharmacology, cellular biology, chemical and enzymatic catalysis, biosynthesis and metabolism, biochemistry, extraction techniques, chromatography, nuclear magnetic resonance and other spectroscopic methods, mass spectrometry and related techniques (MS cytometry, GC- and LC-MS/MS analysis), NMR- and MS-based metabolomics and lipidomics, fluorescent and isotope-labeled probes, microscopy, whole-cell transformation and fermentation from laboratory scale to large industrial reactors. This expertise contributes to the formation of five major research platforms committed to innovative programs in:

- 1) Human Health: drug discovery, medicinal chemistry, neuroscience, cancer research, molecular immunology, preclinical development of drug candidates, microbiome, ex vivo and in vivo model;
- 2) Sustainable Energy: biofuels, hydrogen from catalytic and biological processes;
- 3) Environment: chemical ecology, biological invasion, recycling of potentially polluting industrial waste products;
- 4) Agriculture and Food: novel foods, amelioration of species with nutritional value, active natural ingredients for the nutraceutical, cosmetic and veterinary use;
- 5) Biotechnology: valorization of agro-food residues, biotransformation by extremophilic bacteria and enzymes, CO₂-capture and valorization, biomass and bioproducts from marine microalgae.

Human Resources



Patent

- Nanostructured formulations for the delivery of silibinin and other active ingredients for treating ocular diseases, EP3203989A1
- Use and preparation of beta-glycolipids as adjuvants in vaccines, WO2014199297-A1; CN105307680-A; EP3007725-A1; US2016151483-A1; US2018344843-A1.
- Process for the sequestration of carbon dioxide and the fermentative production of organic compounds, EP2948556B1
- Peptidi e peptidomimetici inibitori delle interazioni proteina-proteina della fosfatasi SHP2 come farmaci nella terapia del cancro e di malattie rare (RASopatie) PCTEP2021055624



Fractionation of small organic molecules. The ICB has a well-established expertise in the synthesis and extraction from natural sources of bioactive molecules that are studied for their pharmacological and functional activities.



Analysis of volatile organic compounds (VOCs) by gas chromatography (GC). The ICB offers an updated array of instrumental resources for the structural characterization and analysis of organic molecules for studies in medicine, food, agriculture, and ecology.



Collection of unicellular microorganisms in liquid cultures. The ICB fosters the study of cell biology, from prokaryotes to eukaryotes, in order to address physiological or pathological issues especially related to human health, as well as to elucidate central metabolic pathways and to implement biotechnological processes.

Our Projects

Joint International Research Unit (UMI)



Project manager
DR. V. DI MARZO

Joint international research unit for chemical and biomolecular research on the microbiome and its impact on metabolic health and nutrition.

<https://www.umilaval.cnr.it/en/>

The Joint International Research Unit (UMI) is a bilateral research unit between the CNR and the Université Laval of Quebec. The UMI has among its proposed ambitious goals the development of research projects, and the innovation, education and knowledge transfer in the biomolecular study of the intestinal microbiome. Among others, the project aims at the identification of microbiome-derived bioactive metabolites and -omic characterization of the oral and gut microbiome of healthy individuals as compared to individuals with high cardiometabolic risk.



ADVISE

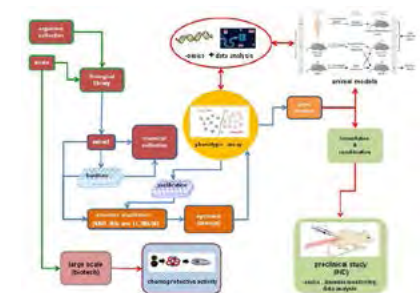


Project manager
DR. A. FONTANA

Antitumor Drugs and Vaccines from the Sea

<https://www.advise.campania.it/>

The project pursue the implementation of a drug discovery platform for marine natural products with chemotherapeutic and immunomodulating activity. The high-level goals are the development of anti-tumor vaccine models, taking advantage from the discovery of the molecular adjuvant called SULFAVANT, and (ii) the identification of new immunotherapeutic molecules of natural origin, (iii) chemopreventive agents. As a proof of concept, ADVISE targets neoplasms chosen from chronic forms and without validated biological markers of lung cancer, melanoma and multiple myeloma.



BioRECO₂VER



Project manager
DR. G. D'IPPOLITO

Biological routes for CO₂ conversion into chemical building blocks

<https://bioreco2ver.eu/>

The goal of this H2020 project (No. 760431) is to demonstrate the technical feasibility of non-photosynthetic anaerobic biotechnological processes for the capture and conversion of CO₂ from industrial point sources into isobutene or lactate. To this end, three hybrid enzymatic processes, including the Capnophilic Lactic Fermentation, are investigated for conversion of off gas CO₂ into the targeted end-products by fermentation and bioelectrochemical systems. The BioRECO₂VER project provides a further step in valorizing CO₂ and manufacturing chemicals in an alternative way.



Excellence of the Institute

The ICB is an updated technological hub for the research and development of small molecules and biotechnological processes. For the pharmaceutical sector, the activities dedicated to the analysis, synthesis and biological evaluation of small bioactive organic molecules are able to support studies of lead compounds and preclinical development of lipids, natural products, peptides, and biomarkers for oncology, immunology, and neuroscience. In this frame, an emerging point of excellence is the research of vaccine adjuvants by the activation of the innate immune system through pattern recognition receptors (PRRs) and small molecules and glyco-conjugates.

The Institute makes available a collection of molecules and extracts, and a database with information on molecules discovered in our laboratories. The ICB also harbors impactful research on the endocannabinoid signaling system and on the pharmacological potential of cannabis. In biotechnology the Institute conducts research in the development and implementation of processes based on extremophilic and whole-cell enzymes for the biological mitigation of CO₂ and for the production of biofuels, hydrogen, food ingredients and functional and / or bioactive compounds from the conversion of natural matrices and agro-food residues.

Website: www.icb.cnr.it

Address: Via Campi Flegrei, 34
80078 - Pozzuoli (NA) - Italy

Tel: +39 081 8675026 - Fax: +39 081 8041770





Institute of Chemistry of Organometallic Compound

Director: **Dr. CLAUDIO SANGREGORIO**



The Institute of Chemistry of Organometallic Compounds (ICCOM) was founded in 2001, merging former ISSECC (Institute for the Study of Stereochemistry and Energetics of Coordination Compounds), founded by Luigi Sacconi in Florence in the 1970s, with three CNR Centers located in Florence, Pisa and Bari, to create a CNR chemistry institute initially mainly focused on organometallic chemistry, homogeneous and heterogeneous catalysis. Since 2006, ICCOM manages the Center for Electronic Microscopy (Ce.M.E.), located within the CNR Florence Research Area, a reference laboratory in the field of electronic microscopy available to CNR Researchers, Universities and the manufacturing and industrial world. In 2011, the expertise in analytical chemistry, spectroscopy methods for health, materials science and cultural heritage, and theoretical chemistry were enhanced

by the arrival of more CNR researchers, who joined the ICCOM Secondary Site in Pisa. A Third Party Research Unit (URT) of ICCOM is located at the Department of Chemistry of the University of Trieste, collaborating on research in nanotechnologies, heterogeneous catalysis and new materials for production of energy from renewables. In 2026 ICCOM has 102 staff units. Moreover, the Institute also had a large number of University associates (31) and many young scientists among PhD students and postdocs (32). ICCOM has established over the years a large number of collaborations in Italy and abroad, spanning from universities, to public institutions, research centers, companies, NPOs, consortia and foundations, across many countries in Europe and worldwide.

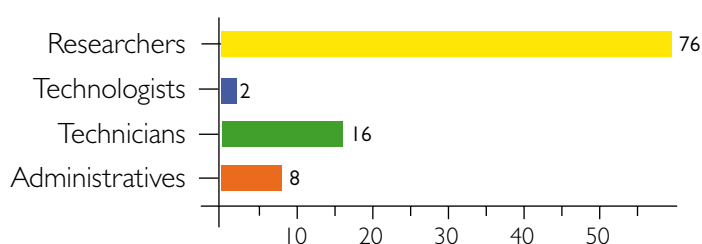


What We Are Doing

The mission of the Institute is to develop fundamental and applied research together with advanced training in the following fields of chemistry and materials sciences:

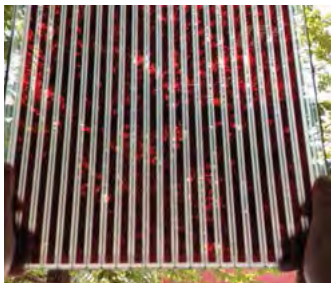
- Green chemistry and sustainable processes: toward high efficiency and selectivity by catalytic and stoichiometric processes optimisation and use of renewables;
- Catalysis, electrocatalysis and photocatalysis for the production of energy;
- Photovoltaic solar cells: organic and organometallic compounds for new generation solar cells;
- Hydrogen chemistry and technology: production, storage and use in fuel cells;
- CO₂ chemistry and technology: valorisation (CCU) and capture (CCS);
- Organic, inorganic and hybrid polymeric materials with tailored functional properties;
- Substitution of critical and strategic raw materials;
- Novel materials and properties under extreme conditions;
- Organic chemistry and magnetic materials for pharmaceutical and medical applications;
- Advanced analytical and spectroscopic techniques for the environment, health and conservation of the artistic and cultural heritage;
- Theoretical and computational chemistry for predictive modelling.

Human Resources

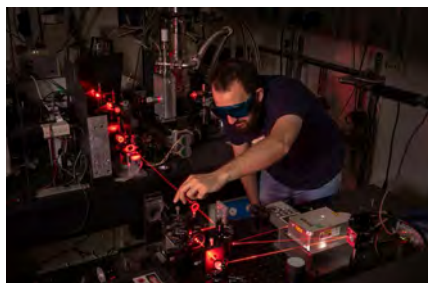


Patent

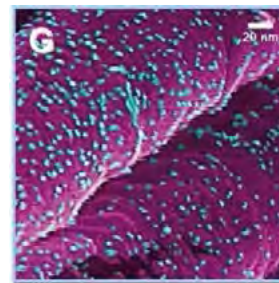
- Coating material for producing an adsorbent, porous, flexible coating for a heat exchanger and method for producing said coating material, World Patent No. WO2020120142A1, 2020.
- Use of exfoliated black phosphorus for the treatment of bone cancers, World Patent No. WO2020049475A1, 2020.
- Hydrometallurgical process for the treatment of lithium batteries and recovery of the metals contained therein, European Patent No. PCT/IT2019/050013, 2019.



DSSC photovoltaic module containing the SB2 photosensitizer synthesized at ICCOM, manufactured in collaboration with the University of Peloponnese (Patras, Greece).



Laboratorio High Pressure Chemistry and Physics ICCOM presso il LENS (European Laboratory for Non-Linear Spectroscopy) Image: Andrea Taschin



Scanning Electron Microscopy (SEM) image of titanium-web substrate nanotubes photocatalyst with the addition of Pd (0.26 wt.%).

