

GIORNATE DI DIPARTIMENTO CNR | DSCTM 2023

Molecular sciences, chemical
technologies and materials for
the global challenges

Chimica Verde

Energie Rinnovabili

Salute

Materiali

Modelling

Beni Culturali

CNR

Dipartimento Scienze Chimiche
e Tecnologie dei Materiali

18 - 20 OTTOBRE
Sestri Levante (GE)



Consiglio Nazionale delle Ricerche
Dipartimento Scienze Chimiche e Tecnologie dei Materiali

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Atti della Conferenza del Dipartimento Scienze Chimiche e Tecnologie dei Materiali
Sestri Levante 18-19-20 ottobre 2023
a cura di Francesco Verginelli, Giuliana Quaglia e Federica Criscuoli

Organizzazione Giornate di Dipartimento 2023 18 - 20 ottobre, Sestri Levante (GE)

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PROGRAMMA

18 ottobre 2023

14:00 Saluti di apertura
Maria Chiara Carrozza, Presidente CNR
Lidia Armelao, Direttore DSCTM

Chairperson: **LUIGIA CRISTINO (ICB)**

14:30 **Francesco Damin (SCITEC)**
Analytical Microsystems for Infectious Diseases: Diagnosis and Monitoring

14:45 **Marianna Carbone (ICB)**
The Importance of Natural Products Chemistry to Recognize and Capture Biodiversity Value: the Contribution of ICB to the National Biodiversity Future Center (NBFC)

15:00 **Andrea Sorrentino (IPCB)**
Printing the Future of Orthopedics: Exploring the Boundless Horizons of Functional Materials and 3D Technologies

15:15 **Giuseppina Rea (IC)**
Space Research and Technologies Addressing Quality of Life on Earth

Chairperson: **FRANCESCA RAVERA (ICMATE)**

15:30 **Francesco Galeotti (SCITEC)**
Functional Surfaces by Nano- and Microscale Fabrication of Soft Materials

15:45 **Ilaria Bergenti (ISMN)**
Spin-tunable Interfaces for High Speed and Low Consumption Electronic Devices

16:00 **Lorenzo Poggini (ICCOM)**
Titanium(III) Mixed-Sandwich Qubits on Surface

16:15 **Leonarda Liotta (ISMN) e Alessandro Mordini (ICCOM)**
Incontro con i componenti eletti del Consiglio Scientifico DSCTM

16:30 **Coffee Break & Poster Session**

Chairperson: SERGIO RIVA (SCITEC)

- 17:15** **Alessandro Benedetti** (ICMATE)
MARECO, the Polythematic Marine Laboratory of Bonassola:
Reconstruction and Perspectives
- 17:30** **Roberto Dragone** (ISMN)
AI Based Satellite and Ground Sensor ANALYSIS for Surface
Waters Protection: The ECONET Project
- 17:45** **Catia Algieri** (ISMN)
Photocatalytic Membrane Reactors: a Possible Route for
Environmental Remediation
- 18:00** **Daniela Caschera** (ISMN)
Waste-derived Cellulose and Nanomaterials: a Smart
Combination for Nanotechnology Application
- 18:15** **Manuela Melucci** (ISOF)
Advanced 2D Materials and Technologies for Environmental Applications

Chairperson: GIUSEPPINA REA (IC)

- 18:30** **Giuseppe Di Natale** (IC)
Study of Peptides Containing the KLVFF Sequence: a Potential
Route for Understanding β Amyloid Aggregation
- 18:45** **Andrea Caporale** (IC)
SAR Study of the Human Host-Defence Peptide LL-37
- 19:00** **Luigia Cristino** (ICB)
Integrative Approaches by Multiscale Imaging, Biochemical and
Functional Screening to Study Neuroactive Molecules
- 19:15** **Elena Michelucci** (ICCOM)
Proteomics Analyses and Integrative Omics Approach to Highlight
the Common Molecular Signatures for Dierent NCL Forms
- 19:30** **Greta Varchi** (ISOF)
Porphyrin-based Supramolecular Nanocomposites: Properties
and Opportunities
- 20:30** **Dinner**

