



**Some new proposals of Collaboration between Serbia
and Italy in the frame of the Protocol of Cooperation
Summary**



The proposals herein collected summarize what CNR could offer in those areas that have been individuated by our Serbian colleagues among those of strategic importance for the country and include the four main topics listed below, which complement and expand the previously presented proposals in the Agri-food area.

- Biology, Agriculture, Food Sciences,
- Green Chemistry,
- Environmental Science

In particular, two departments of CNR are involved in this proposal, *i.e.* the Department of Chemical Science and Materials Technology (DSCTM) and the Department of Biology, Agriculture and Food Sciences (DISBA).

The Department of Chemical Science and Materials Technology is one of the seven core departments of the Italian National Research Council (CNR). It operates through 14 research institutes spread throughout the country. The DSCTM employs around 1000 staff, mostly researchers, technologists and technicians who are dedicated to research activities. In addition to this number, there are several hundreds of young researchers and students undergoing training at graduate and post graduate level as well as PhD grant holders and postdoctoral associates. With such a large number of personnel, the DSCTM represents, in terms of its research activities in a wide range of fields and a high-level of expertise, one of the country's leading scientific entities, able to carry out at a very high level of competence both basic and applied research in all fields of the molecular sciences, chemical technologies and material sciences and technologies.

The synthesis of novel functional compounds and materials for application in various fields of national strategic importance and the understanding of the rules that govern chemical reactivity by anticipating and driving the relationships linking the molecular structure to the chemical and physical properties of systems of molecular and supramolecular materials and new materials, represent the Department *scientific mission*. At the same time, these aspects define the technological competences that the DSCTM may provide to the nation to help successfully tackling the global challenge of smart, sustainable, and inclusive growth.

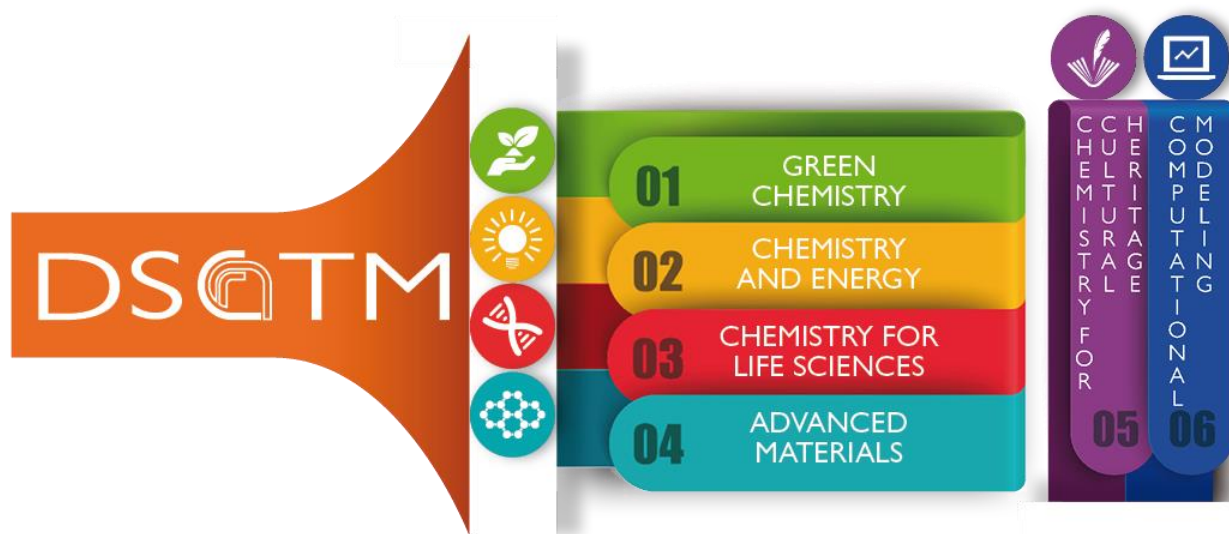
The scientific activities of the DSCTM are organized in four strategic areas that have been identified by a thorough analysis of the expertise and know-how of its 14 institutes

combined with the national priorities expressed by the PNR and the strategies of the Horizon2020 program.

The strategic areas of DSTM are:

- **Chemistry and Materials for Health and Life Sciences,**
- **Renewable Energy,**
- **Materials Chemistry and Technology,**
- **Green Chemistry**

These areas are further enriched by *cross-disciplinary* activities of recognized excellence, such as computational modeling of the reactivity and the functionality and the application of chemistry and materials science to the preservation of cultural heritage. These activities ensure that the DSCTM is an internationally well positioned key player in multiple interdisciplinary projects. The CNR, through such excellence, can leverage competitiveness in the global market and provide contributions to solving the multiple challenges that both science and humanity are currently facing.



The Department of Biology, Agriculture and Food Sciences carries out research and performs innovation and training activities in all fields related to Agriculture and Food Sciences.

The mission of the Department is to promote scientific and technological knowledge for the development and valorization of a sustainable and innovative agri-food system, thereby contributing to tackle the global grand challenges of Future Earth, including the need to

provide enough food, water, and energy to a growing population, through a sustainable use of limited natural resources.

The Department activities are gathered in the following three research areas:

Biology and Biotechnology

Genetic and environmental factors affecting animal and plant production

New biotechnological tools for genetic improvement and plant defense

Molecular and cellular mechanisms underlying growth processes, environment interaction and productivity in plants and animals

Metagenomics and interatomics of complex ecosystems (soil-plant-atmosphere)

Food

Diagnosis techniques and new systems and technologies for food quality and safety along the food chain

Relationship between diet and health, nutraceuticals and nutrigenomics

Biochemical and molecular characterization of food and valorization of typical products

Sustainable Agriculture

Characterization, conservation and valorization of biodiversity in plants, animals and microorganisms

Eco-friendly agricultural techniques and low environmental impact technologies

Advanced technologies for agroecosystem monitoring, protection and management

Climate changes impacts on agri-food production and quality

Wood technology and novel non-food (biomass, bioenergy, biorefinery) productions

Main technological domain and services provided

The Institutes of the Department address research issues related to applications in agriculture, food and forestry sector in the following key areas:

- food safety and quality
 - food processing and packaging
 - valorization of typical products
-

- production of nutraceuticals and functional foods with health-promoting properties
- qualitative and quantitative improvement of agricultural, livestock and forestry production
- agro-meteorological monitoring and remote sensing for crop mapping and precision agriculture • integrated pest management
- biodiversity protection
- environmental impact reduction
- sustainable use of natural resources
- biomass for biofuel, bioenergy and novel high-value non-food products
- valorization of by-products from food industry
- use of forest- and wood-based products.

The Institutes of the Department provide services with high technological content to public and private entities. Some of the most important of such services are:

- characterization and conservation of plant and animal genetic resources
- analytical methods for certification and traceability in agri-food and wood production
- characterization of food by sensory analysis and consumer science
- food preservation and processing methods
- analysis of contaminants and allergens in food quality and safety evaluation
- genetic improvement of plant and animal species
- phytosanitary diagnosis and support for sustainable management of resources
- preparation of serological diagnostic kits
- mass Spectrometry services for -omics (proteomics, metabolomics)
- agrometeorological forecasts for precision farming soil and water testing
- wood characterization.

Moreover, other Departments of the Italian National Research Council like: “**Biomedical Sciences**”, “**Earth and environment**”, “**Physics and technologies of matter**”, “**Engineering, ICT, energy and transportation**”, are ready to collaborate on the possibility to connect industry, economy, agricultural and environmental issues of both Italy and Serbia with the aim to develop research and entrepreneurial projects.



Biology, agriculture and food sciences



The CNR in implementation of the Agreement signed with the Government of Serbia intends to offer its scientific contribution, the transfer of its know-how and its assistance for the definition of products, the industrialization process and the identification of potential markets, in favor of investors Serbians and Italian interested in giving concrete industrial application to research and patents, concerning the following areas.

Farms, Agricultural and agri-food industries, and dairy companies.

In these areas, operate companies with different capacities in the agri-food sector. CNR can participate in the research of the mentioned areas. In particular, the skills and the scientific equipment's existing in the different institutes can be of great help to those companies aimed at investing in these sectors by carrying out highly competitive and highly specialized research and technological innovation.

Potentially interested companies:

Factory farming

Intensive breeding

Large food distribution chains

Active packaging

Dairies

Industries for agricultural products

Agri-food industry

Environmental Pollution and Green Chemistry

In this strategic research and innovation area, one may find industries dedicated to the production and use of chemicals produced from renewable sources such as bio based chemicals. Examples are companies like manufacturers of bioplastics, producers of bio lubricants or biopesticides. Just to mention a few.

From an environmental point of view, the main interest is focused on restoration of polluted sites, industrial processes with low environmental impact and recycling and recovery of both industrial and urban wastes.

Potentially interested companies:

Bio-refineries

Biocompostable polymers


Biobased compounds manufactures

Industries for recycling and reuse of waste bio-lubricants industries

Biopesticides industries biotechnological companies

Enterprises for environmental recovery

In the view of the application of the cooperation agreement, it will be mandatory that the Ministry of Agricultural, Forest and Water of Serbia assesses the proposals and adds other potential interests so that it would be possible to organize a strongly focused workshop where the selected project-ideas could be illustrated and evaluated with the aim to find financing and investors to start up real projects devoted to improve both the level of the Serbian agriculture and the environment quality by reducing the pollution and the impact on everyday life. To achieve these goals and implement this part of the bilateral agreement, it would be highly desirable that the Serbian Government and the Italian Embassy in Belgrade credits DSCTM CNR and Albatros at the Italian MIPAAF as official partners of the Serbian Government in this important initiative.



Mauro Marchetti
Responsible of the CNR Research Area of Sassari

Annex: Projects Skills

Farms, Agricultural and agrifood industries, and dairy companies.

In these areas, operate companies with different capacities in the agri-food sector. The following pages illustrate the possibility for the CNR to participate in the research of the mentioned areas. In particular, the skills and the scientific equipments existing in the different institutes can be of great help to those companies aimed at investing in these sectors by carrying out highly competitive and highly specialized research and technological innovation.

