

PERSONAL INFORMATION

MARCO BOGAR

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Date of birth 30/03/1988 | Nationality Italian

WORK EXPERIENCE

July 2021 – Up to now

Research associate / Lecturer (09/C1, IIND-06/A)University of Trieste, Department of Engineering and Architecture (www.units.it, www.dia.units.it)
Research sector: Energy Systems / Fuel Cells and Water Electrolysers

The actual occupation is related to the management of the Energy Systems Laboratory (hosted within the Mechanical Engineering facilities) and to design and manage the realization of the new Hydrogen Technologies Hub, a new laboratory dedicated to PEM fuel cells and water electrolysers characterization, ranging from the single-cell, up to system level. In these regards, activities include both electrochemical cells design, test benches design for single cell characterization, plants design for stack characterization, plant automation, equipment development, data acquisition, and data analysis.

Concerning research activities, they are currently addressed to *operando* characterization of fuel cells and electrolysers at the single cell level, by combining electrochemical techniques together with X-Ray-based investigation ones (such as Small Angle X-Ray Scattering and X-Ray Absorption Spectroscopy) with the aim of characterising activation and degradation phenomena involving the catalytic layers (causing a reduction of performances) in order to improve efficiency and durability of these types of electrochemical devices at a cell and at a stack level too.

In parallel to research, the didactical duties required have been divided among teaching and tutoring. Teaching activities are divided over three courses: *Machines and engines* (bachelor degree), *Mechanical measurements* (master degree), and *Hydrogen and Fuel Cells* (master degree, course held in English language). Concerning tutoring, the gained experience is divided among tutoring bachelor students in their bachelor thesis definition, editing, and defence and in tutoring a PhD student (topic: improving water electrolysers efficiency by means of novel activation protocols)

May 2021 – June 2022

Postdoctoral researcherUniversity of Trieste, Department of Engineering and Architecture (www.units.it, www.dia.units.it)

Research sector: Energy Systems / Fuel Cells

Same goals as actual occupation, only research-related tasks were required to be fulfilled.

October 2020 – April 2021

Hardware and system engineerEmployed by means of RINA S.p.A. (www.rina.org/en/) and working at Leonardo S.p.A. (<https://www.leonardocompany.com/en/global/europe/italy/>), Ronchi dei Legionari, Italy.

Sector: Aerospace, defence and security.

Hardware and system design for flight simulators.

February 2020 – September 2020

Researcher, PhD

Employed by Graz University of Technology at the SAXS Beamline at ELETTRA Synchrotron, Basovizza, Trieste.

Research sector: Energy systems and Fuel Cells / Physics / SAXS

Contract extension to conclude the doctorate. Same characteristics as previous position.

March 2017 – January 2020

Researcher, PhD

CERIC-ERIC employee at SAXS Beamline at ELETTRA Synchrotron, Basovizza, Trieste.

Research sector: Energy systems and Fuel Cells / Physics / SAXS

The doctoral project dealt with the development of measurement devices and techniques for *in operando* analysis of degradation in Proton Exchange Membrane Fuel Cells (PEMFCs) by means of Small Angle X-ray Scattering (SAXS) and X-Ray Absorption Spectroscopy (XAS). Under the coordination of the research group led by Prof. Vladimir Matolin, at Charles University in Prague, the activities at ELETTRA were carried out under the supervision of Prof. Heinz Amenitsch. Research

activities started from the design of a modified PEMFC for both SAXS and XAS analysis. In parallel, the design and realization of an electrochemical cell for *in situ* Grazing Incidence Small Angle X-Ray Scattering (GISAXS) was performed. The cell was realized via 3D printing and it was used for both studying degradation of a platinum bimetallic alloy used as a catalyst model system for the cathode side of a PEMFC under accelerated stress tests, as well as for investigating nanoporosity formation in bimetallic alloys undergoing electrochemical-induced dissolution.

For both *in operando* and *in situ* analysis, results were complemented by means of micrographs recorded by means of Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM) and electrochemical measurements.

Further experience was gained by developing projects developing in parallel with the doctoral path. The doctorate allowed to learn to deal with SAXS data analysis independently. Igor PRO was used for data analysis and data fitting; in some cases, also the most common software dedicated to SAXS data analysis were employed to extend data analysis.

During the last year of PhD, a particular attention was given to the development of new models for data analysis; in particular a new model for core-shell particles have been developed and a universal model to fit SAXS data had been under development in collaboration with Prof. Heinz Amenitsch, from Graz University of Technology.

March 2016 – February 2017

Researcher

University of Trieste, Department of Chemical Engineering (www.units.it, www.dia.units.it)

Research sector: Organic Electronics.

Research activity was based on producing Organic Semiconducting Single Crystals to be used as X-ray detectors from direct inkjet printing of precursor solution onto rough substrates.

Solution preparation and inkjet printing were carried out in chemical laboratory under fume hood. Optical and morphological characterizations were carried out by means of Atomic Force Microscopy at Area Science Park in collaboration with A.P.E. Research s.r.l..

March 2015 – December 2015

Guest student

IIT@PoliMi – Italian Institute for Technology – Centre for nanoscience and technology

Research sector: Organic Electronics / Biophysics.

Research activity was based on characterization of semiconducting and photosensitive polymers to be used as photoreceptors for a retinal prosthesis within the group led by Prof. Guglielmo Lanzani.

Characterization of polymeric nanoparticles were carried out by means of Dynamic Light Scattering, Time-Resolved Photoluminescence Spectroscopy, their toxicity with respect HEK293 cells (model system for neuron cells) was tested by means of Fluorescence Imaging and MTT assays, while the interaction and cellular stimulation was studied by means of electrophysiological analysis (patch clamp) and calcium imaging.