19 ottobre 2023**Chairperson: ALESSANDRO MORDINI (ICCOM)**

- 08:20** **Vladimiro Dal Santo** (SCITEC)
Materials and Processes for the Sustainable Hydrogen Production
- 08:35** **Donatella Spadaro** (IPCF)
Next-Generation Photovoltaics: Unveiling the Synergy Between Solar Energy, Nanomaterials, Green Chemistry and Technology
- 08:50** **Barbara Ventura** (ISOF)
Photoactive Arrays Based on Porphyrins and Acridinium Units
- 09:05** **Simone Casadio** (ISSMC)
Piezophototronic Materials for Solar Conversion
- 09:20** **Federica Aiello** (IPCF)
Functional Surfaces by Nano- and Microscale Fabrication of Soft Materials

Chairperson: VINCENZO BUSCAGLIA (ICMATE)

- 09:35** **Angela Altomare** (IC)
Developing Advanced Methodology and Computing to Challenge the Structure Characterization of Microcrystalline Materials
- 09:50** **Giacomo Prampolini** (ICCOM)
Integrated Computational Protocols for Materials Science
- 10:05** **Edoardo Mosconi** (SCITEC)
Computational Modeling of Perovskites for Photovoltaics and Photocatalysis
- 10:20** **Coffee Break & Poster Session**

Chairperson: LEONARDA LIOTTA (ISMN)

- 11:05** **Andrea Candini** (ISOF)
Exploiting Fluorescent Nanodiamonds for Imaging and Multimodal Sensing in Biological Systems
- 11:20** **Marzio Rancan** (ICMATE)
Multifunctional Luminescent Lanthanoids Systems for Sensing

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- and Energy Conversion
- 11:35** **Andrea Cintio** (IPCF)
High-temperature Dielectric Characterization for Microwave-assisted Processes
- 11:50** **Mario Prosa** (ISMN)
Smart Integration of Organic Optoelectronic and Photonic Components for a New Class of Miniaturized Biosensors

Chairperson: **GABRIELLA DI CARLO** (ISMN)

- 12:05** **Sabrina Gualtieri** (ISSMC)
Interdisciplinary Methods for the Study and Enhancement of Cultural Heritage Materials
- 12:20** **Brenda Doherty** (SCITEC)
Prediction and Prevention of Irreversible Colour Changes of Dyes and Pigments in Artworks
- 12:35** **Natalia Rovella** (ITM)
Engineered Membranes for Sustainable Preservation and Restoration of Cultural Heritage
- 12:50** **Armida Torreggiani** (ISOF)
Le iniziative di divulgazione scientifica nel DSCTM
- 13:05** Foto di gruppo
- 13:15** Lunch

Chairperson: **MASSIMO TROTTA** (IPCF)

- 14:30** **Fabrizio Cavani** (Invited, Università di Bologna)
Perspectives in the Valorisation of Biomass to Chemicals and Fuels
- 15:10** **Elisabetta Alberico** (ICB)
Methyl Formate as a Liquid Organic Hydrogen Carrier
- 15:25** **Fabio Bazzarelli** (ITM)
Formulation of Bioderived Lipid Particles by Membrane Processes
- 15:40** **Nicola D'Antona** (ICB)
Cascade Biocatalysis Strategies... and Green Approaches in Samothrace Project
- 15:55** **Lucia Conzatti** (SCITEC)
Macrocyclic Oligomers of Condensation Polymers: from Eco-composites to Chemical Recycling

Chairperson: PAOLA STAGNARO (SCITEC)

- 16:10** **Aldobenedetto Zotti** (IPCB)
From Chemistry to Engineering: Development and Characterization of Hierarchical Composites for Structural Applications
- 16:25** **Maria Rosaria Plutino** (ISMN)
Functional Hybrid Nanomaterials as Crucial Tools for Sustainable Highly Efficient Products and Smart Technologies
- 16:40** **Filippo Valorosi** (ISOF)
Graphene-based Heaters for Aeronautical Applications
- 16:55** **Giuseppe Recca** (IPCB)
New Approaches for the Manufacturing of Hollow Composite Parts Using Wax-based Blends Loaded with Ferromagnetic Metal Particles
- 17:10** **Coffee Break & Poster Session**