Potentially interested companies:

Factory farming

Intensive breeding

Large food distribution chains

Dairies

Industries for agricultural products

Agri-food industry

NATIONAL RESEARCH COUNCIL - CNR		N°1
Strategic AREA	<input checked="" type="checkbox"/> Biology, agriculture and food sciences <input type="checkbox"/> Green Chemistry <input type="checkbox"/> Environmental science <input type="checkbox"/> Renewable energy	
Title of research activity	Natural and natural-like phenolic compounds inhibitors of trichothecene biosynthesis and host infection by the durum wheat pathogen <i>Fusarium culmorum</i>	
CNR Institutes	Institute of Biomolecular Chemistry	
Scientific responsible Institute and address Phone, fax e-mail	Giovanna Delogu Institute of Biomolecular Chemistry +39 0792841220 – fax +390792841229 giovanna.delogu@icb.cnr.it	
State of the art	Several <i>Fusarium</i> species, including the cereal pathogens <i>Fusarium culmorum</i> and <i>F. graminearum</i> (<i>Gibberella zeae</i>), are the predominant incitants of fusarium head blight (FHB) and crown and foot rot (CFR) worldwide. Yield and quality losses are caused by FHB, causing the grain to be contaminated with mycotoxins that remain active in the grain and may cause toxicoses on humans or animals consuming contaminated food or feed.	
Activity and targets	In order to minimize the risk of resistance selection, there is an urgent need to develop new inhibitory compounds of new generation, able to counteract the pathogenic and mycotoxigenic potential of natural populations of <i>Fusarium</i> , rather than on their saprophytic phase, or capable to stimulating natural resistance responses by the host plant. New natural and natural-like phenolic inhibitors have been selected and prepared. They belonging to cinnamic acids, benzaldehydes, benzoic acids, phenylpropanoids, acetophenones, and hydroxylated biphenyls, were tested <i>in vitro</i> and <i>in vivo</i> in order to determine their activity on vegetative growth, mycotoxin biosynthesis, <i>TRI</i> gene expression and performance in the field in the presence of <i>F. culmorum</i> . Several compounds proved able to reduced disease severity significantly over a range of 0.5 to 0.25mM.	
Key words	Natural phenols, mycotoxins, fungi, cereals, resistance	
labs,instruments, equipments,	organic synthesis lab, LC-MS, EPR spectroscopy, GC-MS, NMR spectroscopy, analytical and preparative HPLC,	
publications	(co-operation with Dept. of Agriculture, University of Sassari, Italy) <i>J. Agric. Food Chem.</i> 2014, 62, 4969-4978 <i>Mol. Plant Pathol.</i> 2011, 12(8), 759-771 <i>Mol. Plant Physiol.</i> 2013, 14, 323-341	
projects	<i>New natural and natural-like inhibitors of trichothecene biosynthesis in the cereal pathogen Fusarium culmorum</i> – Sardinian Region 2012-2014 (co-operation with Dept. of Agriculture, University of Sassari, Italy) <i>Cell wall determinants to improve durum wheat resistance to Fusarium diseases</i> – Italian Ministry of Education and Research, 2014-2016 (co-operation with Dept. of Agriculture, University of Sassari, Italy)	

NATIONAL RESEARCH COUNCIL - CNR		N°3
Strategic AREA	<input checked="" type="checkbox"/> Biology, agriculture and food sciences <input type="checkbox"/> Green Chemistry <input type="checkbox"/> Environmental science <input type="checkbox"/> Renewable energy	
Title of research activity	Sustainable seed dressing for cereal crop protection	
CNR Institutes	Institute of Biomolecular Chemistry	
Scientific responsible Institute and address Phone, fax e-mail	Giovanna Delogu Institute of Biomolecular Chemistry +39 0792841220 – fax +390792841229 giovanna.delogu@icb.cnr.it	
State of the art	The seed dressing (or coating) with fungicides and/or insecticides is a pest control technique against a broad range of species harmful to crops and it allows pest control with a reduced amount of fungicides and/or insecticides in comparison with other pesticides requiring whole-soil or furrow applications.	
Activity and targets	The research activity entails the inclusion of natural fungicides into beta-cyclodextrin, a no toxic biomatrix, in order to activate a controlled release of the guest that was protected by soil degradation. A simple, sustainable and non expensive preparation of complex inclusion has been perfected. The inclusion complex gives environmental, toxicological and economic benefits. The application in the field gave yields and results on wheat production comparable to that achieved by conventional fungicide formulations against <i>Fusarium graminearum</i> and <i>F.culmorum</i> . Supramolecular complex of fungicide and insecticide cyclodextrin-based has been also prepared.	
Key words	cyclodextrin, natural fungicides, bioactivity, fusarium, inclusion complexes	
labs,instruments, equipments,	organic synthesis lab, LC-MS, EPR spectroscopy, GC-MS, NMR spectroscopy, analytical and preparative HPLC, UV spectroscopy	
publications	(co-operation with Dept. of Agriculture, University of Sassari, Italy) <i>J. Agric. Food Chem.</i> 2006, 54, 480-484 <i>J. Agric. Food Chem.</i> 2014, 62, 4969-4978	
projects	<i>New natural and natural-like inhibitors of trichothecene biosynthesis in the cereal pathogen Fusarium culmorum</i> – Sardinian Region 2012-2014 (co-operation with Dept. of Agriculture, University of Sassari, Italy)	

<i>publications</i>	J. Agric. Food Chem. 2013, 61,296-306 Food Chemistry 2013, 141, 858–864. Postharvest Biology and Technology 2013, 78, 24–33
<i>projects</i>	Advanced research in citrus (RAGRU) - Defense postharvest of citrus fruits by thermotherapy treatments combined with formulated alternative to traditional fungicides, 2007-2010. Research and trials in the Italian citrus sector - Use of thermal conditioning in a controlled atmosphere and treatment with biocompatible compounds for fungicidal activity, 2001-2006.

NATIONAL RESEARCH COUNCIL - CNR		N°7
Strategic AREA	<input checked="" type="checkbox"/> Biology, agriculture and food sciences <input type="checkbox"/> Green Chemistry <input type="checkbox"/> Environmental science <input type="checkbox"/> Renewable energy	
Title of research activity	Integrated postharvest treatments to reduce decay in horticultural commodities	
CNR Institutes	Institute of Sciences of Food Production Institute of Biomolecular Chemistry Institute of Institute for Polymers, Composites and Biomaterials	
Scientific responsible Institute and address Phone, fax e-mail	Salvatore D'Aquino Institute of Science of Food Production +39 0792841708 salvatore.daquino@ispa.cnr.it	
State of the art	<p>Synthetic fungicides are used either postharvest or immediately prior harvest, when not allowed postharvest, to control microbiological spoilage of fresh produce.</p> <p>In all cases continue application of the same compounds has lead to occurrence of pathogens' resistant strains, environmental pollution and hazard for consumers.</p> <p>A large variety of natural compounds, as essential oils, plant extracts, polyphenols, or organic or inorganic salts in several cases used as food additives, have shown at different degrees fungicidal or fungistatic activity. Despite in most cases their curative activity is quite low; when they are combined with synthetic fungicides the resulting activity may be higher than individual treatments, denoting synergistic effect. In cases of organic production or commodities not allowed to be treated postharvest with synthetic fungicides, the use of natural compounds or food additives plays pivotal roles in reducing losses. On the other hand, when combined with conventional fungicides, besides the possible synergistic effects, they can effectively contrast the occurrence of resistance.</p>	
Activity and targets	<p>Studies are carrying out to evaluate not only the curative activity of natural products or food additives, but also their potential as preventive or sanitizing agents.</p> <p>Yet, since many international supermarket chains requirements for residues are more restrictive than those set by legal organisms, efforts are devoted to test integrated different means where only reduced levels of a single fungicide is combined with natural compounds and physical means, as hot water. Efforts are also devoted to modulate the release and availability of these natural compounds gradually over a fixed period, both in cold storage or retail conditions. Appropriate experimental protocols are being elaborated to correlate the efficiency of the combined treatments with that of stand alone treatments, monitor their capacity to control resistant strains of pathogens and their residue levels.</p>	
Key words	Generally as recognized as safe compounds, essential oils, food additive, synthetic, fungicides, fruits, vegetables, storage, postharvest handling.	
labs,instruments, equipments,	postharvest lab, conventional and CA storage rooms, GC, UV spectroscopy, HPLC, wrapping machines	

NATIONAL RESEARCH COUNCIL - CNR		N°8
Strategic AREA	<input checked="" type="checkbox"/> Biology, agriculture and food sciences <input type="checkbox"/> Green Chemistry <input type="checkbox"/> Environmental science <input type="checkbox"/> Renewable energy	
Title of research activity	Minimally processed fruits and vegetables.	
CNR Institutes	Institute of Sciences of Food Production , ISPA U.O. Sassari	
Scientific responsible Institute and address Phone, fax e-mail	Amedeo Palma Institute of Sciences of Food Production (ISPA), National Research Council (CNR), Italy. Phone: +39-0792841709; Fax +39-0792841799; e-mail: amedeo.palma@ispa.cnr.it	
State of the art	Fresh-cut products are a very convenient way to supply consumers with ready-to-eat foods. Washed, bite-size, and packaged fresh fruit and vegetables allow consumers to eat healthy on the run and to save time on food preparation. The availability of fresh-cut fruits in vending machines, in schools and at workplaces would constitute an excellent strategy to improve the nutritional quality of snacks and foods consumed away from home.	
Activity and targets	Development of suitable technologies (processing, packaging and storage condition) to preserve safety, sensorial and nutraceuticals properties of minimally processed fruit and horticultural products. Specific skills: determination of nutraceuticals components using spectroscopic and chromatographic techniques; determination of the shelf- life of the fresh cut fruits and vegetables considering nutritional, microbiological spoilage and safety aspects.	
Key words	Fresh cut fruit and vegetables; quality; nutraceuticals; food safety;	
labs, instruments, equipments,	Peeling and cutting machines for horticultural products, packaging machines operating in a normal and modified atmosphere, cold rooms for products storage, microbiological lab, instruments for determining: physiological activity, qualitative and nutritional parameters of fruits and vegetables.	
Publications	J. Agr. and Food Chem., 2008, 56, 455-460 Postharvest Biology and Technology, 2010, 55, 121-128 Postharvest Biology and Technology, 2013 78, 24-33. Comm. App. Bio. Sci., 2013, 78/2, 73-82. Acta Horticulturae. 2010, 858, 341-347. Acta Horticulturae. 2009, 818, 323-330	
Projects	Responsibility <ul style="list-style-type: none"> • "Postharvest treatments to improve cold storage of fresh and minimally processed fruit of cactus pear and pomegranate". PRIN 2007 (2008-2010). Partecipation <ul style="list-style-type: none"> • "Defense postharvest of citrus fruits by thermotherapy treatments combined with formulated alternative to conventional fungicides," - RAVAGRU - (MIPAF), (2007-2010). • "Evaluation of the attitude to the use processed products as the main cultivars of mandarin and the like." -MiPAF - (2007-2010). • "Use of compounds with low environmental impact to reduce the 	

