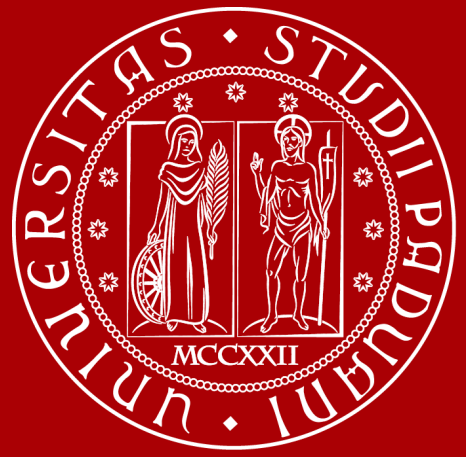


UNIVERSITÀ
DEGLI STUDI
DI PADOVA

UNIPD and UNIVE for NEST - Spoke 9

Innovative materials for solar energy conversion and storage

UNIPD and UNIVE for NEST, spoke 9

WP 9.0: Coordination

WP 9.1: Innovative synthesis of materials for energy applications

- T9.1.1. Strategies to boost the catalytic efficiency of materials
- T9.1.2. Engineering of materials with improved chemico-physical properties
- T9.1.3. Self-assembly of supramolecular and hybrid nanostructured systems
- T9.1.4. Materials operating under non-standard, severe and extreme conditions
- T9.1.5. Multifunctional, composite and low-dimensional materials

WP 9.2: Efficient preparation of sustainable materials

- T9.2.1. Green preparation protocols and materials
- T9.2.2 Design strategies for recyclable materials
- T9.2.3 LCA and new regulations for the development and use of advanced materials in a circular economy approach

WP 9.3: New production processes of materials for energy applications

- T9.3.1 Innovative manufacturing, nanofabrication and consolidation processes
- T9.3.2. Surface functionalization, interface processing, arrays
- T9.3.3 Processing methods to extend materials lifetime

WP 9.4: Materials characterization and testing

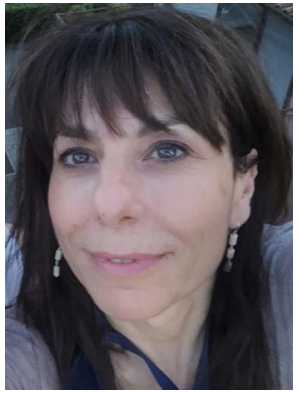
- T9.4.1: Advanced structural and morphological characterization techniques
- T9.4.2: Optical, electrochemical, electronic properties
- T9.4.3: Magnetic, thermal and transport properties
- T9.4.4: In situ, operando characterization and testing of materials

WP 9.5: Advanced computational modelling for materials development

- T9.5.1 Computational methods and modeling to predict materials structure and properties
- T9.5.2 Advanced computational approaches for improving materials efficiency and performance

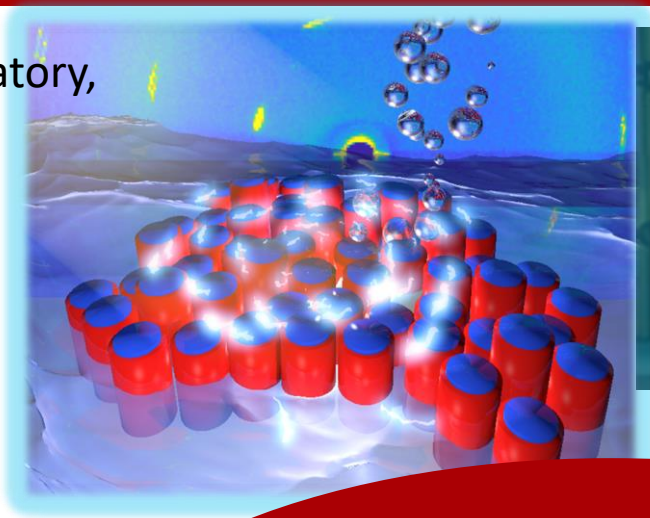
WP 9.6 Dissemination and Communications

UNIPD for NEST, spoke 9



Marcella Bonchio, Nano & Molecular Catalysis Laboratory,
marcella.bonchio@unipd.it
Dept of Chemical Sciences, University of Padova

Daniele Rosa-Gastaldo (RTDa_NEST)
Leonardo Cognigni (PhD)
Ilaria Crea (PhD)
Jintao Liu (PhD)



- photo(electro) catalysis mechanisms @interfaces
- supramolecular catalysis for artificial photosynthesis
- Organic semiconductors and fabrication of photonic electrodes