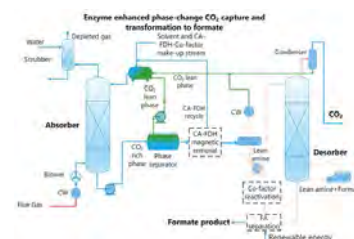
Our Projects



Project Manager
DR. M. CALAMANTE

BIOCUF (2024-2028)

MIMIT – Call “CETPartnership 2023 – Clean Energy Transition Partnership”, project code no. Cetsp-FP-2023-00217. BIOCUF seeks to develop and demonstrate a biotechnological CO₂ capture and utilization (CCU) technology using carbonic anhydrase and formate dehydrogenase coupled enzymatic cascade reaction in a phase-change solvent solution, while simultaneously transforming the captured CO₂ into formate, which can then be converted into higher value-added products. BIOCUF offers a clean technology solution to accelerate CCU in the value chain in a cost and energy efficient manner to reduce CO₂ emissions.



EU HORIZON – RIA “BEETHOVEN” (2024-2028)

(<https://projectbeethoven.eu/the-project/>)

The main goal of BEETHOVEN is to develop innovative and sustainable materials and PMs that can substitute REE in the energy and transportation sectors. We aim at developing and up-scaling innovative materials in order to produce high-entropy alloys magnets and ferrite-based composite magnets with energy products in the range of 55-220 kJ/m³. We will demonstrate a successful substitution of REE-magnets by BEETHOVEN magnets in 3 applications: a wind turbine for energy generation, a drivetrain for electric vehicles (EV) and a flywheel for energy storage.

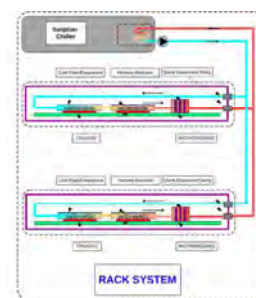


Project Manager
DR. C. SANGREGORIO

HORIZON-EIC-2023-PATHFINDERCHALLENGES “DYMAN” (2024-2027)

(<https://dyman-project.eu/>)

DYMAN targets the development of a completely new design for adsorption chillers that are dynamically managed in Data Centres, based on: (1) new low temperature adsorbents achieving high capacities at very low driving temperatures below 50 °C, and (2) new type of adsorption heat exchangers made of 3D printed structures integrating the adsorption material into a porous structure. Additionally, the project aims to further develop an existing two-phase cooling system, for high-performance computing servers to handle thermal loads more efficiently from next-generation processors and recovering 50% of waste heat from processors. DYMAN proposes a new way of active management of the data center integrating the cooling system as part of the optimization of processor management.



Project Manager
DR. A. FRENI

Excellence of the Institute

The Institute is a Center of Excellence, principally, but not only, in the fields of “Green Chemistry and Sustainable Processes” and “Renewable Energy”. The research activities carried out at ICCOM cover aspects of the hydrogen economy, such as production from renewable resources (e.g. biomass), storage and utilization. Innovative photovoltaic devices are developed, focusing on organic dyes design, and engineered for energy and hydrogen production, the latter from photochemical water splitting. Catalytic, photo- and electrocatalytic processes that convert carbon dioxide with high efficiency into fuels or chemical compounds are also studied. Excellence at ICCOM can also be found in other research fields such as

catalysis for green chemistry, environmental technology, conservation of cultural heritage, advanced polymers, critical raw materials (Libactory and permanent magnets), analytical chemistry, materials under extreme conditions, and nanomaterials for biomedical and energy applications. ICCOM has also a highly qualified group of computational chemists that brings expertise and top scientific contributions to the institute and DSCTM. The Electron Microscopy Centre of the CNR Research Area of Florence, associated to ICCOM, represents a laboratory of excellence for advanced characterization of various materials, attracting interest and financing opportunities from both public and private sectors.

Website: www.iccom.cnr.it

Address: via Madonna del Piano, 10 - Sesto Fiorentino (FI) - 50019
Tel: +39 055 522 5286 Fax: +39 055 522 5203





Institute of Condensed Matter Chemistry and Technologies for Energy

Director: **Dr. MARIA LOSURDO**



The Institute of Condensed Matter Chemistry and Technologies for Energy (ICMATE), founded in 2016, is a multidisciplinary institute involved in several aspects of

materials research with special attention to applications in the field of sustainable energy and growth.

With four units (Genova, Lecco, Milano, Padova) in three Italian regions (Liguria, Lombardia, Veneto), ICMATE is a distributed and interconnected network of laboratories, present also at the University of Padova, operating under the stimulus of different, though converging, viewpoints of chemists, physicists and engineers, with the aim to solve complex problems facing society today and in the future.

The Institute has a consolidated background on the design and synthesis of complex molecules, theoretical modeling at different scale lengths, understanding and prediction of composition-structure-property relationships in materials of different dimensionality, impact of microstructure and surface functionalization on properties.

Research at ICMATE is devoted to the development

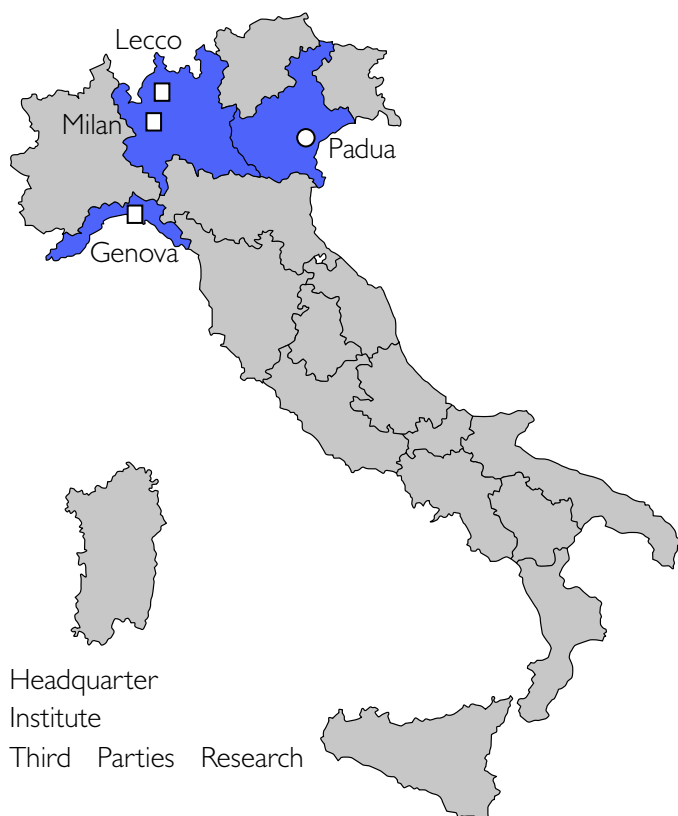
of innovative molecular systems, soft matter, functional surfaces and interfaces, inorganic, metallic and hybrid materials for applications in emerging technologies for energy sustainability and efficiency, advanced manufacturing and the biomedical field.



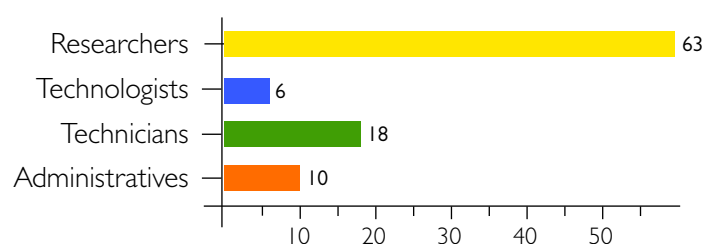
ICMATE coordinates many national and international research projects. Owing to its geographical spreading, the institute actively participates in regional networks, innovation clusters and actions in collaboration with universities, other research centers and companies.

It is actively involved in technological transfer processes from the lab-scale to the industrial level providing a technical-scientific support to enterprises. This fosters consulting activities to public institutions and business, and transfer of knowledge to relevant stakeholders.

ICMATE promotes science to students and citizens, giving an important contribution to educational and professional programs.



Human Resources



What We Are Doing

The research is focused on the strategic areas of renewable energy, energy harvesting and efficiency, reduction of carbon footprint, advanced manufacturing, and nanomedicine.

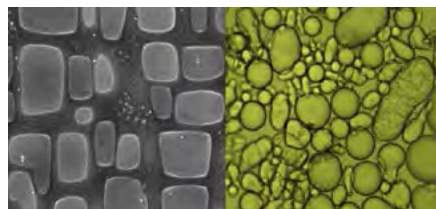
We combine advanced characterization techniques with theoretical and experimental expertise to predict and correlate the compositional and structural characteristics of compounds, nanoscale systems and materials to their functional micro- and macroproperties, and performances. The activities include the innovative synthesis of molecular systems and inorganic materials including films, nanostructures and colloids, the fabrication of bulk alloys, ceramics and composites, the design and control of their surfaces and interfaces, the development of prototype instruments and new methods of analysis, the study of functional surfaces, (photo)catalysts and coatings for innovative technologies of interest in sustainable energy, hydrogen production and separation, advanced metallurgy, cultural heritage, biomaterials and nanomedicine.

Patent

Over the years, ICMATE researchers have deposited several patents ranging from advanced manufacturing, functional surfaces and interfaces and sustainable materials. The most recent example is a patent on a composite made by a geopolymer and construction and demolition waste material mixture, suitable for building and design elements such as ventilated facades or for buildings hydronic heating/cooling. The patent is now under international extension.



Vapor phase deposition is used for applications such as protective coatings (left) and photocatalytic films (right).



Biphasic systems can be fabricated at both the solid state (left) and the liquid state (right, emulsion).



Complex alloys find application, for example, in thermoelectric devices (left) or orthoses (right).

Our Projects



Project manager
DR. A. TUISSI

ADJOINT

Additive manufacturing by binder jetting of sintered metallic components for osseointegration.

The ADJOINT project is funded by Istituto Nazionale Assicurazione Infortuni sul Lavoro (INAIL) and is focused on developing osseointegrated prostheses for the treatment of finger amputations. The project activities are based on the use of Additive Manufacturing technologies for the production of new implantable metal devices "fixtures" with improved osseointegration and antibacterial response tuned on the specific needs of the patient.

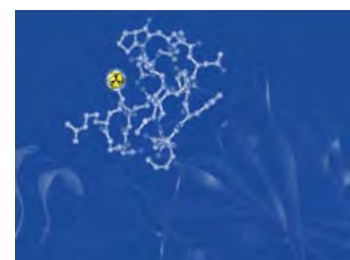


Project manager
DR. C. BOLZATI

TARATA

Targeting high malignant tumors with new $\alpha\beta$ -selective radiopharmaceuticals for imaging and theranostic applications.

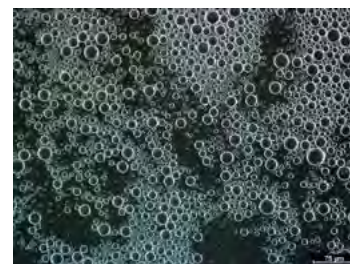
The development of highly selective $\alpha\beta$ -targeting RadioPharmaceuticals (RPs) provides a new opportunity to efficiently image highly malignant tumors (e.g. melanoma and metastatic triple negative breast cancer) and their associated metastases by single-photon-emission-computed-tomography and positron-emission-tomography (SPECT/PET) along with an accurate prognostic stratification of patients. In parallel, RPs offer the unique opportunity to design a theranostic strategy in treatment of cancer of epithelial origin, especially those refractory to conventional therapy. Using the highly selective $\alpha\beta$ RGD_{echi} peptide, a new class of RPs will be designed and developed for SPECT or PET-imaging and subsequent therapeutic applications. Results of TARATA, a project funded by Associazione Italiana per la Ricerca sul Cancro (AIRC), will have a definite impact on detection and therapy of highly aggressive tumors.