	<p>occurrence of physiological disorders of the peel of citrus fruits", - MIPAF. (2007 - 2010</p> <ul style="list-style-type: none"> • "Using the thermal conditioning in a controlled atmosphere and treatment with biocompatible compounds with fungicidal activity." - MIPAF, (2007 - 2010 • "Development of exports of agricultural and food products of the South." - Ministry of Education - (2008-2010). • "Development of innovative biodegradable packaging system to improve shelf-life, quality and safety of high-value sensitive horticultural fresh produce. - FP7-Seventh Framework Smetana (2009-2012).
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NATIONAL RESEARCH COUNCIL - CNR		N°9
Strategic AREA	<input checked="" type="checkbox"/> Biology, agriculture and food sciences <input type="checkbox"/> Green Chemistry <input type="checkbox"/> Environmental science <input type="checkbox"/> Renewable energy	
Title of research activity	Analytical Lab for improvement of Milk and dairy products.	
CNR Institutes	Institute of Biomolecular Chemistry / Associazione Regionale Allevatori Sardegna	
Scientific responsible Institute and address Phone, fax e-mail	Dott. Nicola Culeddu ICB-CNR UOS Sassari via La Crucca,3 i-7100 Italy 39792841211 nicola.culeddu@icb.cnr.it	
State of the art	<p>Milk production is a leader production in Sardinia, mainly obtained by sheep breeding.</p> <p>Since the principal use of Sheep and Goat milk is cheese making, evaluation of its quality is of fundamental economic importance. Systems of quality control for Sheep and Goat milk are applied only in some European Countries and particularly where the sheep and goat sector is well developed. Historically, all these systems take into consideration several parameters such as protein and fat content, and microbiological quality..</p> <p>The organization of a quality control system requires some prerequisites: a qualified laboratory to make the analyses, the logistics to collect the samples and a technical service to assist the farmers in the improvement of milk quality still needs to be provided.</p> <p>Several studies have pointed out that the use of raw milk influences the chemical composition during ripening and the sensory properties of the cheeses favourably, especially for cheeses with a long ripening time; it allows the expression of the production systems, and the link to the region of production.</p> <p>The concept of quality, in any case, has recently evolved considerably: animal welfare, the farm environment and the general organization of production is taken into consideration.</p> <p>These factors are beginning to be included in the PDO cheese specifications.</p> <p>The application of sheep and goat milk quality control systems in European countries are directly related to the development and industrialization of the sector and it has significantly contributed to improve the quality and market price of sheep and goat milk and cheese.</p> <p>As a result of a strictly control of sheep milk quality, and also the quality of cheese produced in Sardinia this year the price of most kinds of Pecorino cheese is higher than the aged corresponding Parmigiano.</p>	
Activity and targets	This Raw Milk Quality Research Program ensures the safe production, handling and transportation of raw milk. This is accomplished through the use of a comprehensive legislative framework, laboratory testing, inspection and audit activities. Implementation of a chemical and microbiological laboratory for the control of the quantitative parameters, microbiological and sanitation of the milk; use of newer techniques for frauds, antibiotics, and quantification of some quality parameters. On field tests and advice on the correct operation of	

	<p>refrigeration systems; Training and consulting with technicians functioning milking equipment; Prophylaxis program with mastitis detection of pathogens on susceptibility and consequent therapy; detection on antibiotics abuse. Collaboration with the dairies in the preparation and simulation models of grills payment quality milk. Promotion of quality improvement, dissemination of results. Help on setting-up of associations between breeders, as well as activities for gathering and processing data for statistical and market: Setting-up of working group on detection and monitoring of the average market prices of the means of production and of agricultural products; Creation databases of technical parameters (paper forage, paper food etc.); Collaborations with local organizations and local research institutes; Organization of courses and training days for farmers on organic livestock.</p>
Key words	Sheep, Goats, Quality control, Veterinary, Freezing, Cheese.
labs,instruments, equipments,	<p>Individual Bacteria Count BactoScan FC200 200 samples/hour Flowcytometer Fossomatic 600 samples/hour Automatic milk analyser MilkoScan™ FT 600 samples/hour Q Exactive™ Hybrid Quadrupole-Orbitrap Mass spectrometer Agilent 1100 LC MSD Model G1946D Mass Spectrometer Agilent GC Systems 7820A GC Agilent GC Systems6890N GC The Finnigan Polaris Q ion-trap mass spectrometer Magnetic Resonance spectrometer 14 T Bruker Avance II Magnetic Resonance spectrometer11 T Varian Mercury plus Mass Spectrometer ...</p>
publications	<p>Quantification of Gluten Exorphin A5 in cerebrospinal fluid by liquid chromatography-mass spectrometry J Chromatogr B Analyt Technol Biomed Life Sci. 2006 Apr 3;833(2):204-9. Epub 2006 Feb 28. Liquid chromatography-mass spectrometry assay for quantification of Gluten Exorphin B5 in cerebrospinal fluid J Chromatogr B Analyt Technol Biomed Life Sci. 2007 Jun 1;852(1-2):485-90. Epub 2007 Feb 15. Chronic treatment with krill powder reduces plasma triglyceride and anandamide levels in mildly obese men Lipids in Health and Disease 2013, 12:78 .</p>
projects	

NATIONAL RESEARCH COUNCIL - CNR		N°11
Strategic AREA	<input checked="" type="checkbox"/> Biology, agriculture and food sciences <input type="checkbox"/> Green Chemistry <input type="checkbox"/> Environmental science <input type="checkbox"/> Renewable energy	
Title of research activity	Milk all year caprine chain	
CNR Institutes	Institute of Biomolecular Chemistry	
Scientific responsible Institute and address Phone, fax e-mail	Mauro Marchetti Institute of Biomolecular Chemistry +39 0792841220 – fax +390792841229 mauro@ss.cnr.it	
State of the art	Goats murciane granadine are suited for the stall housing. The project has aim to the optimize organization and business management of the barn with the use of computer technology to aid the control of milk production, the optimization of the cost of food rations, welfare animals with reduced mortality of newborns. Lactation long (300 days) in connection with the needs of the transformation in fresh and soft cheese and drinking milk.	
Activity and targets	the project expected the breeding of selected goats with lactation until 300 days. destagionalizzano and the milk production with excellent qualitative performances. every adult produce in mean 600 lt. per year with high in fat and protein. Use of lightweight modular structures for stables with low investment makes the project suitable for start up and subsequent stages of growth. The project presents innovations in stall with structured paddock based on the life cycle and lactation of the animals; the automatic distribution of rations by computerising with administration with frequency (5-6 times a day) that meet the animal's metabolism while promoting better assimilation of nutrients; the use the area for weaning automatic reducing mortality and disease in newborns. Global demand for milk continues to grow in strength in the consumption of milk and dairy products in new areas of the world (BRIC)	
Key words	Milk throughout the year in connection with the processing and consumption on the rise of fresh and soft cheese with high digestibility and low fat contents. Generational change in agriculture by encouraging new start-ups launched by young people with skills not related to the sector	
labs, instruments, equipments,	Modular stalls with low investment and low environmental impact, with milk meters that allow better control of ownership; genetic selection of the breed; Automatic distribution of feed ; Area weaning in a protected environment with the use of automatic nursing reducing the transmissibility of the disease to newborns and reduced mortality.	
publications	Original project broadcast by the major television media Italians (RAI, LOCAL TV)	
projects		

NATIONAL RESEARCH COUNCIL - CNR		N°12
Strategic AREA	<input checked="" type="checkbox"/> Biology, agriculture and food sciences <input type="checkbox"/> Green Chemistry <input type="checkbox"/> Environmental science <input type="checkbox"/> Renewable energy	
Title of research activity	Milk all year sheep industry	
CNR Institutes	Institute of Biomolecular Chemistry	
Scientific responsible Institute and address Phone, fax e-mail	Mauro Marchetti Institute of Biomolecular Chemistry +39 0792841220 – fax +390792841229 mauro@ss.cnr.it	
State of the art	Farm sheep breeding of kind Assaf suited for the stall housing. Organization and business management of the barn with the use of computer technology to aid the control of milk production, the optimization of the cost of food rations, welfare animals with reduced mortality of newborns. Lactation long (280 days) in connection with the needs of the transformation in fresh and soft cheese and drinking milk.	
Activity and targets	Sheep breeds with lactation until 280 days. destagionalizzano with milk production with excellent performances - qualitative. Every adult will produce in average 500 lt. of milk per year with high content in fat and protein. Use of lightweight structures for cowshed, low investment and modular structures, suitable for start up and subsequent stages of growth. Innovations with paddock structured depending on the life cycle and lactation animals; Automatic distribution of rations with frequency (5-6 times a day) that meet the animal's metabolism while promoting better assimilation of nutrients; Uses of area of the automatic weaning with reducing mortality and disease in newborns. Global demand for milk continues to grow in strength in the consumption of milk and dairy products in new areas of the world (BRIC)	
Key words	Milk throughout the year in connection with the processing and rise of the consumption of fresh and soft cheese with high digestibility and low fat contents. Generational change in agriculture by encouraging new start-ups launched by young people with skills not related to the sector	
labs,instruments, equipments,	Stalls modular with low investment and low environmental impact, milking using milk meters that allow better control of ownership and genetic selection of the breed; Automatic distribution of feed the requirements of the animal in connection with the life cycle and lactation; Area weaning in a protected environment with the use of automatisms reducing the transmissibility of the disease to newborns and mortality.	
publications	Original project broadcast by the major television media Italians (RAI, LOCAL TV)	
projects		

NATIONAL RESEARCH COUNCIL - CNR		N°13
Strategic AREA	<input checked="" type="checkbox"/> Biology, agriculture and food sciences <input type="checkbox"/> Green Chemistry <input type="checkbox"/> Environmental science <input type="checkbox"/> Renewable energy	
Title of research activity	Beer with native raw materials without addition of CO₂	
CNR Institutes	ICB, ISPAAM, ISPA	
Scientific responsible Institute and address Phone, fax e-mail	Mauro Marchetti Institute of Biomolecular Chemistry +39 0792841220 – fax +390792841229 mauro@ss.cnr.it	
State of the art	<p>The beer is a product that continues to grow around the world for ease of use in many moments of the day, it has a low alcohol content, it represents a nice drink for a wide spectrum of consumers. Recently, The "Gusto from Sardinia" platform has been particularly engaged in the production of raw materials for the production of beer, in collaboration with the most important Italian industry . The gruppoForst / Menabrea.</p>	
Activity and targets	<p>The scientific activity can be developed in the production of corn, two-row barley and hops, but also in the processing of cereals in the final product (corn flour and barley malt)</p>	
Key words	Beer with native raw materials	
labs,instruments, equipments,		
publications		
projects		

NATIONAL RESEARCH COUNCIL - CNR		N°14
Strategic AREA	<input checked="" type="checkbox"/> Biology, agriculture and food sciences <input type="checkbox"/> Green Chemistry <input type="checkbox"/> Environmental science <input type="checkbox"/> Renewable energy	
Title of research activity	Snack on raw materials native	
CNR Institutes	Institute of Biomolecular Chemistry	
Scientific responsible Institute and address Phone, fax e-mail	Mauro Marchetti Institute of Biomolecular Chemistry +39 0792841220 – fax +390792841229 mauro@ss.cnr.it	
State of the art	<p>More and more often we eat in the bar, until recently, places intended to drink but not so much for the lunch. The experience gained in Sardinia allowed to launch local products and typical Sardinian food culture, reinterpreted to accompany non-alcoholic aperitifs, but also spirits, beers and wines</p>	
Activity and targets	<p>The project can be developed in the identification of typical foods Serbs to design as food to pair with these appetizers. The action can be carried out in four phases: agricultural production, processing of grains in groats with high protein content, baking breads and fried snacks ..</p>	
Key words	Typical snacks and delicious with high technological content	
labs,instruments, equipments,		
publications		
projects		