- **Synthesis:** Organic and Inorganic reaction protocols for molecular building blocks and materials doping
- **Characterization:** NMR, MS and optical spectroscopies (FTIR, Raman, Uv-Vis, Fluorescence) for probing the molecular structure and product analysis
- **Properties:** PEC efficiency and selectivity for solar fuel production

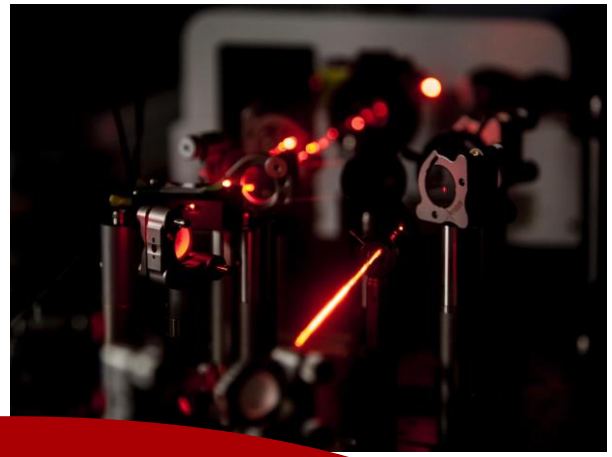
- 9.1 Innovative synthesis of materials for energy applications
- 9.3 New production processes of materials for energy applications

1. Nature Chemistry (2019), 11, 146 https://doi.org/10.1038/s41557-018-0172-y
2. Nature Commun. (2020) 11, 41. https://doi.org/10.1038/s41467-019-13759-1
3. J. Am.Chem.Soc. (2022) 144,14021. https://doi.org/10.1021/jacs.2c05857
4. Nature Catalysis (2023) 6, 657–665 https://doi.org/10.1038/s41929-023-00992-7

UNIPD for NEST, spoke 9

Multidimensional and Ultrafast Optical Spectroscopy Group

Elisabetta Collini
elisabetta.collini@unipd.it



- Time-resolved techniques (from fs to ms timescale)
- Femtoseconds dynamics;
- Multidimensional coherent spectroscopies;
- photophysical and dynamical characterization of light-harvesting and energy transport processes;
- optical properties of functional nanomaterials;
- mechanisms of photo-activated chemical reactions

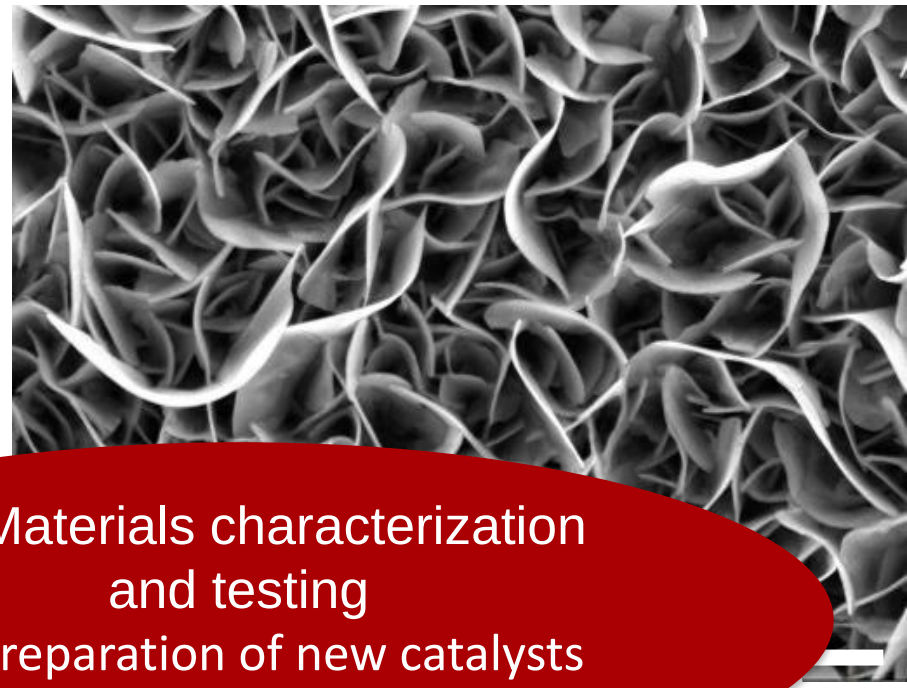
9.4 Materials characterization and testing