EDDI - Emulsion Dynamics and Droplet Interfaces

EDDI is a Microgravity Application project of the European Space Agency (ESA) coordinated by ICMATE involving 14 academic and industrial partners from Europe, Japan, Russia and USA.

The project aims at increasing the comprehension of the influence of equilibrium and dynamic properties of the interfaces between surfactant solutions and oils on the dynamic and structural features of the corresponding emulsions. Experiments are planned on board the International Space Station, utilizing a facility developed by ESA for the study of emulsion aging and droplets dynamics. Within the perspective of a sustainable growth, the results of the research will support the development of models and numerical tools useful for an "on-demand" formulation of emulsion-related products (foods, pharmaceuticals, cosmetics, chemistry, materials), using an optimal resource utilization (energy, surfactants, chemicals) and conjugating economical and societal benefits.



Project manager
DR. L. LIGGERI

Excellence of the Institute

ICMATE operates in multiple research fields, from chemistry to materials science and engineering. Its long-term expertise on the synthesis and investigation of functional molecules, colloids, engineered surfaces and interfaces, multifunctional nanostructures, innovative materials, new architectures and devices is internationally recognized. ICMATE balances basic and applied research to both increase knowledge and provide innovative technological solutions to both public and private sectors. It is actively involved in the transition to a lower carbon footprint society, in green hydrogen technologies, energy efficiency, water purification, advanced manufacturing, waste recycling, nanomedicine and advanced characterization of materials

and interfaces.

The multidisciplinary competences in ICMATE favours its consolidated links with leading national and international research centers, remaining at the forefront of their fields. Our scientists are active in national and international communities, as editors of international journals, presidents and appointed members of scientific societies, experts in international committees for standardization, science officers at the CNR Brussels Liaison Office and as CNR representatives in European initiatives (e.g. ERA, EERA). ICMATE leads and participates to international, national and local projects and is part of technological clusters.

Website: www.icmate.cnr.it

Address: Corso Stati Uniti, 4 - Padua - 35127
Tel: +39 04 98 295 850 Fax: +39 04 98 295 853





Institute of Polymers, Composites and Biomaterials

Director: **Prof. EDOARDO BEMPORAD**



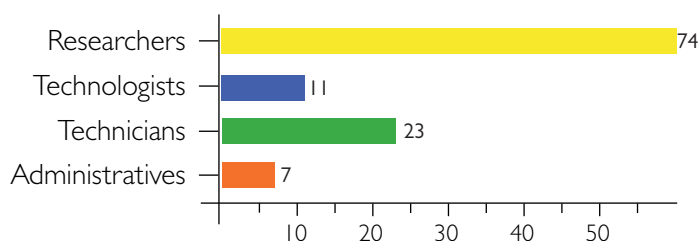
The Institute for Polymers, Composites and Biomaterials (IPCBI) was founded in March 2014 by merging the Institute of Chemistry and Technology of Polymers (ICTP) and the Institute for Composite and Biomedical Materials (IMCB).

The headquarter of the Institute is in Pozzuoli and supporting units are in Napoli/Portici, Catania, Lecco and, as Third Research Unit, in Lecce at the University of Salento. The IPCBI with 115 employees (85 researchers and technologists, 30 technicians and administrative, several post-docs and PhD students and 25 university associates) is the largest CNR Italian institute performing research on polymers, composite materials and related advanced technologies. The research

activities, developed within the area of the Key Enabling Technologies are mainly focused on synthesis and design of advanced polymer-based materials, composites materials for functional and structural aerospace applications, development of personalized solutions in nanomedicine and health, application of chemistry and materials science for the environment and energy, storage, transport, packaging and cultural heritage. Strong partnerships are running with many institutions such as universities, inter-university research's consortium, research centres, technological districts & clusters, SMEs, both at national and international level, operating in different sectors with a focus on societal challenges.



Human Resources



What We Are Doing

The research activities, based on the unique and excellent personnel competences, gained in more than 50 years, organized in the four main research platforms, named Sustainability, Advanced Materials, Health and Nanomedicine, Space&Aerospace materials and technologies, are synthesized as it follows:

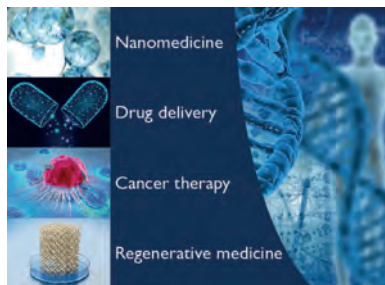
- Polymers, composites and nanostructures (bio- and synthetic) with multifunctional, sensing properties and with tailored resistance to extreme temperatures; flexible polymer-based composite multilayers for critical environmental conditions; ablative materials for space re-entry;
- Advanced and sustainable processing technologies of polymers, biopolymers, composites and nanostructures; additive technologies; polymer-based films for new packaging concepts and multisensorial design;
- Synthesis, functionalization and modelling of polymer-based materials. Structural and functional characterization of macromolecules and polymer-based materials and advanced characterization techniques;
- Multiphase polymer-based materials, nanomaterials and nanostructures (synthetic and natural) for tissue engineering and regenerative/therapeutic medicine including cancer; bio-interfaces; bio-printing;
- Development of innovative nanocarriers stimuli responsive for tailored and local drug delivery;
- Structural characterization of glycoproteins for biomarkers identification;
- Knowledge and technology transfer. Outreaching.

Patent

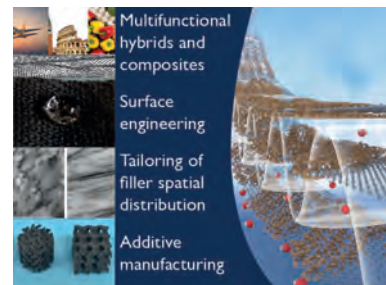
- WO 2017/025829 A1. PCT/IB2016/05430. Device for fluids infusion. Carbone D.C., Recca G.R.M., Maravigna A.
- WO2021013596A1. PCT/EP2020/069695 N-alkyl-D-glucamine based macroporous polymeric cryogel for sequestering and/or removing toxic contaminants. Carroccio S.C., Cunsolo F., Mecca T., Privitera V., Ussia M., Caretti D., Scurti S.
- WO/2020/049475. PCT/IB2019/057444. Use of exfoliated black phosphorus for the treatment of bone cancers". Raucci M.G., Ambrosio L., Fasolino I., Caporali M., Serrano Ruiz M., Peruzzini M.
- WO 2017/017610 A1. PCT/IB2016/054459. A biocomposites of biomineralized graphene oxide and its use for bone tissue engineering. Ambrosio L., Raucci M.G., Longo A., Carotenuto G., Giugliano D.



Sustainability.



Health & Nanomedicine.



Advanced Materials.

Our Projects

PAPILLONS



Project manager
DR. P. CERRUTI

Agricultural Plastics (APs) are essential in farming, but can release chemicals and micro- and nanoplastics (MNPs) that accumulate in soil during use and end-of-life. The long-term impact of this pollution is unknown. PAPILLONS addresses the release of chemicals and MNPs and their impacts on soils, filling the knowledge gap on sources, behaviour and long-term ecological and socioeconomic impacts of MNPs in European soils, providing the background to enable policy, agricultural and industrial innovation to sustainable farm production systems.

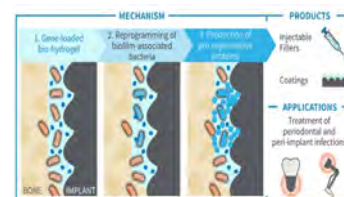


Bacteria biofilm as bio-factory for tissue regeneration



Project manager
DR. L. AMBROSIO

The BIOACTION project, awarded by HORIZON-EIC-2022-PATHFINDEROPEN-01 programme, aims at developing a new methodology in implant technology based on functionalized bio-hydrogels that will convert the negative occurrence of biofilm-associated infections, the primary cause of implant infections and failure, into a positive resource. The main goal of BIOACTION is to use implant-associated bacteria found in the oral cavity or around percutaneous devices to produce programmable proteins for in vivo cell recruitment and tissue regeneration. BIOACTION would drastically advance the future of infection therapy by changing traditional methods, resulting in improved state of care, health outcomes, and significant socioeconomic benefits.

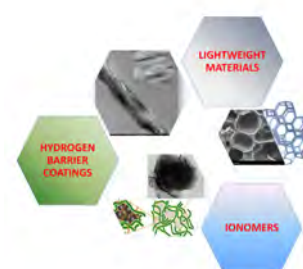


iENTRANCE@ENL



Project manager
DR.M. LAVORGNA

Project funded under the National Recovery and Resilience Plan (NRRP), Mission 04 Component 2 Investment 3.1 – NextGenerationEU, Call for tender n. 3264 dated 28/12/2021, Award Number: 128 dated 21/06/2022 – Project Code: IR0000027 - iENTRANCE@ENL "Infrastructure for Energy TRAnSition aNd Circular Economy @ EuroNanoLab". The aim of the project is to realize a distributed, integrated, and fully interoperable Technological Research Infrastructure of European excellence in Italy devoted to Clean Energy Transition Research. In this context IPCB-CNR activities will be addressed to design, development and structural-functional characterization of polymer-based composite materials, with specific focus on hydrogen barrier coatings for transportation/storage, lightweight materials and polymer-based ionomers for fuel cells, development of porous lightweight materials, complex metamaterials and systems by additive manufacturing, for enhanced energy efficient systems and structures.



Excellence of the Institute

IPCB is an international excellence research institute focused on frontier polymeric materials and composites. This position is determined by the IPCB multidisciplinary approach that is realized through the integration of diversified competences, from molecular designing up to the validation of innovative materials, developed to face the most relevant "societal challenges". The IPCB research strategy well-fits the objectives of the National Research Plan, the National Recovery and Resilience Plan (PNRR) and the challenging targets of the Horizon Europe programme, addressed to increase the sustainable competitiveness of the post-Covid society. Among

the worldwide recognized results of the IPCB researchers and technologists, it is worth mentioning the highly standard level of their scientific production, their involvement in several national and international projects, committee and platforms and their strong innovation capability that, based on the integration of fundamental and applied research, has allowed the set-up several spin-off companies with primary focuses in biomaterials, structural and functional materials and polymeric-based sensors. Finally, internationalization activities represent a further IPBC excellence, as demonstrated by the existing initiatives in Europe, China and USA and the coming in Japan.