May 2009 – February 2012

On call waiter

Collaborations: Viroca s.n.c, Osteria Altran, Trattoria da Toni, Ristorante da Nando, Jolanda de Colò, by means of Umana S.p.A

Sector: Restaurant industry

December 2011 – July 2012

University Internship

Elcon Elettronica S.r.L. (www.elcon-elettronica.com)

Sector: Engineering / Electronics

Activities dealt with designing and prototyping a transducing circuit for a damp sensor by using elemental discrete electronic components. The analogue signal had to be digitally acquired and transmitted to a host by means of PIC microcontroller and ZigBee module, programmed in C++ within the MPLAB IDE environment. The experience was as basis for writing the Bachelor thesis.

EDUCATION AND TRAINING

April 2023	Course: safety for the use of lifting devices (overhead cranes) Università degli Studi di Trieste, Italy (www.units.it).	EQF level 8
August 2017 – January 2021	PhD in Physics Physics Institute, Graz University of Technology, Graz (www.tugraz.at). Thesis title: <i>Operando</i> SAXS Investigation for Polymer Electrolyte Fuel Cells The doctoral project was developed with the aim to develop techniques and methodologies for characterizing the degradation of a PtCeO ₂ catalyst at the anode side of a PEMFC by means of SAXS and XAS at the ELETTRA synchrotron facility. In parallel the development of techniques and methodologies for characterizing <i>in situ</i> catalyst degradation in simulated environments was carried out at the SAXS beamline of ELETTRA synchrotron in Trieste. Study program: exam of X-Ray physics, attendance of HERCULES doctoral school, inventions patents and technology exploitation seminar, fundamental and applied research: funding, grant proposals, collaborations, resources and impact seminar, certificate attendance to at least 15 seminars concerning edge topics in science, followed at both Graz University of Technology, University of Trieste and ELETTRA synchrotron.	EQF level 8
June 2018	2nd NFFA Summer School	
February 2018 – March 2018	HERCULES European Doctoral School The Higher European Research Course for Users of Large Experimental Systems (HERCULES) European Doctoral School was attended in 2018 within the address <i>Applications for physics and chemistry of condensed matter</i> . The course was based at the European Synchrotron Radiation Facility (ESRF) in Grenoble and was focused in teaching the investigation techniques which can be used at synchrotron facilities. In addition, the course allowed to visit the Institut Laue-Langevin in Grenoble and both of the Deutsches Elektronen-Synchrotron and the European X-Ray Free-Electron Laser in Hamburg. In all of the research infrastructure centres lessons were combined together with experimental tutorials.	
September 2013 – December 2015	Master Degree in Physics Engineering (LM-44) Politecnico di Milano, Italy (www.polimi.it). Thesis title: characterization of polythiophene nanoparticles and their interaction with living cells. Solid state physics and X-Ray-based investigation techniques for material characterization; Photonics; Advanced materials: Nanostructured materials and Functional materials; Physics of low dimensional systems: Micro- and nano-fabrications and Physics of surfaces (surface properties and methods of investigation surfaces: electron spectroscopies); Semiconductor physics (optical, magnetic and transportation properties); Digital electronics and information technologies (Arduino system); Applied chemical physics; Nanomedicine; Biomaterials; Biochips.	EQF level 7
March 2013 – August 2013	Integration courses in order to be admitted at the Master Politecnico di Milano, Italy (www.polimi.it). Quantum physics, structure of matter: transport phenomena in metals, magnetic properties of matter, radiation-matter interaction, electron spectroscopies.	EQF level: 6
December 2012	IELTS Certification British Council Examination Services	
September 2007 – March 2012	Bachelor Degree in Electronic Engineering (L-9) Università degli Studi di Trieste, Italy (www.units.it). Thesis title: development of a damp sensor for medical applications. Measure and measure environment, basics of Biomedical Electronics. Analogue Electronics; basics of Optoelectronic; Automation systems. Digital Electronics (Altera FPGA, Microchip Microcontrollers). MATLAB and C++ programming languages; basics of LabVIEW.	EQF level: 6
June 2007	Technician diploma in Electronics and Telecommunications I.T.I. Malignani 2000, Cervignano del Friuli (UD), Italy. Electronics, Telecommunication, IT, PCB design.	EQF level: 4
May 2006	ECDL diploma CNOSFAP Bearzi, Udine File management, Word, Excel, Access, Power Point, the Web.	

PERSONAL SKILLS

Mother tongue(s)	Italian				
Other language(s)	UNDERSTANDING		SPEAKING		WRITING
	Listening	Reading	Spoken interaction	Spoken production	
English	B2/C1	C1	B2	B2	B1/B2
IELTS certification: level 6,5 (year 2012)					
Spanish	B1	B2	B1	A2	A2
Self-assessment					

Levels: A1/2: Basic user - B1/2: Independent user - C1/2 Proficient user /
Common European Framework of Reference for Languages

Communication skills

Excellent communication and team-working skills, good adaptivity and communication skills in multicultural and multilingual environments.

Organisational / managerial skills

Excellent ability to develop a job autonomously and to prioritize task.

Informatic tools known

SOFTWARE TYPE	SOFTWARE NAME	LEVEL OF KNOWLEDGE
▪ General purpose	Microsoft Office Suite	Excellent
▪ Data Analysis and acquisition	Igor	Excellent
	Origin	Excellent
	Matlab	Basic
	Labview	Very good
	DewesoftX	Basic
▪ Software for SAXS data analysis	FitGISAXS	Excellent
	GIFT	Very good
	BornAgain	Good
	ATSAS	Basic
▪ Software CAD	Solidworks	Very good
	Autocad	Good
▪ Programming Languages	C++	Good
	Python	Good
▪ Development systems	Arduino	Very good
	Microchip MPLAB IDE	Basic
▪ 3D modelling	Blender	Basic
▪ Drawing and photo editing	Adobe Illustrator	Very good
	Adobe Photoshop	Very good
	Adobe Lightroom	Very good
▪ Editing and composing	Adobe Premiere	Very good
	Adobe After Effects	Good
	Adobe Audition	Good