NATIONAL RESEARCH COUNCIL - CNR		N°15
Strategic AREA	<input checked="" type="checkbox"/> Biology, agriculture and food sciences <input type="checkbox"/> Green Chemistry <input type="checkbox"/> Environmental science <input type="checkbox"/> Renewable energy	
Title of research activity	Local wines of high quality	
CNR Institutes	Institute of Biomolecular Chemistry	
Scientific responsible Institute and address Phone, fax e-mail	Mauro Marchetti Institute of Biomolecular Chemistry +39 0792841220 – fax +390792841229 mauro@ss.cnr.it	
State of the art	<p>For over thirty years in Sardinia we produce high quality wines, known and appreciated in the world, to the point that you are exporting in more than 100 foreign countries. So many years of experience on the DOC and DOCG IGT, have allowed us to know and improve the quality of wines, and to appreciate the native vines and those endogenous which are perfectly grown in Sardinia.</p>	
Activity and targets	<p>The project can be developed in improving Agricultural Management, the Transformation technologies and the commercial aspects. All agricultural Interventions must be a very low content of chemicals added which allow the finished product to be free from faults, with good alcoholic content; good structure, color and flavor components.</p>	
Key words	High quality wines	
labs,instruments, equipments,		
publications		
projects		

NATIONAL RESEARCH COUNCIL - CNR		N° 17
Strategic AREA	<input checked="" type="checkbox"/> X Biology, agriculture and food sciences <input type="checkbox"/> Green Chemistry <input type="checkbox"/> Environmental science <input type="checkbox"/> Renewable energy	
Title of the research activity	Development and improvement of polysaccharide-based films for potential application in food packaging	
CNR Institute(s)	Institute of Polymers, Composites and Biomaterials, IPCB CNR	
Scientific responsible Institute and address Phone, fax e-mail	Dr. Mario Malinconico IPCB CNR Via Campi Flegrei, 34 - 80078 Pozzuoli, NA, Italy Tel. 00390818675212 Email: mario.malinconico@ipcb.cnr.it	
State of the art		
Activity and targets	The objective of this project is to develop bio-based films useful for food packaging. To gain the purpose, research activities were divided in 2 parts: 1. Further development and/or improvement of the already prepared pectin/poly(ethylene glycol) (PEC/PEG) biodegradable films; 2. Preparation of polysaccharides based films or blends (e.g. chitosan, sodium-alginate, carboxymethyl cellulose etc). The Italian team has been working for a while on blends based on poly(caprolactone) (PCL) and thermoplastic starch (TS) which could be used as food containers. Therefore, a part of the project research is focused on the encapsulation of active substances in the PCL/TS blends by conventional methods or by supercritical carbon-dioxide.	
Key words (max 3)	Food packaging, Films, Chitosan	
labs, instruments, equipments		
Selected publications (max 2)	S Šešlija, A Nešić, J Ružić, MK Krušić, S Veličković, R Avolio, G Santagata, M Malinconico, Food Hydrocolloids, Volume 77, April 2018, Pages 494-501. A Nešić, A Onjia, S Davidović, S Dimitrijević, ME Errico, G Santagata, M Malinconico, Carbohydrate polymers 157, 981-990 (2017).	
Significant projects on the proposed research activity	Executive programme for scientific and technological cooperation between the Italian Republic and the Republic of Serbia for the years 2016-2018. No. 451-03-01231/2015-09/5	

NATIONAL RESEARCH COUNCIL - CNR		N°19
Strategic AREA	<input checked="" type="checkbox"/> Biology, agriculture and food sciences <input type="checkbox"/> Green Chemistry <input type="checkbox"/> Environmental science <input type="checkbox"/> Renewable energy	
Title of the research activity	Novel formulations and valorization of agro-food by-products by advanced membrane operations	
CNR Institute(s)	Institute on Membrane Technology, CNR-ITM	
Scientific responsible Institute and address Phone, fax e-mail	Lidietta Giorno Institute on Membrane Technology, CNR-ITM Via P. Bucci, 17/C – 87036 Rende (CS), Italy Phone: +39 0984 492050 – 492058 Fax: +39 0984 402103 e-mail: l.giorno@itm.cnr.it	
State of the art	<p>New regulations in environment protection, global energy crises and increasing market demands for “green” companies are forcing the industry to consider finding new and sustainable methods of by-products utilization. This project emphasizes the application of integrated membrane processes in formulation of low-fat mayonnaise with high oxidative stability through the valorisation of food industry by-products. The interdisciplinary approach of this project aims to set-up a low energy and cost effective process of a by-product utilization through the combination of fundamental science and modern applied technologies.</p> <p>Existing technologies require additional treatments and a great investment. Due to those facts, the attention of the scientific community is facing with membrane techniques that eventually could replace some stages of the process or could be incorporated into the existing technological process. The possibility to integrate various membrane operations in the same process or in the combination with conventional separation units, promotes better performance in terms of decreasing production costs, energy consumption, waste generation and environmental impact, equipment size and product quality resulting in cheaper and sustainable technical solutions.</p> <p>Nanostructured membranes are suitable for carrying out molecular separations on the basis of biocomponent molecular size and physical-chemical properties. By selecting an adequate membrane, different effects between the phases (micro-, ultra-, nanofiltration) or within the same phase (membrane emulsification) can be achieved.</p> <p>Moreover, membrane technology can also assist formulation. Over the last 10 years, there has been an increasing interest in a membrane emulsification technique for the production of micro- and nanoparticulates. The technique is highly attractive given its simplicity, potentially lower energy demands, need for less surfactant and the resulting narrow droplet-size distributions. It is applicable to both oil-in-water (o/w) and water-in-oil (w/o) emulsions.</p> <p>Therefore, partners have strong interest in joining their expertises for developing membrane emulsification processes (in which Italian Partner has solid expertise) for food formulation (in which Serbian Partner has solid expertise).</p>	
Activity and targets	<p>This project is aiming to develop a sustainable method for utilization of by-products from agro-food industry. The main objective of this project is an introduction of phenolic antioxidant compounds from olive oil pulp in the light mayonnaise formulation using modern membrane processes. Development of the optimal process, including identifying sources of variation, defining the operating parameters that both control variation and provide a successful outcome, and determining the measurements of process success are the main goals which we aim to achieve through different approaches of process management and knowledge transfer between two groups of scientists in the fields of membrane technology and food processing and formulation. The key</p>	

	<p>feature will be in identifying and integrating of highly precise and selective membrane operations in order to minimize waste generation while obtaining high quality food product and valuable co-products instead of by-products.</p> <p>The practical objective of this study is to develop light mayonnaise with high oxidative stability by adding the potential antioxidants from olive oil pulp and reducing the fat content to 40-50%.</p> <p>In the first stage of this bilateral project, extraction and separation of valuable antioxidant components from olive oil pulp will be conducted. Extraction and identification of valuable bio-compounds (phenolic antioxidants) from olive oil pulp using suitable extraction method and coupled membrane processes and phenolic identification methods will be controlled and executed by Italian partner.</p> <p>Before their use in industry, obtained extracts must be concentrated but the use of high temperatures can degrade some compounds. Membrane processes is an option that allows concentration at low temperatures. Nanofiltration represents the appropriate technique for aqueous and ethanolic extracts and each extract results in two distinct fractions: permeate and retentate. Italian Partner ITM-CNR has wide expertise in nano- and micro-porous membrane systems development and integrated membrane process in order to maximize mass and energy intensity while preventing waste generation and promoting solvent recovery and reuse.</p> <p>The concentrated extract will be emulsified in sunflower oil (before the oil is used as a component for mayonnaise) using different membrane emulsification techniques and different membrane materials.</p> <p>Considering previous expertise in the field of emulsion formation, both partners will simultaneously develop optimal conditions for membrane emulsification regarding droplet size, emulsion stability, rheology, etc.</p> <p>The introduction of obtained phenolic compounds and formulation of final product will be performed by Serbian partner. Moreover, full rheology analysis, stability and oxidation characteristics of realized product will be determined at Faculty of Technology from Novi Sad.</p>
Key words (max 3)	Bioactive compounds; Membrane operations; Agro-food by-products
labs, instruments, equipments	<p>ITALIAN TEAM. The research activities that will be carried out at ITM are part of Projects in progress at ITM concerning the olive mill wastewaters treatment. The partnership of these National Projects involves also the participation of small and medium enterprises.</p> <p>Equipments: Microfiltration/ultrafiltration laboratory unit - Nanofiltration/reverse osmosis laboratory unit - Lab plant for characterization of flat-sheet membranes - Osmotic distillation/membrane distillation laboratory unit - Membrane emulsification plants - Light scattering - HPLC - Spectrophotometer - Zeta potential</p> <p>SERBIAN TEAM. The research activities that will be carried out at TFUNS are part of National Projects in progress at TFUNS, of them are "Development of new functional confectionary products based on oilseed" (TR 31014). The partnership of these National Projects involves also the participation of small and medium enterprises.</p> <p>Equipments: HAAKE viscosimeter - TAXT texturometer - Spectrophotometer - Master Sizer Malvern - Microfiltration/ultrafiltration laboratory unit - Glass membrane emulsification unit - Brabender equipment for bakery technology - Polarimeter</p>
Selected publications (max 2)	<ol style="list-style-type: none"> 3. C. Conidi, R. Mazzei, A. Cassano, L. Giorno, Integrated membrane system for the production of phytotherapies from olive mill wastewaters, <i>Journal of Membrane Science</i>, 454 (2014) 322-329. 4. A. Jokic, Z. Zavargo, Z. Šereš, M. Tekic, The effect of turbulence promoter on cross-flow microfiltration of yeast suspensions: A response surface methodology approach, <i>Journal of Membrane Science</i>, 350 (2015) 269-278.