1. Adv Energy Mater (2022) 2103556
https://doi.org/10.1002/aenm.202103556
2. J Phys Chem C 125 (2021) 13096
https://doi.org/10.1021/acs.jpcc.1c02693
3. J Phys Chem Lett 12 (2021) 3983
https://doi.org/10.1021/acs.jpclett.1c00822

UNIPD for NEST, spoke 9

Chiara Maurizio
chiara.maurizio@unipd.it

Yashashree Vernekar (PhD_NEST)
Boris Kalinic RTDa
Alessandro Patelli PA
Paola Ragonese PhD
Bibiana M. Fernandez Perez RTDa



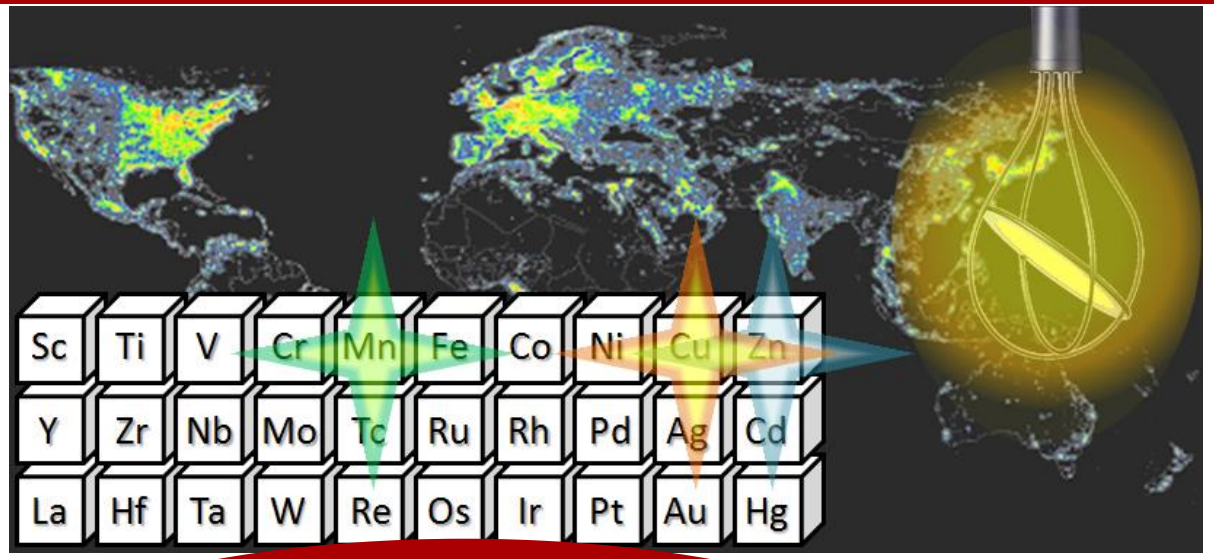
- Nanostructured films for light-driven OER and HER
- Charge transfer@interfaces
- Multi-approach characterization
- Synchrotron radiation-based techniques
- **Synthesis:** PVD, evaporation, patterning, atmospheric pressure plasma
- **Characterization:** SEM-related, AFM-related, in-situ GIXRD, Raman, FTIR, optical spectroscopies (time resolved photoluminescence)
- **Properties:** PEC and related spectroscopies (EIS, IMPS, IMVS)

9.4 Materials characterization and testing
9.1 Preparation of new catalysts
9.3 New production processes

1. Appl. Surf. Sci. 596 (2022) 153552. https://doi.org/10.1016/j.apsusc.2022.153552
2. Appl. Surf. Sci. 439 (2018) 876. 10.1016/j.apsusc.2018.01.121
3. Appl. Surf. Sci. 513 (2020) 145779. https://doi.org/10.1016/j.apsusc.2020.145779

UNIVE (affiliate) for NEST, spoke 9

Marco Bortoluzzi
markos@unive.it
Collaborations
Jesús Castro (Vigo University, Spain).
Valentina Ferraro (KIT, Germany).
Students: Domenico Piccolo, Matteo Donati



- Coordination chemistry
- Synthesis and characterization of luminescent coordination compounds based on earth-abundant elements for energy conversion.
- Steady-state and time-resolved luminescence measurements.
- Computational simulations (DFT, TD-DFT) for energy-converting molecular systems

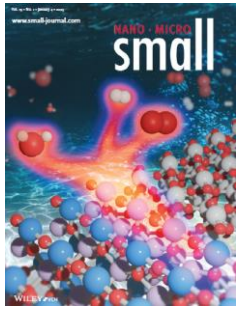
9.4 Optical properties
9.5 Advanced computational methods