Other skills

Main free time activities

- Hiking and outdoor
- Live music
- Wood carving, sculpture and land art

Membership to Associations

- 2023-2025, member of *Associazione Italiana delle Macchine a fluido e dei Sistemi per l'Energia e l'Ambiente (AIMSEA)*
- 2022-2025, member of *Associazione Italiana Termotecnica (ATI)*
- 2018, member of the *Austrian Physical Society (OePG)*

Driving licence

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SCIENTIFIC OUTCOMES

Publications

- 2026
(in grey: planned works)
- *Operando* and *ex situ* comparison of Pt and Pt₃Co catalyst degradation under ORR in PEMFC, Chemical Engineering Journal: Green and Sustainable (I.F. 2025: 13.2), 2026, 1, 100017, <https://doi.org/10.1016/j.cejgas.2025.100017>
 - Preliminary methodology assessment for PEMFC durability testing in transport applications, Electrochemical Acta (I.F. 2026: 5.6), 2026, *in press*, <https://doi.org/10.1016/j.electacta.2026.148267>
 - Operando and post-mortem study of iridium-decorated titanium-based catalysts in PEM water electrolysis, Applied Catalysis B: Environment and Energy (I.F. 2025: 20.3), *finalising*.
 - Small Angle X-Ray Scattering *operando* characterization of Ir-black stability under Accelerated Stress Tests for Proton Exchange Membrane Water Electrolyzers, *in preparation*
 - Effects of potentiodynamic break-in in PEMFCs, *in preparation*.
 - *Metal nanoparticles production via exploding wire method: effects of producing conditions on particle size distribution and aggregation, in preparation.*
- 2025
- Composite thiophene-based nanoparticles: revisiting the PEDOT:PSS/P3HT interface for living cell optical modulation, ACS Applied Materials and Interface (I.F. 2023: 8.5), 2025, 17, 15, 22434–22447, <https://doi.org/10.1021/acscami.5c02115>
- 2024
- A Small Angle X-Ray Scattering approach for investigating fuel cell catalyst degradation for both *ex situ* and *in operando* analyses, International Journal of Hydrogen Energy (I.F. 2024: 7.2), International Journal of Hydrogen Energy 58 (2024) 1673–1681, <https://doi.org/10.1016/j.ijhydene.2024.01.261>
 - Capabilities of a novel electrochemical cell for operando XAS and SAXS investigations for PEM fuel cells and water electrolyzers, Journal of Power Sources (I.F. 2024: 9.2), 615 (2024) 235070, <https://doi.org/10.1016/j.jpowsour.2024.235070>
 - Humidity-Induced Degradation Mapping of Pt₃Co ORR Catalyst for PEFC by *In-Operando* Electrochemistry and *Ex Situ* SAXS, Small (I.F. 2024: 13) (2024), 2407591. <https://doi.org/10.1002/smll.202407591>
 - The role of hydrogen as enabler of industrial port area de-carbonization, Renewable and Sustainable Energy Reviews (I.F.2023: 16.80), Renewable and Sustainable Energy Reviews, 189, B, (2024), 113912. <https://doi.org/10.1016/j.rser.2023.113912>
- 2023
- Tuning the morphology of sputter-deposited platinum: from compact layers to dispersed nanoparticles. Applied Surface Science (I.F.2023: 7.39), 2023, 103079, <https://doi.org/10.1016/j.surf.2023.103079>.
- 2022
- *In situ* Study of Nanoporosity Evolution during Dealloying AgAu and CoPd by Grazing-Incidence Small-Angle X-ray Scattering. the Journal of Physical Chemistry C (I.F.2021: 4.13); 2022, 126(8), 4037–4047, <https://doi.org/10.1021/acs.jpcc.1c09592>.
 - Characterization of innovative Pt-ceria catalysts for PEMFC by means of *ex-situ* and *in-operando* X-Ray Absorption Spectroscopy. International Journal of Hydrogen Energy (I.F.2022: 7.14); 2021, 47(14), 8799–8810, <https://doi.org/10.1016/j.ijhydene.2021.12.241>.
- 2021
- Self-Assembly of Orientated Antibody-Decorated Metal–Organic Framework Nanocrystals for Active Targeting Applications. Advanced Materials (I.F.2021: 30.849); 2021, 2106607, <https://doi.org/10.1002/adma.202106607>
 - Interplay Among Dealloying, Ostwald Ripening, and Coalescence in Pt_xNi_{100-x} Bimetallic Alloys under Fuel-Cell-Related Conditions. ACS Catalysis (I.F.2021: 13.084); 2021, 11(18), 11360–11370, <https://doi.org/10.1021/acscatal.1c01111>.
- 2020
- *In situ* electrochemical grazing incidence small angle X-ray scattering: from the design of an electrochemical cell to an exemplary study of catalyst degradation in fuel cells. Journal of Power sources (I.F.2020: 9.127); 2020, 447, 229030, <https://doi.org/10.1016/j.jpowsour.2020.229030>.
 - Evolution of the PtNi Bimetallic Alloy Fuel Cell Catalyst under Simulated Operational Conditions. ACS Appl. Mater. Interfaces (I.F.2020: 8.758); 2020, 12(15), 17602–17610, <https://doi.org/10.1021/acscami.0c02083>
- 2018
- Direct inkjet printing of TIPS-Pentacene single crystals onto interdigitated electrodes by chemical confinement. Advanced Materials Interfaces (I.F.2018: 4.37); 2018, 5(3), 2196–7350, <https://doi.org/10.1002/admi.201700925>