Website: <http://www.ipcb.cnr.it>

Address: Via Campi Flegrei, 34
80078 - Pozzuoli (Napoli)

Tel: +39 081 8675327 Fax: +39 081 8675230





Institute of Chemical and Physical Processes

Director: **Dr. ONOFRIO M. MARAGO'**



The scientific interests of IPCF center around the study of condensed matter with particular attention to the thermodynamics of the collective processes responsible for the behavior and properties of materials on a mesoscopic scale. Such an intrinsically interdisciplinary activity is characterized by strong international competitiveness, touching aspects relevant to physics, chemistry and materials engineering. Research objectives move from interests purely motivated by scientific curiosity, such as the understanding of the general mechanisms underlying phenomena of self-aggregation and self-organization responsible for the macroscopic properties of complex systems, and then turn to the design and

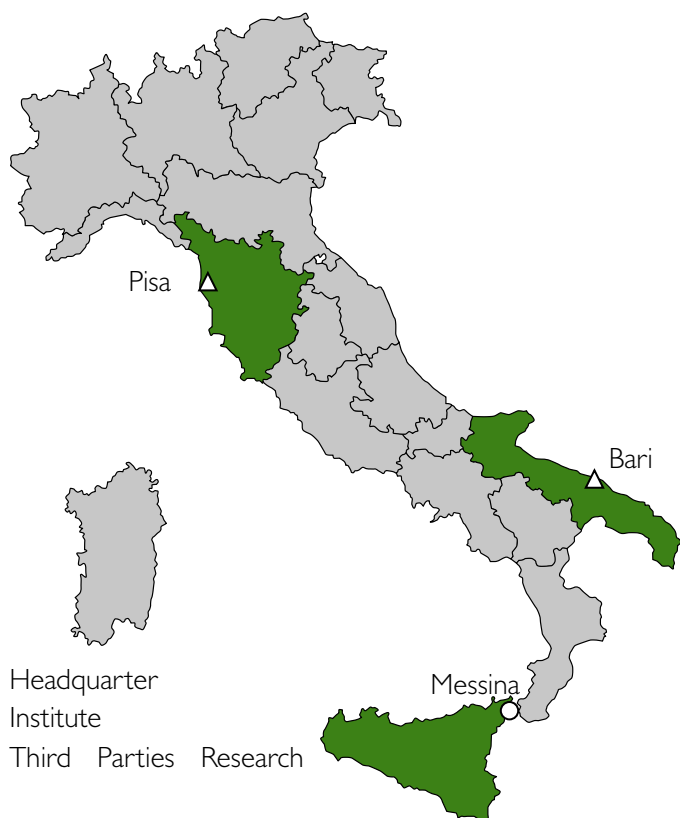
characterization of materials for specific applications and technology transfer in strategic areas as sensors, environment, energy, health, aerospace, cultural heritage with major technological implications, such as: development of organic nanostructures and semiconductors for electronic and photovoltaic applications, development of sensors with plasmonic nanomaterials (SERS, TERS, TERS imaging, etc.), creation of materials with predetermined properties (mechanical, thermal, optical, magnetic, electrical).



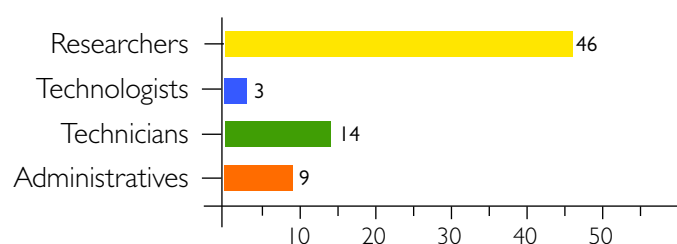
What We Are Doing

Research activities carried on at IPCF are intrinsically interdisciplinary, spanning chemical, physical, life science topics, and their interrelation with key assets for materials, energy, cultural heritage, health, and environment. Different areas in soft and condensed matter are covered:

- Life Science, for isolation, reconstitution and investigation of biomaterials for energy conversion, molecular recognition and tissue interaction;
- Materials science, for synthesis of nanostructured materials, both inorganic and organic, 2D materials, and their manipulation and self-organization for optoelectronic, biomedical, energy, cultural heritage, and environmental applications;
- Design and optical characterization of nanoaggregates, interfaces, and hybrid systems of photochemical interest, for sustainable energy generation and catalysis;
- Physico-chemical characterization of thermal, electrical, and optical properties of materials and systems of interest, by dedicated development of advanced analytical tools and methodology with ultrahigh sensitivity;
- Environmental acoustics for the evaluation of environmental noise exposure from anthropogenic sources, for comparisons with normative limits or for health-effects evaluations, acoustic modelling of transport infrastructures, wind farms, industries, strategic planning of innovative mitigation solutions, acoustic beamforming;
- Multi-scale computational modelling of molecules, supramolecular systems, and hybrid interfaces for applications in medicine, (bio-)optoelectronics, and catalysis.

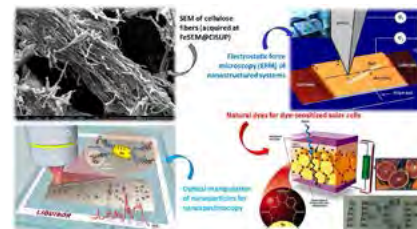
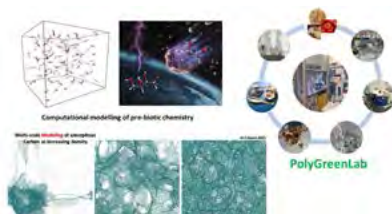
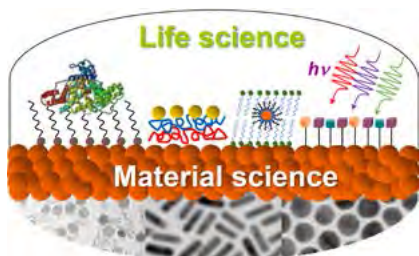


Human Resources



Patent

- US Patent App. 16/754,449, 2020 - Compound for the preparation of rubber products. P Stra', G Cossu, MC Palumbi, R Comparelli
- US Patent App. 16/652,456, 2020 - Silica based nanomaterials as substituted for ZnO in rubber compounds and preparation thereof. G Cossu, MC Palumbi, R Comparelli, V Margiotta



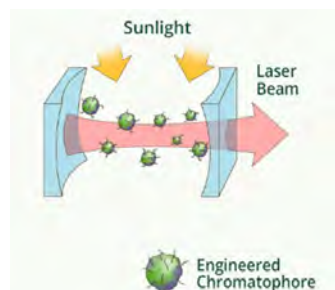
Our Projects

APACE EIC Horizon Europe



Project manager
DR. M. TROTTA

APACE will demonstrate a novel type of bio-inspired sunlight pumped laser, based on photosynthetic complexes, that is capable of upgrading diffuse natural sunlight into a coherent laser beam. In the APACE core strategy, lasing units composed of engineered molecular systems or doped nanocrystals will be attached to a bacteria photosynthetic antenna complex to obtain an engineered photosynthetic antenna. The EIC consortium involves 9 institution at the Europe-an level.

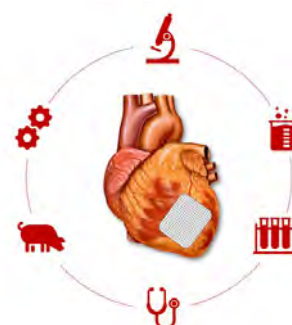


BRAVEHEART PNRR POC



Project manager
DR. C. CRISTALLINI

The project represents an integrated clinical-translational effort for the technology transfer of innovative microstructured electro-conductive drug-eluting cardiac patches as revolutionary therapeutic solutions to prevent heart failure. The team involving clinical, academic and research units with complementary expertise (medicine, cardiac surgery, stem cell biology and bioengineering) will conduct the project. The IPCF will lead the production and chemical-physical, mechanical and functional characterization of the developed cardiac patches.

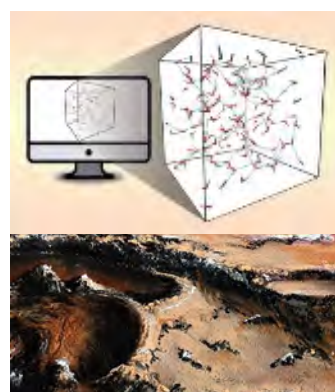


EXO-CASH PRIN2022



Project manager
DR. F. SAIJA

The goal of this project is to use Quantum Chemistry (QM) approaches for predicting vibrational spectra such as Infrared spectra in astrochemical investigations of exoplanet atmospheres. In particular QM will allow to predict relevant molecular structures as well as spectroscopic and thermodynamic properties, such as transition frequencies and reaction enthalpies, to guide and support observations, line assignments, and data analysis in these new and chemically complex situations.



Excellence of the Institute

ADVANCED SPECTROSCOPIC TECHNIQUES: we use advanced spectroscopic techniques for environmental and cultural heritage applications. We combine Raman/Photoluminescence spectroscopy with optical and acoustic trapping to develop unique tools for micro/nanoplastics analysis in liquid and dust particles in air/vacuum, overcoming the technological gaps in environmental sciences and space applications.

Furthermore, SERS active substrates combined with advanced spectroscopic techniques are crucial for analytical characterization of paintings, mosaics and artifacts for cultural heritage applications (Projects PNRR SAMOTHRACE, MICROPLASTIQUE, and PNRR Space-It-Up).

ENERGY & ENVIRONMENT: PNRR NEST and H2 projects deal with the synthesis and investigation of advanced nanostructured materials for solar energy conversion and with biomass valorisation. IPCF is also involved in monitoring and remediation activities related to environmental pollution. Recyclable agri-food waste based adsorbents are synthesized to purify treated water from emerging pollutants, and photocatalytic nanomaterials are successfully applied in the degradation of atmospheric and water pollutants and in the conservation and protection of cultural

heritage. IPCF is also exploiting microorganism for bio-remediation of water and soil. IPCF is also involved in "In-Pair" (INvestigation of Plastics And bioplastics degRadiation) on the study of the behavior of microplastics in marine environments with the aim to follow the aging/degradation with time of commercial plastic pellets and items by morphological, spectroscopic and thermal investigation. Moreover, IPCF collaborates in "SeaCleaner Pellets Watch" for monitoring, mapping, and characterizing the physical-chemical properties of aged plastic pellets collected on Italian beaches.

COMPUTATIONAL MODELLING: we highlight an original multiscale computational approach to predict the morphology of carbonaceous materials via dynamic reactive massaging of the potential energy surface (DynReaxMas), which uses the ReaxFF reactive force field in a simulation protocol that combines potential energy surface transformations with global optimization within a multidescrptor representation. Advanced supercomputing techniques are routinely employed to investigate the behavior of condensed matter under extreme conditions as well as to shed light on the chemical origins of life (i.e., prebiotic/astrochemistry).

Website: <http://www.ipcf.cnr.it>

Address: Viale Ferdinando Stagno d'Alcontres, 37
98158 - Messina

Tel: +39 090 39762 200 Fax: +39 090 39762 252





Institute of Nanostructured Materials

Director: **VITTORIO MORANDI**

CNR ISMN Istituito per lo Studio dei Materiali Nanostrutturati

ISMN is a CNR research institute internationally renowned for its multidisciplinary activities in the field of nanostructured materials and enabling processes and technologies. The institute aims at generating state-of-the-art knowledge in the field of Micro- and Nano-technologies and Materials Science and Technology, Chemical Manufacturing, and at exploiting the research results through the relationship with the industrial and business world. In a stimulating and dynamic environment, thanks to the presence of many young researchers and PhD students from various countries of the world, ISMN has a prestigious scientific track record and regularly performs industrial research programs focused on specific applications.