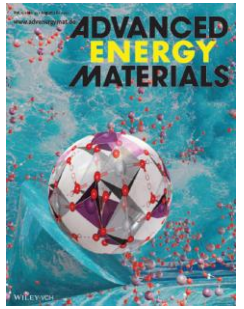
1. New J. Chem. 46 (2022) 18938-18951. https://doi.org/10.1039/D2NJ03165E
2. Dalton Trans. 50 (2021) 3132-3136. https://doi.org/10.1039/D1DT00123J
3. Dalton Trans. 49 (2020) 7525-7534. https://doi.org/10.1039/D0DT01659D

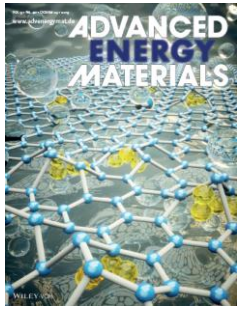
UNIVE (affiliate) for NEST, spoke 9

Alberto Vomiero
alberto.vomiero@unive.it

Tofik Ahmed Shifa - RTD B
Kassa Belay Ibrahim - RTD A
Anastasiia Taranova - PhD student



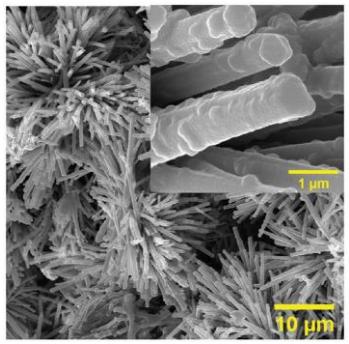


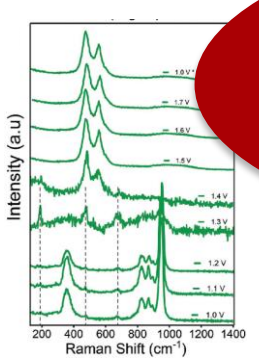


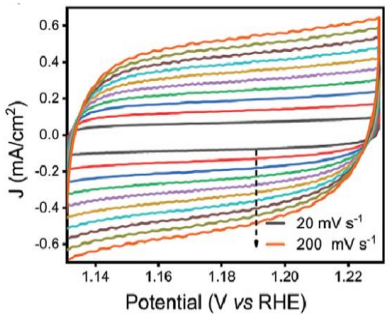
- 0-1-2 D nanomaterials for water splitting / hydrogen production
- Confined catalysis
- Operando spectroscopies

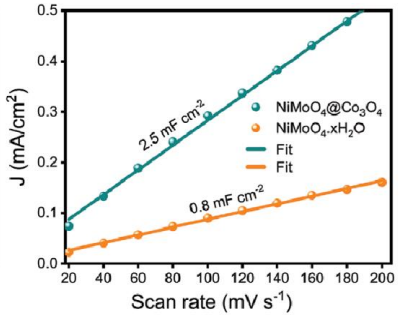
Available techniques:

- PVD growth
- Operando Raman
- Atomic force microscopy
- Optical spectroscopies
- Rutherford backscattering