Conference Papers /
 Contributions in books of
 proceedings

- 2025
- Towards Optimized Maritime Energy: Focus on an Energy Analysis and Management to Replace Conventional Power Systems with Hydrogen Solutions; 21st International Conference on Ships and Maritime Research, NAV 2025; ISBN: 9781643686103; <https://dx.doi.org/10.3233/pmst250067>
 - Development of a decision-oriented tool for operational management of a PEMWE; European Fuel Cell and Hydrogen Conference (EFCH2) 2025; 17th-19th September 2025, Capri, Italy; *bibliographic references not ready yet.*
 - Experimental Characterization of a Small-Scale PEM Water Electrolyzer for Hydrogen Production, Congress of the Italian Thermomechanical Association, 10th -12th September 2025, Benevento, Italy; *bibliographic references not ready yet.*
 - Comparative Design Optimization of Low-Temperature Fuel Cell Systems Powered by Pure Hydrogen and Hydrogen Carriers for Marine Applications: World Hydrogen Technologies Convention 2025; 21st -23rd October 2025, Dublin, Ireland; *bibliographic references not ready yet.*
- 2023
- A unitized reversible fuel cell for in operando SAXS and XAS analysis for fuel cells and electrolyzers. European Fuel Cells and Hydrogen Piero Lunghi conference - Book of proceedings. p. 134-135, ENEA, ISBN: 978-88-8286-446-0, Capri, 13-15 September 2023.
 - Hydrogen Valleys: a catalyst for advancing the global hydrogen value chain. European Fuel Cells and Hydrogen Piero Lunghi conference - Book of proceedings. p. 263-264, ENEA, ISBN: 978-88-8286-446-0, Capri, 13-15 September 2023.
- 2022
- *In-situ GISAXS-Revealed Interplay Among Dealloying, Ostwald Ripening and Coalescence of Pt_xNi_{100-x} Bimetallic Alloy Under PEMFC Simulated Operational Conditions.* 8th Regional Symposium on Electrochemistry of South East Europe / 9th Kurt Schwabe Symposium. Graz, 11-15 July 2022.
 - Technical insights and perspectives on hydrogen valleys deployment as enablers of European clean energy transition. HYPOTHESIS HYdrogen POWer THEoretical & Engineering Solutions International Symposium. p. 136-137, ISBN: 978-626-967-400-8, Taipei, Taiwan, 26-29 September 2022.

Attendance at Conferences

- 2024
- Talk held at European Material Research Society (E-MRS) 2024 Fall Meeting, 16th – 19th September 2024, Warsaw, Poland; Title: “*Ex situ* and *in operando* characterization of Pt and Pt₃Co catalyst degradation for proton-exchange membrane fuel cells”.
- 2023
- **Invited presentation** held at European Material Research Society (E-MRS) 2023 Fall Meeting, 18th – 21st September 2023, Warsaw, Poland; Title: “An electrochemical cell for *in operando* Small Angle X-Ray Scattering and X-Ray Absorption Spectroscopy analyses for Proton Exchange Membrane Fuel Cells and electrolyzers”.
 - Talk held at European Fuel Cells and Hydrogen Piero Lunghi conference (EFC) 2023, 13th – 15th September 2023, Capri, Italy; Title: “A unitized reversible fuel cell for in operando SAXS and XAS analysis for fuel cells and electrolyzers”.
 - Talk held at European Fuel Cells and Hydrogen Piero Lunghi conference (EFC) 2023, 13th – 15th September 2023, Capri, Italy; Title: “Hydrogen Valleys: a catalyst for advancing the global hydrogen value chain”.
- 2022
- **Keynote lesson** held at 8th Regional Symposium on Electrochemistry of South-East Europe, 11th – 15th July 2022, Graz, Austria; title: “*In-situ* GISAXS-Revealed Interplay Among Dealloying, Ostwald Ripening and Coalescence of Pt_xNi_{100-x} Bimetallic Alloy Under PEMFC Simulated Operational Conditions”.
- 2019
- Talk held at Fall MRS 2019, 1st – 6th December 2019, Boston, Massachusetts, USA; title: “*In Situ* GISAXS Investigation of Asymmetric Ostwald Ripening into PtNi Bimetallic Alloy under Operational Conditions of PEM Fuel Cells”.
 - Talk held at SILS annual meeting, 9th – 11th September 2019, University of Camerino, Camerino, Italy; title: “Asymmetric Ostwald Ripening Revealed via *in situ* GISAXS in PtNi Bimetallic Alloy Under Operational Conditions for PEMFC”.
 - Talk held at the 11th European NESY Winter school & Symposium on Neutron and Synchrotron Radiation, 4th – 8th March 2019, Altausee, Austria; title: “*In situ* GISAXS Investigation of PtNi Bimetallic Alloy Under Operational Conditions of Fuel Cells.”

- 2017 ▪ Talk held at Spring E-MRS 2017, Convention Centre of Strasbourg, 22nd – 26th May 2017, Strasbourg, France; title: “Direct inkjet printing of TIPS-Pentacene single crystals onto interdigitated electrodes by chemical confinement”.
- 2016 ▪ Talk held at Fall E-MRS 2016, Warsaw University of Technology, 19th – 22nd September 2016, Warsaw, Poland; title: “Effect of different SAMs over morphology and charge transport proprieties of TIPS-Pentacene crystals by inkjet-printed solution”.

Main Poster Contributions

- 2022 ▪ 8th Regional Symposium on Electrochemistry of South-East Europe, 11th – 15th July 2022, Graz, Austria; title: “A modified Proton Exchange Membrane Fuel Cell for in operando SAXS and XAS “. Poster awarded (3rd position awarded)
- 2019 ▪ GISAXS 2019 international workshop, 20th – 22nd December 2019, DESY, Hamburg, Germany; title: “Degradation of Bimetallic Alloy Under Operational Conditions of Proton Exchange Membrane Fuel Cell Studied via in situ GISAXS”.
- SAXS Excites: international SAXS symposium, 24th – 25th September 2019, Graz, Austria; title: “*In situ* GISAXS investigation of PtNi bimetallic alloy degradation under operational conditions of Proton Exchange Membrane Fuel Cell.
- MASTEC, Materials for today’s energy challenge workshop, 3rd June 2019, Padova, Italy; title: “Degradation of PtNi Bimetallic Alloy Under Operational Conditions of Proton Exchange Membrane Fuel Cells Studied via *in situ* GISAXS.”