ISMN is present throughout the country with its five locations. The headquarters of the Institute is at the Research area of Montelibretti Roma I, while the other locations are in Bologna, Palermo, at the University of Rome Sapienza, and at the University of Messina. In order to reach its objectives, ISMN integrates transversal key enabling technologies, which include advanced materials, electronics, photonics, micro- and nano-fabrication technologies, biotechnology, and advanced chemical and manufacturing processes. These technologies are part of the ISMN assets thanks to its advanced research infrastructures and state-of-the-art scientific and technological equipment.



What We Are Doing

ISMN is recognized internationally for its extensive experience and competencies in the development, fabrication, and modelling of advanced functional nanomaterials and in the development and exploitation of innovative micro- and nano-technological methodologies. This expertise allows ISMN to be strongly involved in the following research areas:

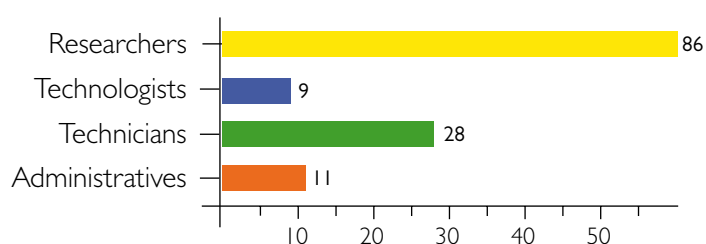
- Energy Transition
- Environment Preservation, Bio-economy and Food
- Circular Economy and Manufacturing 5.0
- Cultural Heritage Preservation and Protection
- Health and Bio-technologies

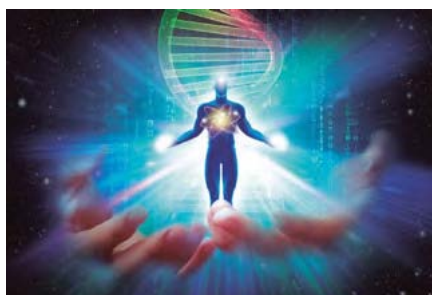


Patent

ISMN holds a significant patent portfolio comprising numerous national and international patents across a wide range of technological sectors, including chemistry and materials science, optoelectronics and photonics, lighting, environment and agrifood, biotechnology, catalysis, green chemistry, and renewable energy. Groups of related patent families are strategically transferred into start-up initiatives to generate value from the developed knowledge and the associated technologies.

Human Resources

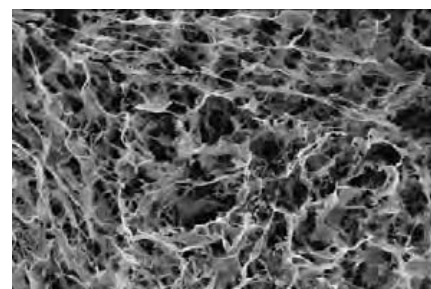




Research on materials devices for human health.



Sustainable technologies and nanomaterials for the environmental preservation and protection.



Highly porous materials purposely designed and developed for the capture of atmospheric pollutants in a museum environment as to inhibit the degradation of the artifacts.

Our Projects

iENTRANCE@ENL



Project Manager
DR. V. MORANDI

iENTRANCE is a research infrastructure funded by PNRR, designed as a single entry point to a broad ecosystem of expertise, instruments, and advanced research facilities. By integrating complementary competencies in physics, chemistry, and engineering, iENTRANCE accelerates scientific innovation and fosters national and international collaboration to support of the energy transition and the circular economy. Coordinated by the National Research Council of Italy (CNR), the initiative connects a distributed network of leading research centers across the country. Through the CRIOS-S4CET project, the infrastructure will further evolve through advanced digitalization, the adoption of FAIR-by-design principles, and the integration of Artificial Intelligence solutions to enhance access, management, and sustainability of research resources.

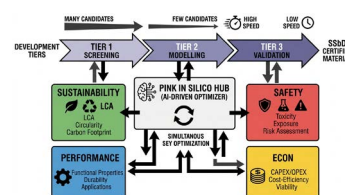


PINK



Project Manager
DR. F. MERCURI

The PINK project integrates the Safe-and-Sustainable-by-Design (SSbD) framework into the development of advanced materials and chemicals. Through a multi-objective optimisation approach, the project balances four key requirements at each stage of development: functionality, cost-efficiency, safety, and sustainability. PINK combines existing data with innovative modelling and simulation methods covering the entire life cycle and value chain. These tools help fill data gaps and support informed decision-making during the innovation process. All five steps of the SSbD framework are applied throughout material development. Early stages rely on preliminary estimates and simplified criteria, while later stages use more advanced methods and richer datasets. This progressive approach allows researchers to focus on the most promising candidates, accelerating the development of safer and more sustainable materials.



NanoCARE



Project Manager
DR. M.R. PLUTINO

The NanoCARE project focuses on the development of advanced polymeric nanocomposites with antibacterial and antiviral properties to reduce healthcare-associated infections (HAIs), protecting both patients and healthcare workers. By integrating modified clays and biocidal nanoparticles into polymer matrices, NanoCARE will create durable and functional materials suitable for 3D-printed surfaces, capable of limiting microbial proliferation in healthcare environments. The project covers the full innovation chain, from material design, synthesis, and characterisation to mechanical and microbiological testing. Prototypes will be validated in real hospital settings to assess their effectiveness and applicability. NanoCARE aims to deliver sustainable, high-performance, and industrially scalable solutions, contributing to safer healthcare environments and improved infection control practices. Funded under the BRIC 2025 INAIL Call, the project brings together leading Italian universities, research institutions, and healthcare partners in a multidisciplinary collaboration.



- A broadly recognised expertise of ISMN at the international level is represented by the capability to carry out advanced materials and processes studies, structural and functional characterization of nanomaterials and devices as well as to develop prototype devices (MEMS-based and optoelectronics devices, energy-related systems, sensors and actuators ...) demonstrating their properties and assessing their potentialities in the relevant application fields.
- A worldwide excellence is represented by hybrid nanostructured magnetic materials, interfaces and devices for applications in the field of mi-

cro-nano electronics (ICT), sensors for biomedical and environmental monitoring, tissue regeneration and other innovative applications in drug delivery and nano medicine.

- A solid and recognized knowledge on advanced chemical, physical, morphological and structural characterization of Cultural Heritage artifacts. Innovative synthesis and validation of low toxic and environmentally-friendly materials are successfully employed to develop and implement sustainable conservation methods.

Excellence of the Institute

Website: <http://www.ismn.cnr.it>

Address: c/o Area della Ricerca di Roma I – Montelibretti
Strada Provinciale 35/d n. 9 - 00010 Montelibretti (RM) - Italy
Tel: +39 06 90 672 484 Fax: +39 06 90 672 372





Institute of Organic Synthesis and Photoreactivity

Director: **Dr. MANUELA MELUCCI**

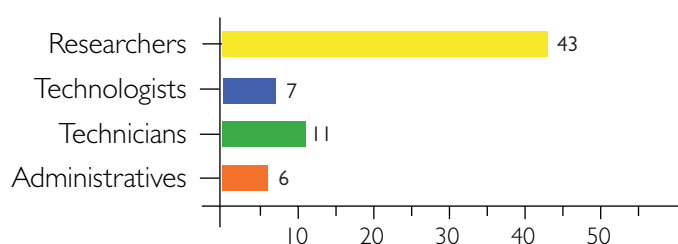


The Institute for Organic Synthesis and Photoreactivity (ISOF) is characterized by a strong and well-established vocation in molecular synthesis and chemical design, advanced functional materials, and photochemistry. The mission of ISOF is to promote high-level research in synthetic chemistry and light-driven processes for the development of tailored molecules and innovative materials. Building on its expertise in molecular design, ISOF develops small molecules (such as taxanes, oligothiophenes, rotaxanes, and cyclodextrins) and advanced functional materials (including graphene and modified graphene), biomaterials (such as silk proteins, keratin, carbohydrates, polydopamine,

phyto-complexes, polysaccharides), composites (polysulfone and biopolymers based) and nanoparticles (such as polymeric, liposomes, protein-based, cyclodextrins, hydrotalcites). These capabilities enable multidisciplinary research across health and life sciences, energy and clean technologies, and environmental sustainability. Moreover, thanks to its strong synthetic expertise, ISOF is one of the CNR-DSCTM nodes of the National Chemical Compound Collection (Chemoteca Nazionale), the first Italian infrastructure contributing to a European library of synthetic small molecules for societal use.



Human Resources



What We Are Doing

Research activities range from materials for sensing and removal of emerging contaminants like PFAS in water; biopolymers and composites for biomedical filtration, photoactive molecules for optoelectronics, solar energy conversion and photovoltaics, 2D and molecular materials for astrocytes interfacing, therapeutic molecules and nanosystems as drug delivery platforms, and nutraceutical solutions. The Institute also develops innovative synthetic approaches supported by advanced reactor design, automation, real-time detection, and process control. Numerical modelling and artificial intelligence enable the optimization of chemical and physicochemical processes, leveraging enabling technologies such as catalysis, photochemistry, pharmaceutical chemistry, electrosynthesis, aerosol chemistry, and photo-electrosynthesis.

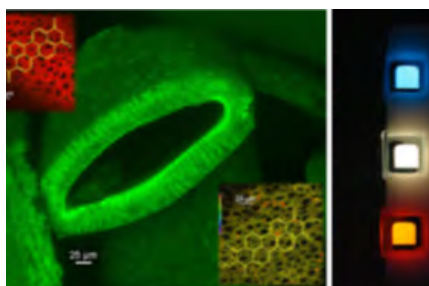
ISOF holds internationally recognized expertise in light-matter interaction and photoinduced processes on fast and ultrafast timescales, supporting key technologies such as CO reutilization, solar fuels, photocatalysis for environmental remediation, hydrogen production, and sustainable energy. Leveraging these strengths, ISOF promotes and disseminates research and innovation with high scientific and technological impact through international collaborations and strong partnerships with industry and research institutions.

Patent

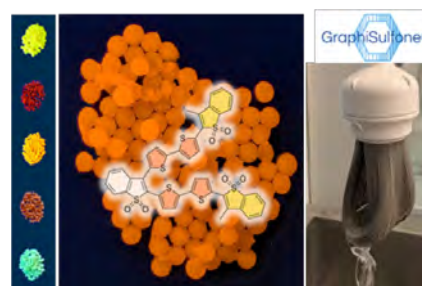
1. Method for the Treatment of a Porous Substrate
Patent Numbers: IT 102018000010402; PCT IB2019/058300; WO2020/099954
Ownership: CNR Medica S.p.A.
2. Method for the Treatment of a Porous Substrate
Patent Numbers: IT 102020000026726; EP 21207308.4
Ownership: CNR Medica S.p.A.
3. Porous Granules of Polysulfone or Derivatives Thereof for the Removal of Organic Molecules from a Fluid
Patent Number: EP 3208241
4. Modified Membrane
Patent Number: EP 3257573
5. Graphisulfone®, Figurative trademark with verbal elements
Ownership: CNR-Medica S.p.A.
6. Nanoparticles as delivery vehicles of active ingredients and methods for the production thereof
Ownership: CNR
Patent number: EP3638214B1



Innovative synthetic approaches (i.e. photocatalysis, aerosol chemistry, and electrosynthesis), synthesis of organic small molecules, nanoparticles, and two-dimensional nanomaterials.