<p><i>Significant projects on the proposed research activity</i></p>	<ol style="list-style-type: none"> 4. 'Studio, progettazione e sviluppo di sistemi tecnologici per il recupero di acqua e componenti bioattivi dai sottoprodotti dell'industria olearia da destinare a nuove applicazioni' - Accordo di Programma Quadro (APQ) in materia di Ricerca Scientifica e Innovazione Tecnologica nella Regione Calabria. 5. PON01_01545 'Sistemi tecnologici avanzati e processi integrati nella filiera olivicola per la valorizzazione dei prodotti e dei sottoprodotti, lo sviluppo di nuovi settori e la creazione di sistemi produttivi eco-compatibili' - OLIO PIÙ - Programma Operativo Nazionale "Ricerca e Competitività 2007-2013" 6. Recupero e valorizzazione di Acque di Vegetazione olearie per nuove applicazioni Eco-friendly nelle Lavorazioni conciarie - POR CALABRIA FESR-FSE 2014-2020 - ASSE I – Promozione della Ricerca e dell'Innovazione
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NATIONAL RESEARCH COUNCIL - CNR		N° 22
Strategic AREA	X Biology, agriculture and food sciences Green Chemistry Environmental science Renewable energy	
Title of the research activity	Technology transfer and implementation of (bio)sensoristic platform 'BEST' for technological innovation in Serbian milk chain monitoring	
CNR Institute(s)	Institute of Nanostructured Materials, ISMN-CNR	
Scientific responsible Institute and address Phone, fax e-mail	Dr. Roberto Dragone ISMN-CNR c/o Dipartimento di Chimica- Università degli Studi di Roma P.le A.Moro, 5 - 00185 Roma -Italy phone +390649913374 roberto.dragone@ismn.cnr.it	
State of the art	<p>The dairy sector in Serbia is of high economic importance and it is mainly based on cow's milk processing: according to the official statistical data, average cow's production has been estimated to 1.6 million tons per year (followed by sheep and goat milk productions) and about 50 % is delivered to dairy plants for further processing. Within Serbia's preparation process for EU membership, for a proper integration and to increase its competitiveness in the EU dairy market it is fundamental for Serbian dairy sector to intercept the major trends in EU's dairy policy. The EU is a major player in the world dairy market and two main features of its policy are the strong market-orientation (also due to its role as lead exporter of many dairy products) as well as enforcement of strategies for milk/dairy products quality and safety. In this context, the Hazard Analysis and Critical Control Points(HACCP) approach plays a central role in intervention measures for monitoring of quality and safety dairy production. HACCP is the widely used on-enterprise strategy to control and manage the safety of food production process, as well as to support traceability and liability (in Serbia, the mandatory adoption of the HACCP principles was firstly introduced by virtue of the Veterinary Law in 2005).</p> <p>It is important to stress that the milk chain is particularly susceptible of contamination in particular at primary production level (we need only consider the example of aflatoxin M1 outbreak in milk and dairy products that occurred in 2013). Thus, the milk chain would benefit of early identification of anomalies to shield from commercial frauds and guarantee safety, authenticity and traceability of the food product. Innovative technologies for monitoring such factors as farm animal health, productivity, food wholesomeness and traceability can make a substantial difference. In this context automated, <i>in continuum</i> control techniques have an impressive potential to assist food companies in food control, including process monitoring.</p> <p>Traditional laboratory analyses are not suitable for continuous monitoring for both response times and costs.</p> <p>The BEST Platform (PCT WO/2010/001432) is a HACCP-like monitoring system that follows an integrated approach for environmental/food diagnostics monitoring and toxicological self-monitoring and traceability in the food chain, including primary production. More specifically, 'BEST' focuses on identification, control, simultaneous, and non-stop monitoring of anomalous throughout agro-zootechnical productions, developed to allow simultaneous collection and analysis of multiple signals. Such signals are produced from a battery of selected bio/chemosensoristic devices (or probes),</p>	

	<p>integrated with each other and functioning simultaneously. The simultaneous acquisition of multiparameters and integrated information can be useful in determining correlations and relationships among different data (through multivariate data analysis), and it can constitute a flexible grid of indexes and multiple markers in series. Such integrated analytical approach helps to define a “fingerprint” and to identify new marker indexes of food matrices. A field validation of BEST prototype was performed in a farm in the Lazio region (Italy) and in the milk plant of Centrale del Latte di Roma within the programme ALERT, funded by the Italian Ministry of Economic Development under the Call <i>Industria 2015 New technologies for Made in Italy</i>.</p>
Activity and targets	<p>The goal of this proposal is the technology transfer and implementation of ‘BEST’ platform in Serbian dairy sector. In terms of operativeness, thanks to its automation, ‘BEST’ platform is conceived to be easily integrable in milkproduction context. Indeed, within Alert programme ‘BEST’ platform was (and is still) employed for monitoring technical/production activities in a farm (milking, raw milk harvesting) as well as in milk plant (for monitoring e.g. milk exiting tank-lorry). This aspect make potentially integration of BEST platform feasible in dairy sector in Serbia. A second fundamental feature of ‘BEST’ is to be technologically open: starting from a previously selected and tested (within Alert programme) grid of physical, chemical, and biological parameters and the building-up of reliable control charts (based on enterprise-specific values acquired during a period of initial data acquisition stage through ‘BEST’ measurements), <i>ad-hoc</i> addition of new (bio) sensoristic devices in the platform could be assessed according to specific requirements (e.g. specific contamination problems) together with the assessment of novel (and relevant as markers) wholesomeness and quality parameters of milk and dairy products. Investments oriented at development and implementation of effective HACCP plans to improving of milk/dairy quality and safety are in line with EU's dairy policy. The proposed application of ‘BEST’ platform in Serbian milk chain monitoring aim exactly at benefits of implementing/operating quality assurance systems(including) and at positive effects on the increased safety of milk/dairy products In a EU dairy market characterized by a fierce competition to sell dairy products to a demanding consumer, the increased customer confidence is an important benefit. Further benefits for Serbian dairy sector could derive from investments in milk/dairy products safety and quality improvement systems, both for the enhance the integration between family farm and processing industry and for dairy companies themselves.</p> <p>Milk, on-site diagnostics, biosensoristic devices ISMN-CNR laboratory c/o Dipartimento di Chimica- Università degli Studi di Roma ‘BEST’ prototype Array of external (bio)sensoristic devices (e.g. ion selective electrodes and whole (including) and at positive effects on the increased safety of milk/dairy products, cell based biosensoristic devices for general toxicity assays and assessment of level of herbicide contamination).</p>
labs, instruments, equipments	Cary Eclipse Spectrofluorimeter
Selected publications (max 2)	<p>Dragone, R., Grasso, G., Muccini, M., & Toffanin, S. (2017). Portable bio/chemosensoristic devices: innovative systems for environmental health and food safety diagnostics. <i>Frontiers in public health</i>, 5, 80</p> <p>Frazzoli, C. (30%), Mantovani, A. (20%), Campanella L. (20%), Dragone, R. (30%), diagnostic and monitoring and self-control of food chain, including primary production and relevant method for quik management of hazard (BEST – integrated toxicity (bio)sensor’s system for hazard analysis and management in the food chain and the environment). International Patent PCT WO 20110/0001432.</p>

Significant projects on the proposed research activity	<p>Italian programme ALERT (<i>Integrated system of biosensors and sensors ("BEST") for the monitoring of wholesomeness and quality, as well as for traceability in the cow milk chain</i>)- Industria 2015, Made in Italy. Budget: about 6 Millions €</p> <p>Partners: 3 Public Bodies and 7 Enterprises.</p>
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Environmental Pollution and Green Chemistry

In this strategic research and innovation area, one may find industries dedicated to the production and use of chemicals produced from renewable sources such as biobased chemicals. Examples are companies like manufacturers of bioplastics, producers of biolubricants or biopesticides. Just to mention a few.

From an environmental point of view, the main interest is focused on restoration of polluted sites, industrial processes with low environmental impact and recycling and recovery of both industrial and urban wastes.

Potentially interested companies:

Bio-refineries

Biobased compounds manufactures

Industries for recycling and reuse of waste

bio-lubricants industries

biopesticides industries

biotechnological companies

Enterprises for environmental recovery

NATIONAL RESEARCH COUNCIL - CNR		N°2
Strategic AREA	<input checked="" type="checkbox"/> Biology, agriculture and food sciences <input type="checkbox"/> Green Chemistry <input type="checkbox"/> Environmental science <input type="checkbox"/> Renewable energy	
Title of research activity	Agricultural residues as raw materials for the recovery/transformation of high added-value compounds	
CNR Institutes	Institute of Biomolecular Chemistry Institute of Sciences of Food Production Institute of Ecosystem Studies Institute for the Animal Production System in Mediterranean Environment	
Scientific responsible Institute and address Phone, fax e-mail	Giovanna Delogu Institute of Biomolecular Chemistry +39 0792841220 – fax +39 0792841229 giovanna.delogu@icb.cnr.it	
State of the art	Agricultural residues are a source of bioactive natural products. Nowadays, different strategies have been developed in order to use agricultural residues as a source of high value added products. This gives economical, toxicological and environmental benefits because agricultural residues cause management and economic problems worldwide.	
Activity and targets	<p>Efforts are devoted to the appropriated exploitation of agricultural residues as well as no-food and no-feed plants in order to increase the overall profitability of crops.</p> <p>The capability of a number of extraction techniques and methodologies are investigated, such as solvent extraction with sustainable solvents, pressurized water extraction, acid-base extractions, ultrasound extraction (UE), microwave assisted extraction (MAE), accelerated solvent extraction (ASE). They have a significant influence on the recovery of bioactive compounds whose antioxidant activity has been detected by EPR/UV spectroscopies and by biosensors. The recovery of bioactive compounds with biopesticidal and antimicrobial activities are also evaluated.</p> <p>Chemo-enzymatic modification of bioactive compounds isolated from biomass by-products are carried out in order to obtain semi- synthetic analogues with improved biological activity.</p>	
Key words	Biomass, phenols, extraction, biopesticides, biochemicals, bioactivity	
labs,instruments, equipments,	organic synthesis lab, LC-MS, EPR spectroscopy, GC-MS, NMR spectroscopy, analytical and preparative HPLC, UV spectroscopy, extraction technologies: MAE, UE, ASE.	
publications	<i>Food Chem.</i> 2014, 157, 263-274 <i>Food Anal. Methods.</i> 2012, 5, 759-766 <i>J.Food Comp. Anal.</i> 2014, 35, 112-119 <i>Anal.Chem.</i> 2014, 86,8727-8734	
projects	Green Chemistry Cluster BIT3G– 3th Generation biorefinery from biomass to chemicals. Italian Ministry of Education and Research, 2014-2016. Genomic and metabolomic fingerprint of sardinian artichoke – Sardinia Region, 2011-2013.	