Awards

- 2025 ▪ Contributed to the paper granted with the *Best paper award* at the World Hydrogen Technology Convention (WHTC 2025), 21st – 23rd October 2025, Dublin, Ireland. Title: “*Comparative Design Optimization of Low-Temperature Fuel Cell Systems Powered by Pure Hydrogen and Hydrogen Carriers for Marine Applications*”
- 2022 ▪ 3rd classified - Poster award at the 8th Regional Symposium on Electrochemistry of South-East Europe, 11th – 15th July 2022, Graz, Austria. Title: “*A modified Proton Exchange Membrane Fuel Cell for in operando SAXS and XAS*”.

TEACHING EXPERIENCES

Academic year 2025/2026

- Holding the course *Hydrogen technologies and Fuel Cells*, Department of Engineering and Architecture, University of Trieste (Master degree, language: English).
- Seminar "Comparison between National Instruments and Dewesoft real time data acquisition systems (with workshop); within the course: *Mechanical, and thermal measurements*, Department of Engineering and Architecture, University of Trieste (Master degree, language: Italian)

Academic year 2024/2025

- Holding the course *Hydrogen technologies and Fuel Cells*, Department of Engineering and Architecture, University of Trieste (Master degree, language: English). The course was designed in collaboration with my supervisor, but I am currently in charge for managing the course. My personal contribution to the course consists in introducing electrochemistry and dealing with electrochemical devices operation and characterization from the single cell level to the stack level.
- Teaching in the course: *Mechanical, and thermal measurements*, Department of Engineering and Architecture, University of Trieste (Master degree, language: Italian). Currently responsible for the workshops held within the course by using both Labview and Dewesoft acquisition systems.
- Teaching in the course: *Machines and Engines*, Department of Engineering and Architecture, University of Trieste (Bachelor degree, language: Italian).

Academic year 2023/2024

- Holding the course *Hydrogen technologies and Fuel Cells*, Department of Engineering and Architecture, University of Trieste (Master degree, language: English).
- Teaching in the course: *Mechanical, and thermal measurements*, Department of Engineering and Architecture, University of Trieste (Master degree, language: Italian).
- Teaching in the course: *Machines and Engines*, Department of Engineering and Architecture, University of Trieste (Bachelor degree, language: Italian).

Academic year 2022/2023

- Teaching in the courses: *Mechanical, and thermal measurements*, and *Machines and Engines*, academic year 2022/2023, University of Trieste.
- Teaching in the course: *Machines and Engines*, Department of Engineering and Architecture, University of Trieste (Bachelor degree, language: Italian).

Academic year 2021/2022

- Supporting in laboratory activities for the course *Mechanical, and thermal measurements*, academic year 2021/2022, University of Trieste (Master degree, language: Italian).
- Supporting in laboratory activities for the course *Machines and Engines*, academic year 2021/2022, University of Trieste (Bachelor degree, language: Italian).

September 2019

- Seminar given at the seminar for doctoral students of Graz University of Technology, 26th September 2019; title: "*In situ and operando* SAXS investigation of Proton Exchange Membrane Fuel Cells".

PARTICIPATION TO EVALUATION COMMITTEES

Academic year 2024/2025

- Participation as commissioner to several committees for evaluating bachelor and master students' degrees
- Participation as commissioner for evaluating the resume of candidates to be hired as consultants or teachers

Academic year 2023/2024

- Participation as member of the committee to evaluate the purchase of an X-Ray Diffractometer for recording diffraction patterns in transmission, grazing-incidence, in reflection geometries, as well as for recording small angle scattering patterns
- Participation as commissioner to several committees for evaluating bachelor and master students' degrees,
- Participation as commissioner for evaluating the resume of candidates to be hired as consultants or teachers

Academic year 2022/2023

- Participation as commissioner to several committees for evaluating bachelor and master students' degrees
- Participation as commissioner for evaluating the resume of candidates to be hired as consultants or teachers

PROJECT WRITING AND MANAGEMENT

- 2026-2030** RISE-H₂: Ricerca e Innovazione per Sviluppare l'Ecosistema dell'H₂ (research and innovation for developing the hydrogen ecosystem)
 Framework: research funds granted from the Friuli Venezia Giulia Region dedicated to funding research activities based on the equipment funded within E4H2 project. The grant has been provided within the PNRR framework.
 Aim: support basic and applied research by exploiting the equipment funded within the previous call, where E4H2 project was funded.
 Role in project writing: conceptualization and writing of the scientific activities which are going to be carried out by the Department of Engineering and Architecture.
 Role foreseen after project started: Laboratory commissioning and principal investigator of experimental activities planned.
- 2024-2027** E4H2: Efficiency for Hydrogen
 Framework: research funds granted from the Friuli Venezia Giulia Region dedicated to renovating the infrastructures dedicated to the research and development addressing the use of renewable hydrogen as an energy vector. The grant has been provided within the PNRR framework.
 Website: <https://www.regione.fvg.it/rafvfg/cms/RAFVFG/ricerca/fare-ricerca/FOGLIA27/#indice-contenuti>
 Aim of the project: upgrade existing research infrastructure facilities of the Department of Engineering and Architecture dedicated to hydrogen-based technologies to the state of the art, with the aim of promoting the increase of efficiency within the overall hydrogen-value chain.
 Role in project writing: among the main contributors to project writing.
 Active role within the project: entitled to design and realize the new laboratories dedicated to fuel cells and electrolysers characterization of the Department of Engineering and Architecture of the University of Trieste (budget: 2 M€). Principal investigator of experimental activities planned after laboratory commissioning.
- 2024-2030** NAHV: North Adriatic Hydrogen Valley
 Framework: HORIZON.2.5 - Climate, Energy and Mobility
 DOI: 10.3030/101111927
 Website: <https://www.nahv.eu/>
 Role: contributed to project writing.
- 2023** FRA 2023: Fondi di Ricerca Ateneo 2023
 Framework: funds dedicated to research granted from University of Trieste
 Role: project proposer and main writer, principal investigator, involved in setup design dedicated to electrochemical characterization of fuel cells and electrolysers.
- 2022 – 2025** Investigation of aging phenomena on fuel cells
 Framework: granted by the University of Trieste
 Role: project proposer and main writer; senior researcher, involved in the experimental activities foreseen within the project
- 2022 – 2025** sHYpS: Sustainable HYdrogen powered Shipping
 Framework: HORIZON.2.5 - Climate, Energy and Mobility
 DOI: 10.3030/101056940
 Website: <https://www.shyps.eu/>
 Role: project management activities for University of Trieste. Assisting research carried out by the group
- 2017-2022** CEROP (Deciphering single-atom catalysis in Pt/ceria systems via advancing the CERIC operando methods)
 Framework: in-house CERIC-ERIC research project
 Website: <https://www.ceric-eric.eu/2018/06/06/cerop-deciphering-single-atom-catalysis-in-pt-ceria-systems-via-advancing-the-ceric-operando-methods/>
 Role: PhD student, involved in the experimental activities foreseen within the project