Fluorescent molecules, nanomaterials and surfaces functionalization for biomedical and optoelectronic devices. Left: perylene functionalized polymeric hollow fiber membrane; Right: rgb OLEDs.



Materials for sensing and removal of emerging contaminants such as PFAS from water. ISOF has developed photocatalysts and composites, including GraphiSulione® a graphene-based drinking water filter.

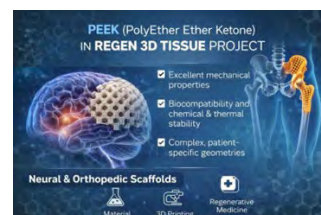
Our Projects

ADVANCING REGENERATIVE MEDICINE THROUGH INNOVATIVE POLYMER (REGEN-3D TISSUE)

Understanding and developing new polymeric and hybrid materials is a central challenge of our project. By bridging materials science, biology, and 3D engineering, we aim to open new regenerative strategies for patients affected by severe injuries and chronic diseases. In conditions such as trauma, neurodegenerative disorders, and musculoskeletal pathologies, the human body often lacks the intrinsic ability to fully repair complex tissues, as occurs in brain or bone tissue. This is where engineered materials converge with advanced 3D printing technologies to create soft, biocompatible scaffolds and implants suitable for brain tissue, as well as materials that combine mechanical strength with biological signalling to promote bone and cartilage regeneration. Within the REGEN-3D TISSUE project, we are exploring the potential of 3D printing applied to PEEK based-biomaterials. PEEK is one of the most promising polymer in the biomedical field due to its high biocompatibility, mechanical properties, excellent chemical and thermal resistance and radiolucency, which makes it ideal for medical imaging. Through additive manufacturing, it becomes possible to customize implants and scaffolds from TC, optimize porosity and geometry to improve the integration with biological tissues. The 3D printing of PEEK and its derivatives represents a high-impact clinical solution for the future of regenerative custom-made medicine.



Project Manager
DR. E. SARACINO



PEEK (PolyEther Ether Ketone) IN REGEN 3D TISSUE PROJECT

- Excellent mechanical properties
- Biocompatibility and chemical & thermal stability
- Complex, patient-specific geometries

Neural & Orthopedic Scaffolds

Material 3D Printing Regenerative Medicine

EUROPEAN DEFEND FUND (EDF) 2023, SUSTAINABLE WATER INNOVATIONS FOR FIELDED TROOPS (S.W.I.F.T)

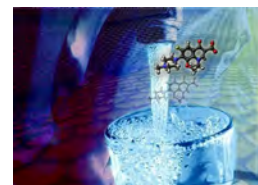


Project Manager
DR. M. MELUCCI

The goal of S.W.I.F.T is to apply a disruptive approach for water management through technological innovations for modular field camps suitable for deployed military units.

In particular, the project aims to develop disruptive approach for water management through technological innovations for modular field camps suitable for deployed military units within expeditionary and European defense contexts.

Specifically, the project concentrates on exploring the potential of emerging water reuse concepts and technologies, including, but not restricted to, graphene-based treatment technologies, and advanced photocatalytic processes, to provide clean and safe water for military personnel in various often harsh operational environments. The role of ISOF is to develop and validate innovative materials for emerging contaminants adsorption under real operational conditions in a dedicated pilot plant located in Bologna site.



RICERCA E SVILUPPO DI TECNOLOGIE PER LA FILIERA DELL'IDROGENO (POR H2), ADP MMES/ENEA WITH INVOLVEMENT OF CNR AND RSE, PNRR



Project Manager
DR. A. BARBIERI

The Research Operational Plan focuses on four key areas: green hydrogen production; innovative storage, transport, and conversion into e-fuels; fuel cells; and smart integrated management of hydrogen infrastructures. Developed jointly by ENEA, CNR, and RSE, the project promotes interdisciplinary collaboration to strengthen hydrogen as a key energy carrier for national decarbonization and to support the objectives of the PNRR.

ISOF coordinates the activity line LA2.1.12, "Liquid hydrogen carriers obtained from the photochemical and photoelectrochemical conversion of CO₂ and water" and participates in the activity lines LA1.1.35, "Hydrogen production through photocatalytic and photoelectrocatalytic processes" and LA2.3.6, "Innovative materials for chemical and physical sorption and storage of hydrogen at low temperatures in the solid-state"

ISOF coordinates the activity line LA2.1.12, "Liquid hydrogen carriers obtained from the photochemical and photoelectrochemical conversion of CO₂ and water", studying photoinduced charge transport processes on fast and ultrafast time scales in photoanodes of dye-sensitized photoelectrochemical cells (DS-PEC) for water splitting. These types of studies are essential for understanding the kinetics of charge injection in semiconductor materials, improving the efficiency of photoreduction and photooxidation processes.



Excellence of the Institute

ISOF publishes an average of 90 articles per year in peer-reviewed international journals, with a citation h-index of 103 (Scopus, June 2021). Beyond scientific communication, ISOF has a strong record of technology transfer and industrial collaboration, with long-term contracts and partnerships with major companies such as ENI, MEDICA, UFI-Hydrogen, HERA, AIRBUS, LEONARDO. Industrial activities are carried out within research projects (e.g., LIFE-REMEMBRANCE, AQUAIM, BICYCLOS) and through direct agreements with industrial partners (e.g., Tetra Pak, UFI-Hydrogen, HERA) focusing on the development and validation of materials for water treatment. ISOF is co-owner of two pilot plants for materials validation in water treatment: one at its Bologna headquarters and a second water living lab at the HERA drinking water plant in Pontelagoscuro (Ferrara). Clean energy technologies, optoelectronics and photocatalysis are key topics in ISOF, supported by individual and collaborative projects (LefkoPhos d-f, SupraPhthal).

ISOF also hosts a joint research laboratory with the University of Bolo-

gna 'Center for Light Activated Nanostructures (CLAN)', focusing on light-driven processes for energy conversion and medical applications.

CNR-ISOF is actively participating to the activities of the Clust-ER Health, chairing the value chain Mat-ER-ials (Materials for Health). Clust-ER Health in Emilia-Romagna is a premier public-private association supporting the competitiveness of the region's health and wellness industries.

In the field of health, ISOF carries out advanced research on the development of molecules and materials for the treatment of cancer and other non-communicable diseases, including cardiovascular and metabolic disorders such as diabetes. This activity integrates chemistry, materials science, biology and photonic approaches, with particular attention to innovative therapeutic strategies, including light-activated therapies. ISOF is actively involved in both international and national research programmes in this area, including Marie Skłodowska-Curie Doctoral Networks and national competitive schemes such as PRIN, contributing to multidisciplinary consortia and translational research efforts.

Website: <http://www.isof.cnr.it/>

Address: CNR-ISOF, Area della Ricerca del CNR via P. Gobetti, 101
Bologna - 40129

Tel: +39 051 639 9773 Fax: +39 051 639 9990





Institute of Science and Technology for Ceramics

Director: **Dr. ALESSANDRA SANSON**

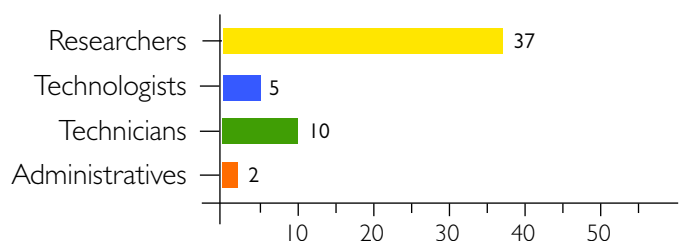


ISTEC is an interdisciplinary Institute entirely devoted to the scientific research, technology transfer and education on ceramics-based materials. Beside traditional and ancient ceramics, it has unique and renowned international expertise on the study and development of structural & functional ceramics, as well as hybrid materials for application in health, nanotechnology & nanosafety, aerospace, mechatronics, energy and environment. ISTEC researches cover basic science, materials design and prototyping, and full characterization from the nano- to the macro-scale with distinguished experience on the synthesis of inorganic materials, set-up of ceramic and biomineralization processes, optimization of consolidation and functionalization techniques. Ameliorative approaches are driven by renowned mastery in the establishment of the relationships between process, microstructure

and properties while state of the art instrumentations are coupled with pre-pilot ones able to cope with different industrial needs. The intense activity of research and development in the frame of projects with companies in different industrial sectors is in fact another peculiarity of the ISTEC activity. Other than that, the institute has a long-lasting coordination experience in major collaborative European and international projects (as for example with USA), as well as national and regional ones, which has driven the improvement and implementation of many existing lines and enable the development of new ones. Finally, in the last 10 years, ISTEC has generated several patents, many of them licensed within technological transfer activities and generated innovative start-ups and internationally renowned spin-off companies.



Human Resources



What We Are Doing

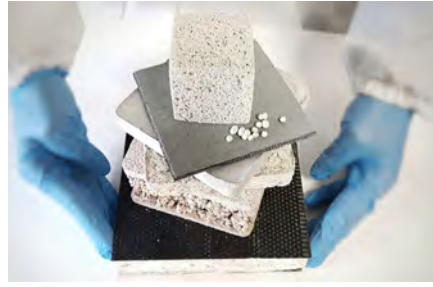
The research in ISTEC is mainly focused on tailoring the properties and performance of ceramic devices by controlling the process conditions and by engineering materials addressed to specific applications. Different solutions are also offered to impart new advanced features and performances to traditional products. ISTEC has developed expertise on the development of new nature-inspired processes overcoming the limitations of the current processing methods in the generation of smart nanoceramics and hybrids as well as processes of additive manufacturing to satisfy an increase demand of materials and devices complexity. The engineering of materials is approached considering the different aspects involved: from the starting raw materials to the processes involved in their production, up to the integration in the final device and the functional validation.

Patent

EP3253369A1; US10,525,432 B2: Process for the preparation of nanoparticles of noble metals in hydrogel and nanoparticles thus obtained (2016).
 I02016000023614: Physical solar filter consisting of substituted hydroxyapatite in an organic matrix (2016).
 WO2017130134(A1): Composite material based on C/SiC fibers with ultra-refractory, high tenacity and ablation resistant matrix (2017).
 IT201800010441(A1): Procedimento per ottenere ceramici ultra-refrattari compositi rinforzati con fibre (2020).



Prototype of historical wall with embedded sensors for pH and chlorides detection.



Geopolymer based materials and composites for high temperature applications, chemical engineering and circular economy.



Prototype of Dye Sensitized Solar Cells (DSSC) for building integrated photovoltaics.