9.1 Preparation of new catalysts / Confined catalysis
9.4 Materials characterization and testing

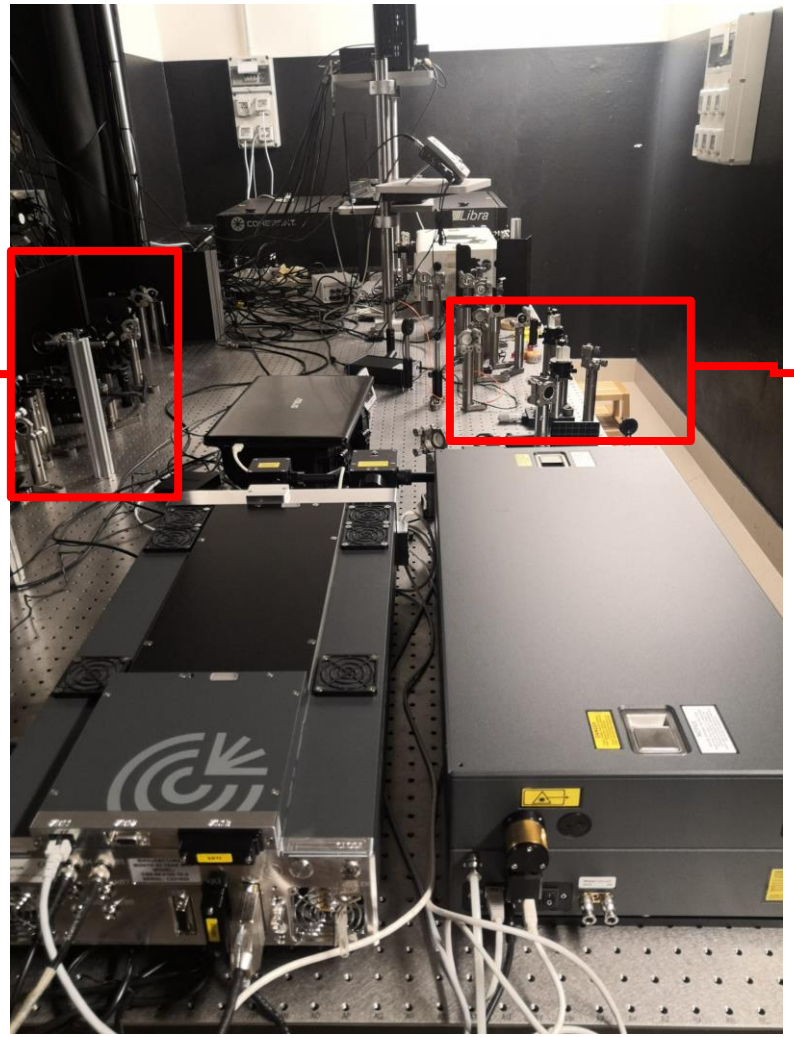
[$NiMoO_4$@Co_3O_4 Core–Shell Nanorods: In Situ Catalyst Reconstruction toward High Efficiency Oxygen Evolution Reaction]
G Solomon, et al. Adv En Mater 11 (2021) 2101324

[Facile Electron Transfer in Atomically Coupled Heterointerface for Accelerated Oxygen Evolution]
KB Ibrahim, et al. Small 19 (2023) 2204765

[Interfacing CrOx and CuS for synergistically enhanced water oxidation catalysis]
TA Shifa, et al. Chem Eng J 453 (2023) 139781

UNIPD for NEST, spoke 9

optically detected
2DES setup



Photocurrent detected
2DES setup

new laser source (Carbide+NOPA) purchased with PNRR funds:

- 50KHz rep rate
- Tunable from 200 to 750 nm
- 10-20 fs pulse duration

T9.4.1: Advanced structural and morphological characterization techniques

T9.4.2: Optical, electrochemical, electronic properties

UNIPD and UNIVE for NEST, spoke 9

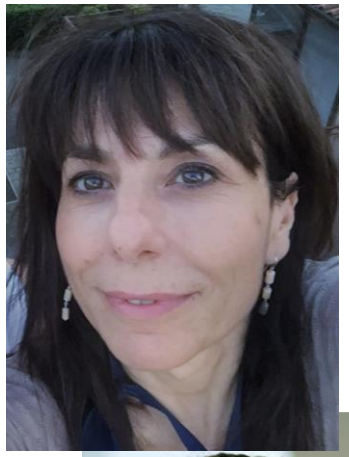
Marcella Bonchio (spoke person for UNIPD)
marcella.bonchio@unipd.it
Department of Chemical Science, UNIPD

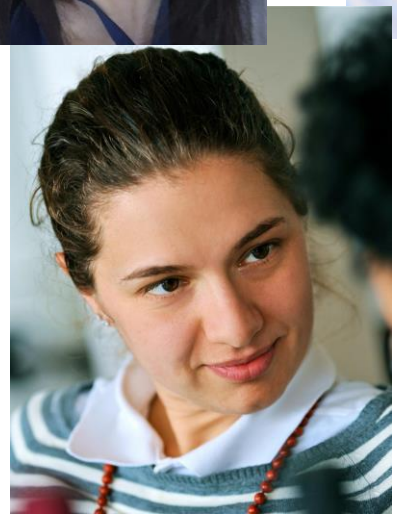
Elisabetta Collini
elisabetta.collini@unipd.it
Department of Chemical Science, UNIPD

Chiara Maurizio
chiara.maurizio@unipd.it
Physics and Astronomy Dept. (UNIPD)

Alberto Vomiero
alberto.vomiero@unive.it
Dep. of Scienze Molecolari e Nanosistemi
University Ca' Foscari of Venice (UNIVE)

Marco Bortoluzzi
markos@unive.it
Dep. of Scienze Molecolari e Nanosistemi
University Ca' Foscari of Venice (UNIVE)




UNIVERSITÀ
DEGLI STUDI
DI PADOVA