DESIGN EXPERIENCES

- 2025 / 2027, University of Trieste **Design and realization of a laboratory dedicated at fuel cells and water electrolyzers characterization.**
 Within the framework of the project E4H2 (introduced in the previous section), a novel laboratory for characterising fuel cells and water electrolyzers, starting from the cell level up to the stack level has been commissioned. The laboratory has been designed considering all of the requirements in terms of safety concerning gas delivery. The laboratory is planned to be equipped with both commercial and self-made testing stations and with the instrumentation needed for performing the standard electrochemical characterization techniques. It is planned to be supplied with the standard equipment needed to support the basic fabrication activities for supporting either fabrication of membrane electrode assemblies (the functional layers at the base of fuel cells and electrolyzers operation – thus composed by chemical hoods, spray coating machine, hot press, among the others), either to support mechanical fabrication via photolithographic 3D printing. Budget: 2 M€.
- 2023 / 2024, University of Trieste **Design and realization of a test rig for a stack of an Anion Exchange Membrane and a Proton Exchange Membrane Water Electrolyser cells.**
 The test rigs are composed by a water distribution circuit, by a gas management system, and by a heating system. Novel potentiostat and dedicated power supply were purchased too. Budget: 50k€.
- 2023 / 2024, University of Trieste **Design and realization of a portable control station for Fuel Cells.**
 The portable control station is composed by a heating system, by a system for humidify gases and by the automation system, for controlling fuel cell and gas temperature, and gas relative humidity. It is commonly used during measurement activities carried out at synchrotron facilities.
- 2021 / 2022, University of Trieste **Design and realization of a test rig for an 8kW stack of Proton Exchange Membrane Fuel Cells.**
 The test rig is composed by: a water-based cooling system, an air- and a hydrogen-supply system and by an automation system, which is used to measure and process the electrical parameters of the stack (temperature and conductivity of the coolant liquid, flow of the supplied air) in order to properly adjust the working conditions of the fuel cell stack system. Budget for the balance of plant: 20k€
 Tools used: Solidworks 2021 and Autocad 2021 for mechanical and electrical design; Labview, in combination with the Compact RIO system for realizing the automation part.
- 2018, ELETTRA Synchrotron **Design and realization via 3D printing of an experimental cell with flow-thought system for in situ GISAXS electrochemical measurements and of a chemical cell for SAXS measurements.**
 Activity developed within the doctoral project, carried out at ELETTRA synchrotron, Trieste, Italy.
 Tools used: Solidworks 2017 for cell design, SAXS chemical laboratory for prototyping and testing, SAXS beamline for SAXS experiments.
- 2012, January – June
 Elcon Elettronica s.r.l. **Development of a damp sensor for medical applications**
 Activity developed for writing the Bachelor degree thesis, carried out at Elcon Elettronica s.r.l. Padriciano, Italy.
 Tools used: Microchip MPLAB IDE, oscilloscope, discrete electronics components for prototyping the transducing circuit for a damp sensor to be used in a network of wireless sensors to be used for medical applications.
- 2011, November,
 University of Trieste **Development of a FPGA interface for an electronic compass**
 Laboratory project for the exam FPGA of Bachelor Degree in Electronics Engineering.
 Tools used: Altera development system.
- 2011, September,
 University of Trieste **Development of a position control system for a servo-assisted mechanical arm with PIC microcontroller**
 Laboratory project for the exam Microcontrollers and DSPs, of Bachelor Degree in Electronics Engineering.
 Tools used: Microchip MPLAB IDE development system.
- 2011, January,
 University of Trieste **Development of a VCO system**
 Laboratory for the exam Analog electronics of Bachelor Degree in Electronics Engineering.
 Tools used: analogue electronic components for realizing the VCO, Labview software for creating a spectroscopy for signal analysis.

SYNCHROTRON-RELATED EXPERIENCE

Beamtimes gathered via proposal submission
2025

- Title: "SAXS characterization of metal nanoparticles produced via exploding wire method: effects of producing conditions on size distribution and aggregation behaviour"
Instrumentation used: SAXS beamline Proposal CERIC-ERIC: 20247215
Partners involved: University of Pisa

- Title: "Unrevealing the effects of break-in procedure on catalyst materials for PEMFC via in operando and ex situ SAXS and XAS analysis"
Instrumentation used: SAXS XAFS beamlines Proposal CERIC-ERIC: 20247183
Partners involved: Charles University, Prague / University of Split / University of Modena-Reggio Emilia

2024

- Title: "In-operando SAXS analysis of contamination induced PEMWE degradation".
Instrumentation used: SAXS beamline Proposal CERIC-ERIC:20242243
Partners involved: Graz University of Technology / Charles University, Prague

- Title: "In-operando Small-Angle and Wide-Angle X-ray Scattering Analysis of Iridium Morphological Changes in Water Electrolyzers Under Accelerated Stress Conditions"
Instrumentation used: SAXS beamline Proposal CERIC-ERIC: 20237230
Partners involved: Charles University, Prague