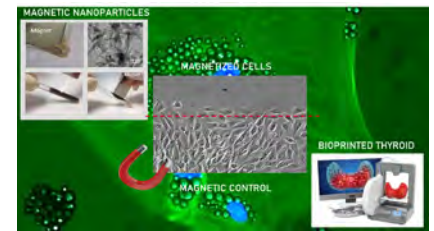
Our Projects

SCREENED



Project manager
Dr. M.SANDRI

(H2020-SCI-BHC-27-2018-20): Screening for the influence of endocrine disruptors. SCREENED is part of the EU Cluster EURION, comprises 9 partners and is focused on the study of a multistage model of thyroid gland for screening endocrine-disrupting chemicals (EDC) that strongly interfere with its functioning. ISTECON contributes with the development of biomimetic Fe-doped hydroxyapatite nanoparticles endowed with magnetic properties which are already the topic of a worldwide patent. Internalized by cells they allow to obtain magnetically labelled cells that can be driven by a remote magnetic field, that is strategic to achieve fully colonized 3D thyroid bioconstructs.

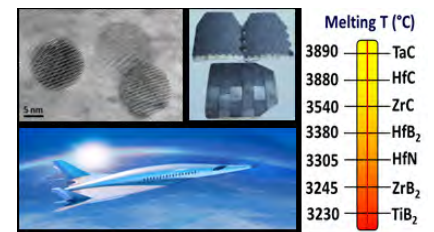


SUSPENCE



Project manager
DR. L. SILVESTRONI

(NATO SPS –MYP G5767, 2020-23): Super Strong ceramics for Protection in harsh environment & Defence. SUSPENCE is a 3-y NATO funded project within the Science for Peace and Security Programme, involving Italy, Serbia and the USA. The aim is to develop new ceramics with unprecedented strength from room temperature up to at least 2000°C for use in severe environments, like body armour protection and hypersonic aerospace vehicles that can be used for defence against terrorist attacks. The scientific goal is to achieve enhanced strength retention, impact resistance and ablation resistance in nano-textured ceramics in the form of plates and a sharp cone for testing in relevant environments.

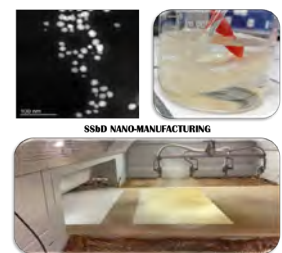


ASINA



Project manager
Dr. A. L. COSTA

H2020-NMBP-15-2018-2020- 862444, 2020-2023 Safe & Sustainable-by-design nano-manufacturing. ASINA project has the ambition to promote Safe & Sustainable-by-design (SSbD) nano-manufacturing practices. Nanofabrication facilities are available through research and industrial partners of ASINA consortium, in order to optimise products and processes and match technical specifications and safety requirements, referring to the whole nano-enabled product (NEP) life cycle. A multicriteria analysis tool (ASINA Expert System) will use suitable algorithms for the minimization or maximization of response functions and identification of the most efficient SSbD solutions. Due to ASINA target NEPs (anti-microbial coatings and nano-capsules) ASINA has been officially included within the cluster of European projects that are tackling the battle against Corona Virus. The project involves 21 partners from academia, industrial innovators, standardisation bodies, 6M Euro total budget.



Excellence of the Institute

Hi-tech Ceramics for Severe Environments such as carbides, borides and nitrides find applications in high temperature engineering, aerospace, energy and automotive. Biomimetic, bioactive and bio-resorbable 3D structures and nanoparticles able to exert therapeutic or diagnostic functions as well as as nature-inspired approaches generate innovative Bioceramics and Bio-hybrid Composites capable of unpreceded performances that can also be implemented with mechanisms of remote, on-demand, activation for smart personalized medicine. These activities are complemented with studies on cell-biomaterial interaction. Nano-products for application in clean technology, health and environment protection are coupled with

Safety-by-Product Design approaches to prevent and control potentially adverse effects generated by nano-objects handling. Strategies and processes to enhance static and dynamic repellence of various materials against water and oils, for applications in anti-soiling, drag and friction reduction, anti-fouling, de-frost and anti-icing properties characterized the research on Smart Surfaces while the activities on Geopolymers are focused on environmental-friendly net-shaped ceramics as refractories, insulators and catalysts. New materials and devices able to shift the fossil fuel economy towards eco-sustainable energy sources like batteries, solar and fuel cells and electrolyzers are the focus of the activities on the Energy field.

Website: <http://www.istec.cnr.it>
Address: Via Granarolo, 64
48018 - Faenza - Italy
Tel: +39 0546 699 725 - Fax: +39 0546 46 381





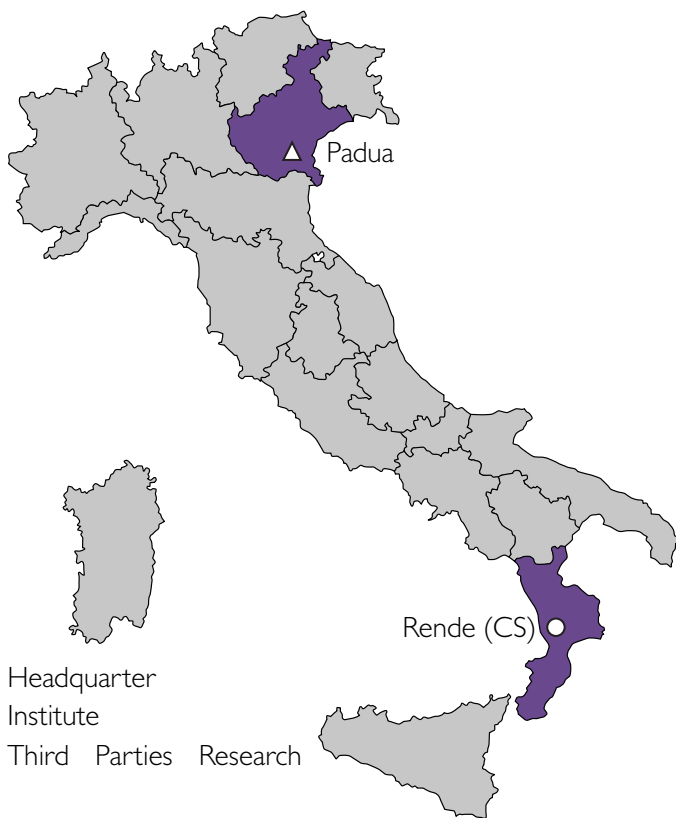
Institute on Membrane Technology

Director: **Dr. ALBERTO FIGOLI**

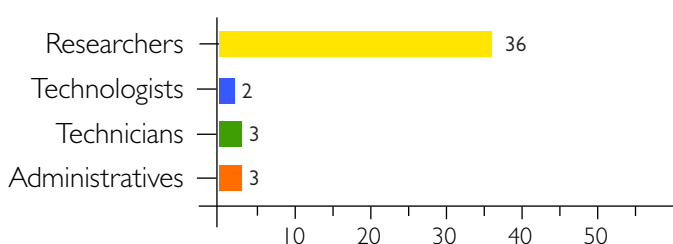


Mission of the Institute on Membrane Technology (ITM) is the research and development in the field of science and engineering of membranes. The research activities aim to promote knowledge, innovation and high-level training in the field of membranes and their application in water treatment, gas separation, energy, bioartificial organs, biotechnology, food and agriculture. With more than 110 people (including 44 permanent staff, 16 research contracts, 5 associated professors, 22 PhD students, 20 foreign visiting scientists, 20 master students, 12 trainees), ITM is one of the major critical mass in the world specialized in membrane technology. It is internationally recognized for its peculiar skills in the preparation and characterization of membranes (organic, inorganic, mixed matrix, biohybrid, ion exchange); transport phenomena through membranes; molecular selective membrane separations; development of catalytic membranes, catalytic membrane reactors, membranes for electrolyzers and reverse electro dialysis,

membrane contactors (including crystallizers, condensers and emulsifiers); development of integrated membrane processes; development of membranes in biotechnology, regenerative medicine and tissue engineering. Membrane technologies have achieved a leading role with a more than 20% annual growth. ITM has established collaborations with various Research Institutes, Universities and Companies located in Italy, Europe, Middle East, China, South Korea, Vietnam, Mexico, Argentina, India, United States and Australia. This reflects a remarkable ability to attract funds for research, development and high education, affecting the socio-economic and cultural environment. ITM attracts many researchers from renowned foreign Universities and Research Institutions, generating a dynamic and multicultural environment that enriches and stimulates further the activities of the Institute.



Human Resources



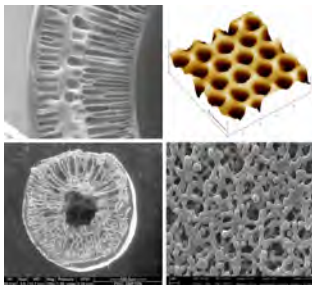
What We Are Doing

The main research activities of ITM are focused on:

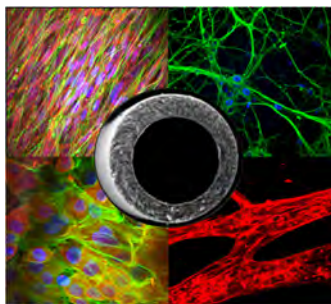
- Development of advanced membranes, including polymeric, inorganic, mixed matrix, imprinted, ion exchange, bioinspired and (bio)catalytic membranes
- Innovative Membranes for desalination, water, wastewater treatment and energy production
- Nanostructured and nanocomposite polymeric membranes for gas and vapor separation
- Catalytic membrane reactors in green fuels, including hydrogen, methanol, bioethanol
- Membrane contactors, membrane crystalizers, membrane condenser, membrane emulsification
- Multiscale modelling and simulation of transport phenomena in membranes
- Study and development of membrane operations and integrated systems in water, agro-food, energy and industrial gas
- Membranes and membrane operations for bioartificial organs, regenerative medicine and tissue engineering
- Membrane and membrane operations in biotechnology, membrane bioreactors and biosensors.

Patent

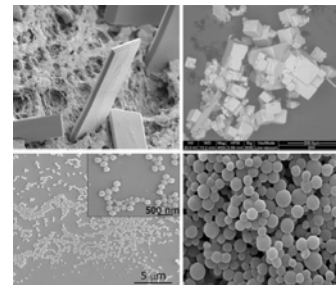
- A. Figoli, J.C Jansen, E. Fontananova, E. Esposito, R. Jerace, M. Longo, A. Minotti, Dispositivo elettrochimico atto a funzionare da elettrolizzatore e da cella a combustibile, Italian Patent n. 10202200001 1999, filed on 07/06/2022.
- A. Figoli, F. Galiano, G. Barbieri, L. Giorno, B. Gabriele, R. Mancuso, C.S. Pomelli, C. Chiappe, Innovative polymerised ionic liquid membranes for gas separation, Italian Patent n.: 102018000003374 (08/03/2018) extended to PCT/IT2019/050050 and WO/2019/171409 on 12/09/2019. 25/02 2021: US Patent 11,517,860,, 2022.
- A. Figoli, J. Hoinkis, B. Gabriele, G. De Luca, F. Galiano, S.A. Deowan. Bicontinuous microemulsion polymerized coating for water treatment. PCT/EP2014/070603 = WO2014/EP070603 (2014).
- E. Curcio, E. Drioli, G. Di Profio, E. Fontananova. Direct crystallization of enantiomers by heterogeneous stereoselective nucleation on a membrane. WO2013/160926 A1 (2013).