NATIONAL RESEARCH COUNCIL - CNR		N°21
Strategic AREA	<input checked="" type="checkbox"/> Biology, agriculture and food sciences <input type="checkbox"/> Green Chemistry <input checked="" type="checkbox"/> Environmental science <input type="checkbox"/> Renewable energy	
Title of the research activity	Biotechnological applications of photosynthesis	
CNR Institute(s)	Institute of Crystallography, IC-CNR	
Scientific responsible Institute and address Phone, fax e-mail	Giuseppina Rea, PhD Institute of Crystallography CNR, 00015 Monterotondo Scalo, Rome, Italy Phone: 0039 06 90672631 Fax: 0039 06 90672630 e-mail: giuseppina.rea@ic.cnr.it	
State of the art	Photosynthetic pigment–protein complexes continuously attract the attention of researchers working in diverse scientific disciplines. Their unique hierarchical-structural organization in the photosynthetic active membranes allows them to perform photochemical energy conversion with the highest production yield. Recently, the possibility to integrate photosynthetic active organisms, or their subcomponents, into optoelectronic devices for energy production or biosensor development has gained renewed interest in the exploitation of noninvasive techniques for activity determination. The use of photosynthetic complexes as a sensing element for toxic compounds opened new frontiers in the field of environmental monitoring. This applicative possibility is substantially due to the sensitivity of photosystem II to different toxic compounds, such as herbicides and heavy metals.	
Activity and targets	Development of <i>ad hoc</i> photosynthetic cells and/or artificial biomimetics tailored to the environmental and agri-food sectors. The research proposes the optimization of bioassays and biosensors for the detection of different classes of pesticides, endocrine disruptor chemicals as well as heavy ions, through the isolation and characterization of photosynthetic strains with improved capability of keeping the proper functionality of the photosynthetic reactions in a hostile environment. Moreover, specific candidate strains will be studied, implemented and optimised as effective accumulators and degraders useful for the bioremediation of different kinds of organic and inorganic pollutants.	
Key words (max 3)	Photosynthesis, biosensors, bioassays	
labs, instruments, equipments	The CNR_IC labs of molecular biology and biotechnology, photosynthesis, algal growth and chromatography host as main instruments spectrophotometers, spectrofluorometer, different fluorimeters for chlorophyll induction measurements, oxygraph, PCR and Real-Time PCR Systems, French Press, lyophilizator, static and orbital photo-thermic shakers for growth of microorganisms, optical microscope, chemical and laminar flow hoods. Basic equipment includes electrophoresis systems for proteins and nucleic acids, freezers and ultra-freezers, centrifuges, analytical balances, and so on.	
Selected publications (max 2)	I. Husu, G. Rodio, E. Touloupakis, M.D. Lambreva, K. Buonasera, S.C. Litescu, M.T. Giardi, G. Rea (2013). Insights into photo-electrochemical sensing of herbicides driven by Chlamydomonas reinhardtii cells. Sensors & Actuators: B. Chemical 185: 321–330. Lambreva MD, Giardi MT, Rambaldi I, Antonacci A, Pastorelli S, Bertalan I.,	

	Husu I., Johanningmeier U, Rea G. (2013) A Powerful Molecular Engineering Tool Provided Efficient <i>Chlamydomonas</i> Mutants as Bio-Sensing Elements for Herbicides Detection. PLoS ONE 8(4): e61851.
<i>Significant projects on the proposed research activity</i>	<p>2011-2015. <u>EU COST Action TD1102</u>: Title: Photosynthetic proteins for technological applications: biosensors and biochips. Acronym: PHOTOTECH.</p> <p>2009-2011. <u>EU FP7-SME-2008-1</u> project, ID: 232522. Project title: Biosensors and Sensors for the industrial biosynthesis process of widely used commercial antioxidants: nutraceuticals as additives for food and aquaculture promoting public health and safety. Acronym: SENSBIOSYN.</p> <p>2008-2010. <u>EU/MAP project Eurotransbio</u> n. B01/0580/02/X10. Project title: A new Biotechnology Platform for multipurpose Biosensors. Acronym: MULTIBIOPLAT.</p> <p>2009-2011. <u>EU FP7-SME-2008-1</u> project ID: 232082. Bio-sensor for Effective Environmental Protection and Commercialization – ENhanced. Acronym: BEEP-C-EN.</p> <p>2009-2012. <u>Filas</u>; prot. N. 27/2009 del 15/01/09. Project “Sistema biosensoristico per la determinazione di contaminanti pericolosi per la salute umana in prodotti agro-alimentari”. Acronym: BIOAL.</p>

NATIONAL RESEARCH COUNCIL - CNR		N°23
Strategic AREA	Biology, agriculture and food sciences X Green Chemistry X Environmental science Renewable energy	
Title of the research activity	Sustainable fabrication of functional hybrid nanomaterials for the development of smart textile fabrics with photocatalytic, self cleaning, flame retardant and oil/water separation properties	
CNR Institute(s)	Institute for the study of Nanostructured Materials, ISMN-CNR	
Scientific responsible e-mail Institute and address Phone, fax	Daniela Caschera daniela.caschera@ismn.cnr.it ISMN Via Salaria Km 29,300 +39 0690672848	
State of the art	In recent decades, there has been a notable increase in the market for non- apparel fabrics, which, thanks specially to the application of nanotechnologies, has increased the development of specific sectors of the textile industry, such as new interdisciplinary fields. Promising recent developments in material processing, device design and system configuration enable the scientific and industrial community to concentrate efforts on the realization of smart textiles. The combination of implementable properties of the fabrics such as strength, together with intrinsic flexibility and toughness of the fibers themselves, linked with the possibility of nanotechnology to add innovative properties, can allow the development of new engineering areas of the textile industry. In this view the textiles of the future will improve people's everyday lives and benefit the industry, the health care sector and the environment.	
Activity and targets	The aim of the research activity is the design and construction of smart and multifunctional textile-based systems through the proper functionalization and modification of the surface properties of the cellulosic substrates. The research activity will include in particular the use of wet chemistry (sol-gel), and/or CVD deposition techniques, to introduce on natural or synthetic fibers surface, new functionalities, without altering the intrinsic characteristics and the bulk properties of the textile itself. In this way it will be possible to control specific properties of the fiber surface such as wettability, electrical conduction, photodegradation capacity of polluting organic molecules, antibacterial properties, flame retardant properties, as in the case of technical fabrics. It will also be possible to deposit suitable substances that allow the modified system to respond to external stimuli (light, pH) or detect the presence and variation of environmental analytes (gas or small organic molecules), which can act as components of "smart devices", as in interactive or intelligent fabrics. The hybrid nanomaterials can be used as innovative systems in different technological sectors (smart textile, biosensing and biomedicine, safety textile).	
Key words (max 3)	Smart textiles, superhydrophobic textiles, photocatalytic membrane	
labs, instruments, equipments	Involved labs: Chemical Vapour Deposition Laboratory; Chemical Synthesis Laboratory, Optical, Structural and Morphologies Characterization Laboratories. Plasma Enhanced Chemical Vapour Deposition (PECVD) Apparatus,	

	Spectrometer and Uv Lamps for photodegradation measurements, Flame Retardant Measurements, Contact-angle measurements, Raman Spectroscopy, SEM and AFM microscopy
<i>Selected publications (max 2)</i>	<p><i>Superhydrophobic Fabrics For Oil/Water Separation through a diamond like carbon (DLC) Coating</i>, B. Cortese, D. Caschera, F. Federici, G.M. Ingo, G. Gigli <i>Journal of Material Chemistry A</i>, 2 (2014) 6781-6789</p> <p><i>Fabrication of Eu-TiO₂ NCs functionalized cotton textile as a multifunctional photocatalyst for dye pollutants degradation</i>, D. Caschera, P. Calandra, B. Cortese, F. Federici, T. de Caro, A. Mezzi, R. Lo Nigro, R.G. Toro <i>Applied Surface Science</i> 427 (2018) 81–91</p>
<i>Significant projects on the proposed</i>	<p>2010-2013 FIRB Rete Nazionale di Ricerca sulle Nanoscienze ItalNanoNet(RBRR055H2P) “ Synthesis and Functionalization of nanoparticles and surfaces and nanocatalysis – Development of nanostructured coatings on technological substrates”</p> <p>From 2016 Progetto Strategico di Istituto "Processi manifatturieri per la sostenibilità ambientale e l'efficienza energetica"- ISMN</p>

NATIONAL RESEARCH COUNCIL - CNR		N°24
Strategic AREA	<input type="checkbox"/> Biology, agriculture and food sciences <input checked="" type="checkbox"/> Green Chemistry <input checked="" type="checkbox"/> Environmental science <input type="checkbox"/> Renewable energy	
Title of the research activity	Foams and emulsions stabilized by nanoparticles	
CNR Institute(s)	Institute of Condensed Matter Chemistry and Technologies for Energy, ICMATE-CNR	
Scientific responsible Institute and address Phone, fax e-mail	Santini Eva ICMATE, via de Marini 6, 16149 Genova Phone: +390106475709, Fax: +390106475700 eva.santini@ge.icmate.cnr.it	
State of the art	The study of the formation and stability of dispersed systems, such as foams and emulsions, in the presence of complex surfactant systems (nanoparticles + surfactant) finds applications in several technological fields. Among them, the production of solid foams by the consolidation of the corresponding liquid foams. This topic has been already discussed together with researchers of the Faculty of Technology of Novi Sad (Dr. Jaroslav Katona and Dr. Nenad Mucic) in view of possible applications to national and international calls.	
Activity and targets	Preparation and study of the behavior of foams and emulsions: depending on the formulation and on the nature of the stabilizer components, it is possible to obtain materials for different applications, such as biocompatible foams for body-care or pharmaceutical application, porous materials for gas adsorption or catalysis.	
Key words (max 3)	Dispersed systems, nanoparticles, interfacial properties	
labs, instruments, equipments	The laboratory is equipped for the study of the interfacial surface tension and viscoelasticity of the fluid interfaces, for the preparation and study of the stability of foams and emulsions, for the preparation of solid foams. Instruments: Profile Analysis Tensiometer (PAT1), Langmuir- Blodgett Trough, Dynamic Light Scattering, Ultraturrax driller, Optical Microscope, Scanning Electron Microscopy.	
Selected publications (max 2)	- Zabiegaj D.; Santini E.; Ferrari M.; Liggieri L.; Ravera F., <i>Carbon based porous materials from particle stabilized wet foams</i> , Colloids and Surfaces A: 473 (2015) 24-31. - Santini E.; Guzman E.; Ferrari M.; Liggieri L., <i>Emulsions stabilized by the interaction of silica nanoparticles and palmitic acid at the water-hexane interface</i> , Colloids and Surfaces. A: 460 (2014) 333-341.	
Significant projects on the proposed research activity	ASI-PASTA - Particle Stabilized Emulsion and Foams ESA - SOFT MATTER DYNAMICS	