Chairperson: DOMENICO GAROZZO (IPCB)

- 17:55** **Loredana De Bartolo** (ITM)
Multifunctional Membranes: New Insights into Regenerative Medicine
- 18:10** **Mariangela Di Donato** (ICCOM)
Design of a New Class of Light Activated Photoswitches for Applications in Photopharmacology
- 18:25** **Giancarlo Tria** (IC)
Potentiating the Italian Capacity for Structural Biology Services in Instruct-ERIC
- 18:40** **Giunta DSCTM**
- 20:30** **Social Dinner**

20 ottobre 2023

Chairperson: ALESSANDRO MORDINI (ICCOM)

- 08:30** **Manuela Bevilacqua (ICCOM)**
The Role of Electrochemistry and Electrocatalysis in a Sustainable Future Perspective: Representative Case Studies
- 08:45** **Riccardo Donnini (ICMATE)**
Assessment of Mechanical and Microstructural Properties of Structural Alloys in Fusion Energy Design for the Eurofusion Framework
- 09:00** **Chiara Aliotta (ISMN)**
Doping Strategies on Perovskite Oxides-Based Materials for Clean Energy and Energy Vectors

Chairperson: LOREDANA DE BARTOLO (ITM)

- 09:15** **Monica Montesi (ISSMC)**
3D Scaffold-based Cellular Model Mimicking the Heterogeneity of Osteosarcoma Microenvironment, a New Platform for Preclinical Study
- 09:30** **Alessia Famengo (ICMATE)**
Hybrids cellulose/TiO₂ Substrates for Biomedical Applications
- 09:45** **Francesca Della Sala (IPCB)**
Natural Polymers Based Substrates for Pulmonary Tissue Regeneration
- 10:00** **Lorenzo Degli Esposti (ISSMC)**
Calcium Phosphate Nanoparticles Loaded with Therapeutic Biomolecules for Treatment of Cardiovascular Diseases and Bacterial Infections
- 10:15** **Fausta Ulgheri (ICB)**
PNRR PE13 INFACIT: Development of Immunomodulatory and Antiviral Lead Compounds
- 10:30** **Coffee Break**

Chairperson: MICHELE DONDI (ISSMC)

- 11:00** **Mario Marchionna** (INVITED, SAIPEM)
Solutions for the Decarbonization of Hard To Abate Industries: a Zero-Carbon Puzzle?
- 11:40** **Frederic Monteverde** (ISSMC)
Entropy as Thermodynamic Boost to Stabilize Compositionally Complex Ceramics: a Diamond in a Rough
- 11:55** **Francesca Villa** (ICMATE)
Thermomechanical and Elastocaloric Properties of NiMn-based Shape Memory Alloys for Solid-state Cooling Applications
- 12:10** **Marinella Striccoli** (IPCF)
Carbon Dots: New Uorescent Nanoparticles for Advanced Optical Applications
- 12:25** **Francesco Galiano** (ITM)
A New Coating Technology for the Preparation of Anti-fouling Membranes

Chairperson: NORBERTO LIBORIO MICALI (IPCF)

- 12:40** **Massimo Trotta** (IPCF)
From Sustainability To Circularity. The Mighty Power of Photosynthesis
- 12:55** **Pietro Russo** (IPCB)
Green Composites for Automotive Applications: Opportunities, Challenges and Perspectives
- 13:10** **Gianluca Di Profio** (ITM)
Advanced Membrane Operations for the Downstream Processing of Therapeutic Biomolecules
- 13:25** **Conclusioni Direttore DSCTM**
- 13:40** Lunch

ABSTRACT

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Photosensitising Materials based on Cyclodextrin and Porphyrins with Antimicrobial Photodynamic Action