Membranes with different structure, morphology and configuration.



Dermis, epidermis vascular and neuronal constructs on polymeric membranes.



Crystal of proteins, salts and Capsules formed by membrane crystallisation.

Our Projects

doMino

Project manager
DR. A. FUOCO

doMino

doMino (PRIN - 2020P9KKBKZ) is an interdisciplinary project aimed to develop efficient mixed matrix membranes (MMMs) based on purposely synthesized (per-)fluorinated metal organic frameworks for the treatment of large amounts of CO₂ for the reduction of green gas house emission and a sustainable development of industrial processes. The research activities of doMino span from the modeling, synthesis and characterization of highly innovative materials to their exploitation for the preparation of MMMs for gas separation. The consortium, led by CNR-ITM and with CNR-ICCOM as partner, involves also the Univ. of Perugia, Univ. of Pisa and Univ. of Torino. Website: <http://www.prin-domino.it/>



MEASURED

Project manager
DR. A. CRISCUOLI

MEASURED

MEASURED - Membrane Scale Up for Chemical Industries, funded by the EU Horizon Europe research and innovation programme (G.A. n. 101091887) is aimed at developing and demonstrating advanced membrane materials for Pervaporation (PV), Membrane Distillation (MD) and Gas Separation (GS) to be applied in industrial operative conditions (up to TRL 7). ITM leads the production of more sustainable and highly hydrophobic MD membranes for wastewater treatment coming from the coagulation baths of an industrial membrane preparation line. The work is in cooperation with ISSMC for the inorganic coating of the new polymeric membranes produced by ITM. Website: <https://cordis.europa.eu/project/id/101091887>



MELODIZER

Project manager
DR. F. MACEDONIO

MELODIZER

MELODIZER - The "Sustainable Membrane Distillation for industrial water reuse and decentralised Desalination approaching ZERO waste" (G.A. n. 101091915) aims to implement high-performance membranes and modules in strategic membrane distillation (MD) applications. The membranes and modules will be installed as core components of four MD pilot systems and implemented at four different demonstration sites, in Greece, Spain, and Israel. MELODIZER. CNR-ITM coordinates the activities of fabrication/functionalization/characterisation/testing of the new green membranes and modules and acts as Project Manager of the whole project. Website: <https://www.melodizer.eu/>



Excellence of the Institute

ITM is internationally recognized as a centre of excellence in the field of membrane science and technology. ITM is leader in the development of novel membrane operations such as membrane crystallizers, membrane condenser, membrane emulsification, membrane dryer. Unique skills and expertise are in the development of membranes and membrane operations for agro-food and water treatment, preparation and characterization of highly selective membranes for gas separation using mixed gases and in presence of contaminants, membrane bioartificial organs and biocatalytic membrane systems.

The scientific achievements are published in the leading journals in the field of membrane science, engineering, related subject areas and in the most prestigious journals, such as Advance Material, Energy Environmental Science, Nature Materials, Science. ITM international reputation is also testified by the involvement of researchers in the editorial board of ISI journals, editing of encyclopedia and books published by Wiley, Elsevier, De Gruyter, Springer etc. ITM is partner and coordinator of European, transnational, international and national projects.

Website: www.itm.cnr.it

Address: via P. Bucci cubo 17C c/o University of Calabria
Rende (CS) - 87036

Tel: +39 0984 49 2027/2025 Fax: +39 0984 40 2103





Institute of Chemical Sciences and Technologies

Director: **Dr. VLADIMIRO DEL SANTO**



SCITEC was founded in 2019 by merging the Institute of Macromolecular Studies (ISMAC), the Institute of Molecular Recognition Chemistry (ICRM), and the Institute of Molecular Science and Technology (ISTM) with the objective of converging the multidisciplinary competences of the three institutes towards the current research challenges in the fields of Advanced Materials and Technologies, Health and Sustainable Processes. SCITEC headquarter is in Milan and the activities are performed in eight distinct operative units (5 in Milano, Genova, Perugia and Roma). SCITEC has fundamental and highly integrated chemical expertise covering the entire research chain, from the synthesis of molecules, biomolecules, macromolecules and polymers to their characterization, modeling and validation

to the development of materials, nanomaterials and hybrid systems, through sustainable processes. These solid vertical skills are accompanied by transversal skills in the field of scientific communication, public engagement and technology transfer, which foster innovation processes and significantly amplify the impact of research results on a scientific, technological and socio-economic level.



The Institute is currently running about 50 research projects and has many interactions with national and international research Institutions both on fundamental and applied research activities. Technology transfer and support to national and international industries are provided by several laboratories dedicated to the analysis and solution of industrial problems.

What We Are Doing

- Study and development of bio-based molecules and macromolecules, of interest in the fields of fine chemicals and pharmaceuticals, and materials;
- Development of innovative methodologies for decontamination from toxic chemical agents/radiological contaminants, and advanced analytical methodologies for the evaluation of food quality and the identification of nutraceutical compounds;
- Study and development of materials and processes for the direct conversion of solar energy into chemical energy, production of hydrogen and decarbonized energy carriers, organic and hybrid photovoltaic cells, and to reduce the use of critical and strategic raw materials;
- Development of predictive models based on Machine Learning of the chemical-physical properties of molecules, materials and for the optimization of processes; study and development of functional materials and nanomaterials for applications in optoelectronics, sensors, construction, diagnostics, sustainable mobility and smart packaging;
- Study and characterization of degradation materials and processes with multi-scale spectroscopy techniques, computational modeling, use of interoperable databases and Big Data methodologies, to support the conservation, restoration and monitoring of cultural heritage;
- Study and development of bioactive molecules as modulators of pathological pathways with synthetic protocols, analytical methods and computer-aided drug design approaches, and of platforms for diagnostics and targeted drug delivery based on smart materials and nanomaterials.

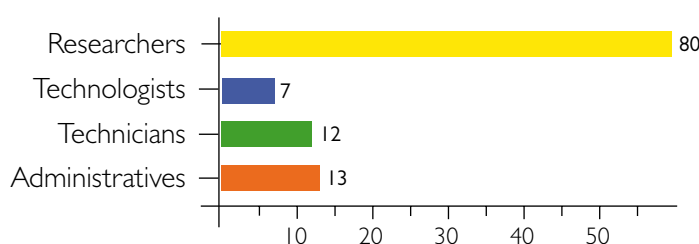
Patent

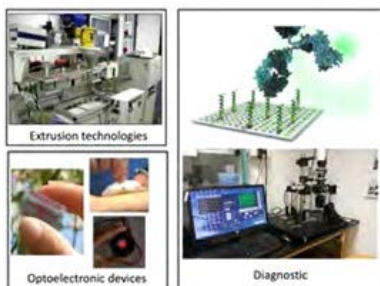
Many patents have been licensed or sold to industrial companies. Selected active patents are:

- WO2023135532, IT202200000359, WO2023/135533, EP4463164, US20240425508, Compounds useful in the prevention and/or treatment of senescent cell-related pathologies and diseases
- PCT/IB2024/055589, WO2024/256935, Phosphorescent complex comprising iridium or platinum, production method thereof, its use in the preparation of optoelectronic devices
- IT 2018800005276, WO2019/215313 (A1) Elastomeric copolymers with a high sulfur content and process for their preparation

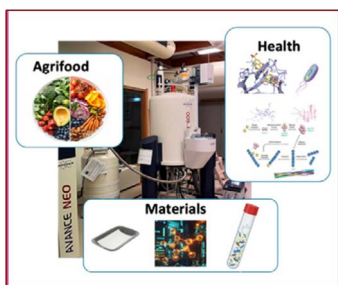


Human Resources





Prototyping and processing labs include: extrusion (fibers and films preparation), compression and rotational molding for thermoplastic polymers, and solution and vapor phase fabrication equipment for (OLEDs, OPV, sensors and detectors).



NMR facility drives research in rational drug design, agrifood and sustainable materials.



A selection of images from the Mobile Laboratory (MOLAB) campaigns, where artworks from various CNR European museums are investigated by CNR researchers supported by European Research Infrastructure for Heritage Science (E-RIHS).

Our Projects

LUCRA



Project Manager
DR. S. IANNACE

The EU project LUCRA is dedicated to reshaping the production of succinic acid by demonstrating the technical and economic feasibility of turning organic waste into bio-succinic acid on a pre-industrial scale. This versatile building block holds the key to biobased innovation across a multitude of industries, including packaging, textiles, agriculture, and automotive. The role of SCITEC is to assess the polymerization of bio-succinic acid for the synthesis of novel (co)polyesters for different applications.
<https://lucra-project.eu>

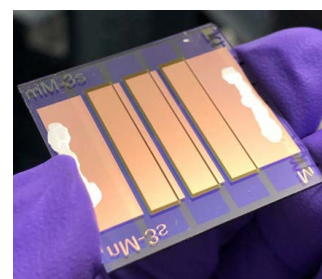


VALHALLA



Project Manager
DR. D. MEGGIOLARO

VALHALLA will develop perovskite solar cells and modules with power conversion efficiencies above 26% (23% for modules) and an extrapolated lifetime > 25 years, guided by eco-design principles that decrease the environmental impact of perovskite photovoltaics: scalable production processes, no harmful solvents, optimized use of materials, circularity and recyclability. VALHALLA will develop rigid, flexible and semi-transparent perovskites with three bandgap ranges together with their optimized charge transport materials.
<https://valhalla-solar.eu/>



Co.Science



Project Manager
DR. L. POLITO

Co.Science brings science to cities and schools through 5 partners: CNR, National Museum of Science and Technology L. da Vinci, University of Insubria, Italtiotec, and the Federation of Technical and Scientific Associations. The project's objectives are: 1) to create public spaces for dialogue between researchers and the community (organization of European Researchers' Night); 2) to engage with young people in schools; 3) to design training modules to improve communication skills; 4) to present the European perspectives of research.
<https://www.coscience.eu/index.html>



Excellence of the Institute

- Valorization of biomass and secondary raw materials by green chemistry, circular economy, and sustainability methodologies for the production of molecules, macromolecules, and polymers of interest in the fields of fine and pharmaceutical chemicals, and of materials.
- Development of conjugated molecules and polymers, nano- and hybrid materials and smart coatings for photonics, perovskite and organic solar cells, sensors, novel smart optoelectronic and responsive polymer systems for flexible devices including their photophysical, morphological, and optoelectronic characterization.
- Design and development of bioactive molecules by integrated processes

- based on organic synthesis, bio-organic chemistry and biotechnologies.
- Development of platforms for diagnostics and targeted drug delivery based on smart materials and nanomaterials.
- Development of innovative methodologies for decontamination from toxic chemical agents/radiological contaminants, and of advanced NMR methodologies for the evaluation of food quality.
- Multi-scale spectroscopy and computational modeling methodologies for the conservation and restoration of cultural heritage.
- Computation modelling for the in silico design of molecules, macromolecules, polymers, and advanced materials.

Website: <http://www.scitec.cnr.it/>

Address: via Alfonso Corti, 12
20133 - Milan

Tel: +39 02 23699 476 Fax: +39 02 70636400