NATIONAL RESEARCH COUNCIL - CNR		N°25
Strategic AREA	<input type="checkbox"/> Biology, agriculture and food sciences <input type="checkbox"/> Green Chemistry <input checked="" type="checkbox"/> Environmental science <input type="checkbox"/> Renewable energy	
Title of the research activity	Pollutant adsorption and degradation by Bi-based inorganic nanostructures	
CNR Institute(s)	Institute of Condensed Matter Chemistry and Technologies for Energy, ICMATE-CNR	
Scientific responsible Institute and address Phone, fax e-mail	Dr. Gregorio Bottaro, Dr. Marzio Rancan Emails: gregorio.bottaro@cnr.it ; marzio.rancan@cnr.it ICMATE-CNR c/o Dept. Chemical Sciences University of Padova, Via Marzolo 1, 35131 Padova (Italy)	
State of the art	The interest toward multifunctional materials has continuously increased over the last few years. Materials capable of pollutant adsorption and degradation at the same time are highly desirable for environmental remediation. The development of strategies to rapidly remove contaminants from wastewaters and/or for their degradation is a fundamental target for environmental protection and remediation. Over the last few years, bismuthyl ion (BiO^+) based nanostructures have been studied to develop innovative adsorbent-photocatalytic systems owing to their peculiar physicochemical properties, layered structures, morphologies, and low toxicity. In particular, bismuth oxyhalogenides (BiOX , $\text{X} = \text{Cl, Br, I}$, and their mixtures) and bismuth subcarbonate, $(\text{BiO})_2\text{CO}_3$, nanostructures displayed encouraging performances. Besides the single oxychlorides or subcarbonate, the $\text{BiOCl/Bi}_2\text{O}_3$, BiOCl/BiOI , and $\text{BiOI/Bi}_{12}\text{O}_{17}\text{Cl}_2$ composite systems that display heterojunction structures can operate far better than the single components thanks to the presence of synergic effects at the interface between the two phases.	
Activity and targets	Activity: preparation of inorganic nanocomposites by soft solution methods and subsequent post-synthesis treatments (thermal and cold UV-light-assisted) to modulate their properties and hence the dye absorption-degradation capability. These functional properties are affected by several factors correlated to both bulk and surface characteristics of the materials. To fully characterize the materials, we employ powder X-ray diffraction, Raman spectroscopy, optical absorption spectroscopy, and X-ray photoelectron spectroscopy (XPS). Sample morphology is explored by scanning electron microscopy (SEM). The adsorption capacity (AC) and degradation activity of the $\text{Bi}_{12}\text{O}_{17}\text{Cl}_2/(\text{BiO})_2\text{CO}_3$ nanocomposite materials under visible light irradiation are tested toward cationic and anionic dyes. Targets: - development of synthesis routes to nanocomposites materials displaying heterojunction structures - correlation of composition, structure and heterojunction properties with the wastewater purification ability	
Key words (max 3)	Pollutant degradation, inorganic materials, photo-activation	
labs, instruments, equipments	- Fully equipped chemical lab to perform modern inorganic and coordination chemistry (fumehoods, drybox, dip-coater, spin-coater...) - Available characterization techniques: UV-Vis-NIR and FT-IR spectrometers Powder and single crystal diffractometers (PXRD and SCXRD) X-ray photoelectron spectrometer (XPS) Atomic Force Microscopy (AFM) Scanning Electron Microscope (SEM) Spectrofluorometer for UV-Vis steady state and lifetimes (variable temperature) Micro-Raman (variable temperature) with ultra low frequency capability (down to 5 cm^{-1})	

<i>Selected publications (max 2)</i>	<ul style="list-style-type: none"> - F. Mian, G. Bottaro, M. Rancan, L. Pezzato, V. Gombac, P. Fornasiero, L. Armelao $\text{Bi}_{12}\text{O}_{17}\text{Cl}_2/(\text{BiO})_2\text{CO}_3$ Nanocomposite Materials for Pollutant Adsorption and Degradation: Modulation of the Functional Properties by Composition Tailoring, ACS Omega, 2017, 2, 6298. - L. Armelao, G. Bottaro, C. Maccato and E. Tondello, Bismuth oxychloride nanoflakes: Interplay between composition-structure and optical properties, Dalton Trans., 2012, 41, 5480.
<i>Significant projects on the proposed research activity</i>	

NATIONAL RESEARCH COUNCIL - CNR		N°28
Strategic AREA	<input type="checkbox"/> Biology, agriculture and food sciences <input type="checkbox"/> Green Chemistry <input checked="" type="checkbox"/> Environmental science <input type="checkbox"/> Renewable energy	
Title of the research activity	AMPHIPHOBIC COATINGS FOR MATERIALS PROTECTION	
CNR Institute(s)	Institute of Condensed Matter Chemistry and Energy Technologies, ICMATE-CNR	
Scientific responsible Institute and address Phone, fax e-mail	MICHELE FERRARI ICMATE VIA DE MARINI, 6 GENOVA Ph.:+390106475723 fax: +390106475700 michele.ferrari@ge.icmate.cnr.it	
State of the art	TRL 4 – 5 (ON FIELD TESTS)	
Activity and targets	DEVELOPMENT OF HIGHLY WATER AND OLEO REPELLENT COATINGS FOR 4. ANTIFOULING, ANTICORROSION IN MARINE ENVIRONMENT 5. SELF CLEANING APPLICATION IN SOLAR PANELS 6. PROTECTION IN CULTURAL HERITAGE (IN COLLABORATION WITH UNIGE ASSOCIATED TO ICMATE)	
Key words (max 3)	SUPERHYDROPHOBIC, FOULING, CORROSION	
labs, instruments, equipments	SURFACE SCIENCE LAB, DROP SHAPE TENSIOLOGIES, AFM, 3D CONFOCAL INTERFEROMETRIC PROFILOMETER, SEM, BAM-ELLIPSOMETRY, HIGH SPEED CAMERA	
Selected publications (max 2)	Cirisano F., Benedetti A., Liggieri L., Ravera F., Santini E., Ferrari M. Amphiphobic coatings for antifouling in marine environment Colloids and Surfaces A: Physicochemical and Engineering Aspects 158-164 505 2016/ Benedetti A., Cirisano F., Delucchi M., Faimali M., Ferrari M. Potentiodynamic study of Al-Mg alloy with superhydrophobic coating in photobiologically active/not active natural seawater Colloids and Surfaces B: Biointerfaces 167-175 137 2016/1/1	
Significant projects on the proposed research activity	<ul style="list-style-type: none"> RITMARE CNR FLAGSHIP PROJECT FONDAZIONE SAN PAOLO 	

NATIONAL RESEARCH COUNCIL - CNR		N°29
Strategic AREA	<input type="checkbox"/> Biology, agriculture and food sciences <input checked="" type="checkbox"/> Green Chemistry <input checked="" type="checkbox"/> Environmental science <input type="checkbox"/> Renewable energy	
Title of the research activity	Synthesis and characterization of innovative TiO₂-based photocatalysts for water decontamination	
CNR Institute(s)	Institute of Condensed Matter Chemistry and Technologies for Energy, ICMATE-CNR	
Scientific responsible Institute and address Phone, fax e-mail	Dr.ssa Rosalba Gerbasi, ICMATE-CNR, Corso stati Uniti 4, 35127 Padova, 0498295948, rosalba.gerbasi@cnr.it	
State of the art	<p>Titanium dioxide (titania, TiO₂) is the most widely investigated material for heterogeneous photocatalysis. Irradiation of TiO₂ with UV light (< 380-390 nm) causes the transition of electrons from the valence to the conduction band. This mechanism generates electron-hole pairs which lead to a sequence of redox reactions responsible for the degradation of organic contaminants.</p> <p>Titania has been actively investigated due to practical interests as catalysts in air and water remediation, self-cleaning of surfaces, and light-assisted production of hydrogen. The most widely used catalysts is Degussa P25 TiO₂ powder utilized in the dispersed state in wastewaters. However, the sub-micrometric size of the particles makes the photocatalyst difficult to be recovered at the end of the treatment. Such disadvantage represents a substantial limitation for the scale-up of the process. "Shadowing effect" is another drawback as the TiO₂ suspension, causing an attenuation of the irradiation intensity. Efforts have been made to overcome these drawbacks, by immobilizing the semiconductor onto substrates, such as glass beads, glass fibers, silica, stainless steel, textiles. However, the immobilization of the photocatalyst inevitably leads to a loss of photocatalytic efficiency because its active surface is reduced once deposited onto a surface. Therefore, the design and implementation of novel TiO₂-based photocatalysts deposited onto suitable substrates to obtain materials exploitable for environmental applications, is a challenging task. The aim of producing visible-light activated TiO₂-based photocatalysts will be also pursued in order to enhance the exploitation of solar and artificial lights.</p>	
Activity and targets	<p>Metal-Organic Chemical Vapor Deposition (MOCVD) will be exploited for the direct synthesis of TiO₂ catalyst onto a substrate. MOCVD is widely used to prepare thin films with high quality, high uniformity and controlled properties; it offers many benefits such as high deposition rates, inherent flexibility, excellent conformal step coverage and adaptability to large scale processing also on complex substrates.</p> <p>The TiO₂-based photocatalysts will also be synthesized by soft wet procedures in order to prepare sub-micrometric active powders to be finally supported on suitable substrates.</p> <p>The aim of the proposed research is the fabrication of innovative catalysts, whose properties will be tailored to optimize their efficiency. The new catalysts will be tested for water treatment and application to the removal of model contaminants from waters.</p>	
Key words (max 3)	Photocatalysis, TiO ₂ , environmental decontamination	
labs, instruments, equipments	MOCVD reactors, Spray Pyrolysis, XRD, UV-Vis spectroscopy, SEM, profilometer, Contact angle	
Selected publications (max 2)	A. Galenda, F. Visentin, R. Gerbasi, S. Battiston, N. El Habra, <i>Effective and low-cost synthesis of Sulphur modified-TiO₂ nanopowder with improved photocatalytic</i>	

	<p><i>performances in water treatment applications</i>, Water Air Soil Pollut., 2017, 228:416</p> <p>S. Murgolo, V. Yargeau, R. Gerbasi, F. Visentin, N. El Habra, G. Ricco, I. Lacchetti, M. Carere, M. L. Curri, G. Mascolo, ‘<i>A new supported TiO₂ film deposited on stainless steel for the photocatalytic degradation of contaminants of emerging concern</i>’, Chemical Engineering Journal, 318 (2017) 103–111</p>
<p><i>Significant projects on the proposed research activity</i></p>	<p>SolarPharma - “Degradation of pharmaceuticals in water by solar-based photocatalytic processes employing supported catalyst” - EU-DG RTD’s project: “The European Solar Research Infrastructure for Concentrated Solar power. Second Phase – SFERA –II” (nr. 312643 between CIEMAT-PSA and the European Commission).</p> <p>-EcoShopping - “Energy efficient & Cost competitive retrofitting solutions for Shopping buildings” - EU-FP7 grant agreement n° 609180, call FP7-2013-NMP-ENV-EeB</p>