- Title: "Characterization of cutting-edge chiral cobalt oxide nanoparticle catalysts doped with iron ($\text{Co}_{(3-x)}\text{Fe}_x\text{O}_4$) through operando XAS investigations"
Instrumentation used: XAFS beamline Proposal ELETTRA: 20235287
Partners involved: Charles University, Prague / University of Modena-Reggio Emilia

- Title: "Structural evolution of cutting-edge chiral cobalt oxide nanoparticle catalysts doped with iron ($\text{Co}_{(3-x)}\text{Fe}_x\text{O}_4$) through operando SAXS investigations"
Instrumentation used: SAXS beamline Proposal CERIC-ERIC: 20242132
Partners involved: Charles University, Prague / University of Modena-Reggio Emilia

2023

- Title: "In-operando study of supported Ir catalysts for water electrolyzers and reversible fuel cells using Small-Angle X-ray Scattering and X-Ray Photoelectron Spectroscopy"
Instrumentation used: SAXS beamline Proposal CERIC-ERIC: 20232198
EnviroESCA Electron Spectroscopy (Charles University)
Partners involved: Charles University, Prague / Graz University of Technology

- Title: "Feasibility study for in operando fuel cell analysis on SAXS laboratory equipment"
Instrumentation used: SAXS facility@TUGraz CERIC fast track proposal: 20232001
Partners involved: Charles University, Prague

- Title: "Spatially-resolved humidity-induced degradation mapping of PtCo/C ORR catalyst in PEMFCs by combined in operando electrochemistry and ex situ SAXS"
Instrumentation used: SAXS beamline CERIC fast track proposal: 20227044
Partners involved: Graz University of Technology

2022

- Title: "Stabilization and activation mechanisms of Ir-based catalysts for oxygen evolution reaction probed by GISAXS"
Instrumentation used: SAXS beamline CERIC fast track proposal: 20227278
Partners involved: Slovenian National Institute of Chemistry

- In situ GISAXS and WAXS investigations of Pt-based MPCA/HEA alloys as electrocatalysts for energy conversion reactions.
Instrumentation used: SAXS beamline CERIC fast track proposal: 20227277
Partners involved: Max-Planck-Innovation (Electrochemistry for Energy Conversion)

- Title: "In situ GISAXS investigation of the composition-dependent Pt-Au fuel cell electrocatalyst during accelerated durability test"
Instrumentation used: SAXS beamline Proposal CERIC-ERIC: 20222274
Partners involved: Charles University, Prague

- Title: "In-operando investigation of catalyst degradation under Oxygen Reduction Reaction in a low-temperature Fuel Cell / Water Electrolyzer by Small-Angle X-ray Scattering"
Instrumentation used: SAXS beamline Proposal CERIC-ERIC: 20222217
Partners involved: Charles University, Prague

- Title: "In-operando characterization of catalyst layer for low-temperature fuel cell/electrolyzer by X-ray absorption spectroscopy"
 - Instrumentation used: XAFS beamline Proposal ELETTRA: 20220525
 - Partners involved: Charles University, Prague
- Title: "Comparison of different MEA architectures: a preliminary study for further in operando fuel cell analysis"
 - Instrumentation used: SAXS beamline Proposal CERIC-ERIC: 20217220
 - Partners involved: Charles University, Prague
- 2020
 - Title: "In situ Synthesis of PEDOT:PSS/P3HT core/shell nanoparticles for bio-applications."
 - Instrumentation used: SAXS beamline Proposal CERIC-ERIC: 20202129
 - Partners involved: CNST - Center for Nano Science and Technology, IIT-Milan
 - Title: "PEDOT:PSS/P3HT core/shell nanoparticles as tool to control mammalian cells activity."
 - Instrumentation used: SAXS facility@TUGraz CERIC fast track proposal: 20202021
 - Partners involved: CNST - Center for Nano Science and Technology, IIT-Milan
 - Title: "Revealing the growth evolution of shape-controlled platinum nanocrystals using in-situ GISAXS."
 - Instrumentation used: SAXS beamline Proposal CERIC-ERIC: 20197128
 - Partners involved: Charles University, Prague
- 2019
 - Title: "In situ SAXS and XAS study of Hydrogen Oxidation Reaction on Pt-CeOx and Pt-Co catalysts in Proton Exchange Membrane Fuel Cell in completely hydrated and operando conditions"
 - Instrumentation used: SAXS and XAFS beamlines Proposal CERIC-ERIC: 20192108
 - Partners involved: Charles University, Prague
 - Title: "In situ study of nanoporosity evolution during potential assisted dealloying with GISAXS."
 - Instrumentation used: SAXS beamline Proposal CERIC-ERIC: 20187126
 - Partners involved: Graz University of Technology
 - Title: "In situ SAXS study of Hydrogen Oxidation Reaction on Pt-CeOx and Pt-Co catalysts in completely hydrated Proton Exchange Membrane Fuel Cell and into Anion Exchange Membrane Fuel Cell."
 - Instrumentation used: SAXS beamline Proposal CERIC-ERIC: 20187112
 - Partners involved: Graz University of Technology
 - Title: "In situ SAXS and XAS study of Hydrogen Oxidation Reaction on Pt-CeOx and Pt-Co catalysts in Proton Exchange Membrane Fuel Cell in completely hydrated and operando conditions".
 - Instrumentation used: SAXS beamline Proposal CERIC-ERIC: 20192108
 - Partners involved: Charles University, Prague
- 2018
 - Title: "In situ GISAXS investigation of the composition-dependent PtNi fuel cell electrocatalyst degradation during accelerated durability test."
 - Instrumentation used: SAXS beamline Proposal CERIC-ERIC: 20182166
 - Partners involved: Charles University, Prague
 - Title: "In situ SAXS and XAS study of Hydrogen Oxidation Reaction on Pt-CeOx and Pt-Co catalysts in Proton Exchange Membrane Fuel Cell."
 - Instrumentation used: SAXS beamline Proposal CERIC-ERIC: 20182141
 - Partners involved: Charles University, Prague
 - Title: "Operando SAXS and XAS study of Hydrogen Oxidation Reaction on Pt-CeOx catalysts in Proton Exchange Membrane Fuel Cell".
 - Instrumentation used: SAXS and XAFS beamlines Proposal CERIC-ERIC: 20177083
 - Partners involved: Charles University, Prague
- 2017
 - Title: "In situ GISAXS investigation of the Pt-Ni fuel cell electrocatalyst coarsening during accelerated durability test."
 - Instrumentation used: SAXS beamline Proposal CERIC-ERIC: 20172085
 - High Resolution FESEM, Charles University, Prague
 - Partners involved: Charles University, Prague