Roberto Zagami,^{1,2} Domenico Franco,² Nina Burduja,^{1,2} Giuseppe Nocito,¹ Mariachiara Trapani¹ and Antonino Mazzaglia¹

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¹ ISMN

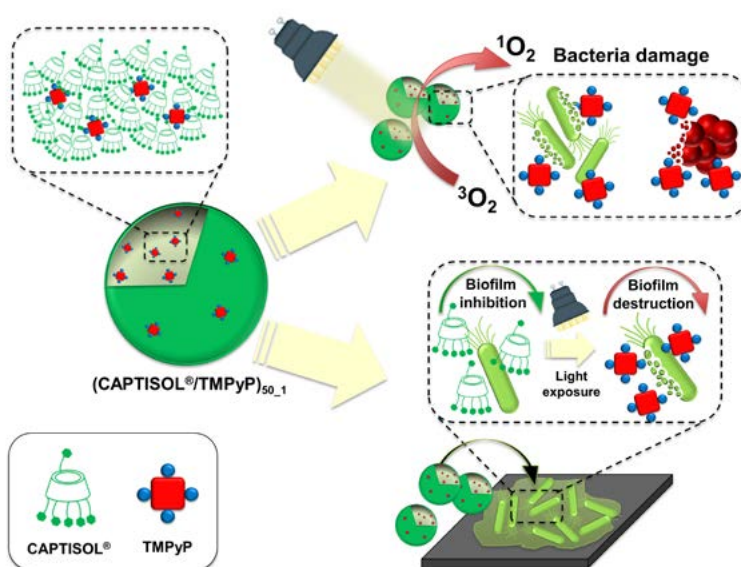
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Developing new broad-spectrum antimicrobial strategies, as alternatives to antibiotics and being able to efficiently inactivate pathogens without inducing resistance, is one of the main objectives in public health. Antimicrobial photodynamic therapy (aPDT), based on the light-induced production of reactive oxygen species from photosensitizers (PS), is attracting growing interest in the context of infection treatment, also including biofilm destruction. Photosensitizer nanosystems, so-called nanophotosensitisers (nanoPS), are currently developed to address the drawbacks due the limitation of single photoactive molecules such as the lack of solubility and stability in the biological media, biocompatibility, bioavailability, selectivity in the target tissue and stimuli-responsiveness upon triggers for controlled release of the photosensitizer. Here we will discuss different nanoPS releasing systems studied in our research labs based on the cationic porphyrin (N-methyl- 4-pyridyl)-21H,23H-porphyrin (TMPyP) assembled with two different cyclodextrins (CDs), namely the trade sulfobutylether-beta-cyclodextrin (CAPTISOL®) [1,2] and CD nanosponge (βNS) [3]. Nanoassemblies were prepared in ultrapure water by mixing PS and CDs, by exploiting their mutual electrostatic interaction, and characterized by various spectroscopic techniques such as UV/Vis, Steady-State and Time Resolved Fluorescence, Dynamic Light Scattering and ζ-potential. NanoPSs produced appreciable amount of single oxygen similar to free porphyrin and a prolonged stability after 6 days of incubations in physiological conditions and following photoirradiation. Antimicrobial photodynamic action of TMPyP/ βNS against fatal hospital-acquired infections such as *P. aeruginosa* and *S. aureus* was investigated by pointing out the ability of cationic porphyrin loaded-CD nanosponges to photo-kill bacterial cells at prolonged time of incubation and following irradiation. Moreover, nanoPS based on CAPTISOL® and TMPyP with photodynamic features exhibited photo-antimicrobial activity against Gram-negative and Gram-positive bacteria (Figure 1). Results from *P. aeruginosa* reveal that CAPTISOL® alone inhibits pyocyanin (PYO) production, also affecting bacterial biofilm formation. Finally, we obtained a synergistic effect of inhibition and destruction of *P. aeruginosa* biofilm by using the combination of CAPTISOL® and TMPyP

Keywords: Nanophotosensitisers, Cyclodextrins, Antimicrobial Photodynamic Therapy

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