NATIONAL RESEARCH COUNCIL - CNR		N°30
Strategic AREA	<input type="checkbox"/> Biology, agriculture and food sciences <input checked="" type="checkbox"/> Green Chemistry <input checked="" type="checkbox"/> Environmental science <input checked="" type="checkbox"/> Renewable energy	
Title of the research activity	Multi-functional nanomaterials for safety, environmental remediation and sustainable energy production	
CNR Institute(s)	Institute of Condensed Matter Chemistry and Energy Technologies, ICMATE-CNR	
Scientific responsible Institute and address Phone, fax e-mail	Davide Barreca Senior Research Scientist - Contract Professor European Editor - Journal of Nanoscience and Nanotechnology (http://www.aspbs.com/jnn) European Editor - Nanoscience and Nanotechnology Letters (http://www.aspbs.com/nnl) Associate Editor - Surface Science Spectra (http://avs.scitation.org/sss/) ICMATE-CNR c/o Department of Chemistry, Padova University Via Marzolo 1, I-35131 Padova, ITALY Phone: +39-049-8275170, Fax: +39-049-8275161 Email: davide.barreca@unipd.it ; davide.barreca@cnr.it http://www.chimica.unipd.it/multi-functional-material-group/ https://orcid.org/0000-0002-8779-3386	
State of the art	<p>The real-time gas-phase detection of toxic/flammable chemicals (such as CO, H₂, CH₄, NO₂, O₃,...) is an open challenge of utmost importance for environmental and health protection, as well as for public security. In this regard, continuous efforts are devoted to the development of low-cost, miniaturized sensors with enhanced service life and optimal selectivity and stability. Nevertheless, the development of systems simultaneously endowed with all these features is still far from being completely fulfilled, and represents the main bottleneck in order to meet the actual technological requirements.</p> <p>In addition, the development of renewable energy sources has become an increasingly urgent task due to the depletion of fossil fuels and the serious environmental problems related to their combustion. Among the possible alternatives, hydrogen has attracted a remarkable interest as one of the most promising energy carriers. Nevertheless, the transition to the so-called hydrogen economy as a network of primary energy sources is still hindered by significant technological challenges related to the sustainable H₂ preparation. In this regard, sunlight-driven H₂ generation driven by suitable semiconductors is a clean and sustainable approach for a viable utilization of solar energy, a largely available and intrinsically renewable energy resource, in the production of a carbon-free energy carrier. As a matter of fact, photoactivated methods, including photoelectrochemical water splitting as well as photoreforming processes, are amenable and strategic alternatives for a small and medium-size scale H₂ generation, paving the way to a new world energy economy.</p> <p>Besides energy supply problems, the huge population and fast economic development of emerging countries have introduced issues of pollution and waste disposal. In particular, the growing concern about environmental issues in the global world have significantly boosted the attention towards "green" and renewable techniques. In this regard, considerable efforts have been devoted to semiconductor photocatalysis for the decomposition of hazardous pollutants and highly poisonous contaminants even at ppm levels, with high potential harm to wildlife and human health.</p>	
Activity and targets	It is generally recognized that the performances of solid state gas sensors are directly dependent on the structure and spatial organization of the active material. As a consequence, nanostructured thin films, and, more recently, nanocomposites	

	<p>and 1D systems such as nanowires and nanobelts, have attracted the attention of several investigators. In this context, over the last decade my group group has devoted various efforts to the fabrication of the active elements for conductometric sensors based on CeO_2, ZnO, ZnO-TiO_2, Cu_xO ($x = 1,2$), CuO-TiO_2, Fe_2O_3, Co_3O_4, ZnO-X ($X = \text{Ag, CuO}$). Particular attention is dedicated to modulations of the chemical composition (doping, composite formation) and functionalization with metal particles (Pt, Ag, Au) to achieve improved sensing responses and lower detection limits. The active materials are deposited directly onto the substrates used for functional applications and subjected to a thorough chemico-physical characterization, with the aim of unraveling the interrelation between chemico-physical properties and sensing performances and improve thus the system behavior.</p> <p>As regards sustainable energy production, over the last ten years my group has been exploring the use of supported oxide-based nanomaterials, which enable an easy catalyst recovery and exhibit unique advantages due to their peculiar nano-organization for hydrogen production by both direct photocatalysis and photoelectrochemical water splitting. Very attractive/unprecedented performances have been obtained in the development of tailored nanomaterials based on Cu_xO ($x = 1,2$), Co_3O_4, ZnO-X ($X = \text{Ag, CuO}$), pure and doped Fe_2O_3, even in the form of nanocomposites, like $\text{Fe}_2\text{O}_3\text{-TiO}_2$. Milestones of the present results are the possibilities to use starting oxygenate compounds sustainably produced from largely available biomasses, thus reducing the ecological footprint, as well as the utilization of sea water and solar light, to trigger hydrogen production by photoelectrochemical processes.</p> <p>With regard to environmental remediation, my group has a long experience in the fabrication of supported oxide-based nanostructures as highly active photocatalysts based on TiO_2, Ag- and Au-TiO_2, ZnO, Fe_2O_3, $\text{Fe}_2\text{O}_3\text{-WO}_3$ nanomaterials in different forms. The target systems are designed, fabricated and characterized in detail with particular regard to their structure, chemical composition, morphology. The synthetic protocols are optimized to control the material spatial organization of the target oxide materials and their characteristics in terms of surface area, chemical reactivity and long-term stability. After the achievement of such goals, attention is dedicated to functional tests in the removal of solid, liquid and gaseous phase pollutants, activated by UV, Vis and simulated solar light. The ultimate aim of the present research activities is the development of supported photocatalysts for real-world applications in wastewater treatment, air quality control and self-cleaning systems for a variety of end-uses, from windows to portable devices.</p>
Key words (max 3)	Nanomaterials; oxides; vapor phase synthesis
labs, instruments, equipments	<p><u>Material synthesis</u> Multifunctional reactors for Thermal-CVD, PE-CVD and sputtering experiments, operating under high-vacuum conditions and equipped with an in-situ laser reflection interferometer and an FT-IR spectrometer for the real-time monitoring of the deposition process both on the solid substrate and in the gas phase</p> <p><u>Material characterization</u></p> <ul style="list-style-type: none"> • Bruker D8 Advance diffractometer for GIXRD and XRD analyses. • Multi-technique PHI 5600 ci XPS-Auger spectrometer with standard Al and Mg X-ray sources, for surface and in-depth XPS and Auger compositional analyses. • AFM NT-MDT microscope operating in air for morphological analyses. • FE-SEM Zeiss Supra 40 VP microscope, equipped with an Oxford INCA x-sight X-ray detector for EDXS measurements. • Cary 5E spectrophotometer for UV-Vis-NIR measurements in transmittance mode, as well as diffuse and specular reflectance mode

	<ul style="list-style-type: none"> Nexus 870 and VIR 9500 Jasco FT-IR instruments for IR measurements in transmittance and reflectance mode.
<i>Selected publications (max 2)</i>	<p>D. Barreca, G. Carraro, E. Comini, A. Gasparotto, C. Maccato, C. Sada, G. Sberveglieri, E. Tondello “Novel synthesis and gas sensing performances of CuO-TiO₂ nanocomposites functionalized with Au nanoparticles” <i>Journal of Physical Chemistry C</i>, 2011, 115, 10510</p> <p>G. Carraro, C. Maccato, A. Gasparotto, T. Montini, S. Turner, O.I. Lebedev, V. Gombac, G. Adami, G. Van Tendeloo, D. Barreca, P. Fornasiero “Enhanced hydrogen production by photoreforming of renewable oxygenates through nanostructured Fe₂O₃ polymorphs” <i>Advanced Functional Materials</i>, 2014, 24, 372</p>
<i>Significant projects on the proposed research activity</i>	<p>P-DiSC – Padova University “Multi-component oxide nanoSystEms as chemical seNsorS for potentiAl securiT y warnIng and enviroNmentAL threats”, numero contratto: #SENSATIONAL BIRD2016-UNIPD</p> <p>Water Oxidation Nanocatalysts for Sustainable Solar Hydrogen Production through Visible-Light Activity” (SOLAROGENIX) - Call Identifier: NMP.2012.1.1-1 - Funding Scheme: Collaborative Project; NMP4-SL-2012-310333</p>

NATIONAL RESEARCH COUNCIL - CNR		N°34
Strategic AREA	<input type="checkbox"/> Biology, agriculture and food sciences <input checked="" type="checkbox"/> Green Chemistry <input type="checkbox"/> Environmental science <input type="checkbox"/> Renewable energy	
Title of the research activity	Discovery and synthetic application of novel biocatalysts	
CNR Institute(s)	Istituto di Chimica del Riconoscimento Molecolare, ICRM-CNR	
Scientific responsible Institute and address Phone, fax e-mail	Dr. Daniela Monti ICRM, Via Mario Bianco 9, 20131 Milano, Italy Phone 0039 0228500025, Fax 0039 0228901239 e-mail: daniela.monti@icrm.cnr.it	
State of the art	Biocatalysis, i.e., the application of enzymes and whole microbial cells in synthetic chemistry, contributes to the development of eco-friendly and sustainable production processes in various areas, from the production of bulk chemicals to highly selective synthesis of fine chemicals and pharmaceutical products. The bottleneck in the application of biocatalysis is often the availability of suitable enzymes with improved or synthetically useful properties.	
Activity and targets	Novel biocatalysts can be discovered by applying different strategies, such as (meta)genome mining in natural biodiversity and design of selectively modified variants on the basis of available structure/activity information. The novel biocatalysts are produced in recombinant form and used for the development of efficient biocatalyzed processes, e.g., through the use of free and immobilized enzymes, and the application of multienzymatic and chemo-enzymatic cascade systems.	
Key words (max 3)	Biocatalysis; Industrial Biotechnology; Enzyme Discovery	
labs, instruments, equipments	General instrumentation for microbiology, biochemistry and molecular biology (sterile cabin, autoclave, fermenters, orbital shakers, spectrophotometer, electrophoresis apparatus, Gel Doc Imaging System, thermocyclers, microtiter plate reader, homogenizer, Nanodrop spectrophotometer, etc.). Analytical equipment for enzymes and products characterization: NMR and MS spectrometry, polarimeter, CD, FTIR, HPLC, GC, GC-MS.	
Selected publications (max 2)	<ul style="list-style-type: none"> Ferrandi, E.E. et al., "Novel thermostable amine transferases from hot spring metagenomes", <i>Appl. Microbiol. Biotechnol.</i>, 101, 4963-4979 (2017). Ferrandi, E.E. et al., "Discovery and characterization of thermophilic limonene-1,2-epoxide hydrolases from hot spring metagenomic libraries" <i>FEBS Journal</i>, 282, 2879-2894 (2015). 	
Significant projects on the proposed research activity	"Bioflow" Project (2017-2019, Cariplo Foundation, Italy); ERA CoBioTech "Hotsolute" Project (2018-2020, EU Horizon2020, GA no. 722361); "Hotzyme" Project (EU FP7, GA no. 265933); "Suschem Lombardia" Project (Regione Lombardia - CNR, Italy); "INBOX" Project (Cariplo Foundation, Italy).	