ADDITIONAL EXPERIMENTAL EXPERIENCE

Experimental time gathered via proposal submission
2026
(in grey planned activities)

- Title: "Validation of theoretical models of PEMFC degradation on FC/battery hybrid systems for naval applications
Instrumentation used: Hydrogen Technologies Centre, Charles University, Prague
Proposal: CERIC-ERIC: *planned for the next call.*
- 2025
▪ Title: "Experimental load-induced PEMFC degradation study for maritime applications".
Instrumentation used: Hydrogen Technologies Centre, Charles University, Prague
Proposal: CERIC-ERIC:20247011 / fast-track
Partners involved: Delft University of Technology
- Title: "Experimental Durability study of Low Temperature Proton Exchange Membrane Fuel Cells for Maritime Applications"
Instrumentation used: Hydrogen Technologies Centre, Charles University, Prague
Proposal: CERIC-ERIC: 20252128
Partners involved: Delft University of Technology

Hardware development for ELETTRA SAXS beamline
2018 / 2019

Renovation of the data acquisition system of the SAXS beamline

The aim of this activity was to renovate the signal acquisition system of the SAXS beamline. In particular, two pico-ammeters AH501B (developed by the Electromagnetism Group of ELETTRA), have been embedded in the beamline measuring system in order to acquire the electronic signal produced from the ionization chamber and from the photodiode. These signals are further used for data normalization. Quality of signal and correct synchronization of the acquisition system with the detector had been the main aspects faced. Integration of the pico-ammeters with the beamline software was carried out in collaboration with the personnel of the SAXS beamline.

2017/2019 Addition and integration of the potentiostat with the SAXS beamline measuring system

A potentiostat (SP-240, Biologic) was added to the SAXS chemical laboratory at first. After having acquired the know how concerning the operation of the instrument, the potentiostat had been integrated in the beamline measuring system by establishing a communication between the EC-Lab software (the management software of the potentiostat) and the Labview software used to run the SAXS beamline.

2018 Design and realization via 3D printing of an experimental cell with flow-thought system for *in situ* GISAXS electrochemical measurements

The design of the cell was based on a previous experimental chamber already present at the beamline. The cell was designed and realized in collaboration with the personnel of the Vacuum and Optical Engineering Group who took care about the 3D printing of the device. The testing of the cell was made in the SAXS electrochemical laboratory at first and it was later used at the SAXS beamline for electrochemical *in situ* GISAXS experiments.

2018 Design and realization via 3D printing of an experimental cell for SAXS chemical measurements

The design of the cell was based on a previous experimental chamber already present at the beamline. Cell design and the realization were carried out in collaboration with Ing. Alessandro Gambitta e Luca Romanzin from the Mechanical, Vacuum and Optical Engineering Group who took care about the 3D printing of the device. The testing of the cell was made in the SAXS chemical laboratory at first and it was later used at the SAXS beamline for monitoring reactions in liquids.

Software development for
ELETTRA SAXS beamline
2017 / 2019

Renovation and improvement of procedures for real time data evaluation for the SAXS beamline

During the PhD, part of the time was dedicated to renovation and extension of the library set used for data crunching and analysis at the SAXS beamline, which is based on Igor PRO software. Improvements involved both the software used at the beamline and the libraries internally sheared within the SAXS group. Concerning the software used at the beamline, a new procedure was developed in order to automatically load and normalize the measured scattering patterns in real time. This allows to monitor more easily the evolution of the SAXS pattern during an experiment. Concerning the libraries used internally within the SAXS group, the main activities had been focused to more specific purposes related to SAXS data analysis, such as a new model for data fitting (which is able to retrieve size distribution of core and shell for the analysis of core-shell particles) or routines for serial analysis of large datasets.

User support for SAXS beamline

2019

- Involvement into ACCELERATE project, led by CERIC-ERIC allowed to provide user support in terms of assistance to proposal editing and experimental activities.

2017 / 2019

- Taken care about organization of experiments carried out during the doctorate in all of their aspects. In particular, the doctoral project allowed to face aspects of experimental design, consumables and equipment acquisition, experimental activity and data analysis to be provided to collaborators.

COLLATERAL EXPERIENCES

Participations to festivals
and art exhibitions

Ongoing

A study on the plastic nature of flora, sculpture, carved from wood block, in preparation:

Long live to the new flesh, sculpture in Plexiglas and clay, in preparation

2025

Di cronopios, famas ed esperanzas, land art sculpture, Pečno Park, Tolmin, Slovenia, June 2025

Brutal-Ibis land art sculpture, Paluzza, Italy, June 2025

2024

Istrice / Porcupine, land art sculpture, Bologna Art Mountain, June 2024

Neuromagma, plaster sculpture for collective exhibition, July 2024

2023

Nautilus, land art sculpture, Aeson Festival, July 2023

2022

Grifone / Griffin, land art sculpture, L'Energia dei Luoghi Festival, July 2022

2022

Post Semen, land art sculpture, Aeson Festival, Fiumicello, Italy, July 2022

2021

Blooming, land art sculpture, Aeson Festival, July 2021

2020

Segno / Sign, land art sculpture, Aeson Festival, July 2020

2019

Inserzione-Espulsione / Insertion-Expulsion, land art sculpture, Aeson Festival, July 2019

Trieste, 29/01/2026