



TO MAGNIFICO RETTORE OF UNIVERSITA' DEGLI STUDI DI MILANO

ID CODE 6717

I the undersigned asks to participate in the public selection, for qualifications and examinations, for the awarding of a type B fellowship at **Dipartimento di Chimica**

Scientist- in - charge: Dott. Ivan Grigioni

[Annalisa Polo]

## CURRICULUM VITAE

### PERSONAL INFORMATION

Surname	Polo
Name	Annalisa

### PRESENT OCCUPATION

Appointment	Structure
Postdoc researcher	Department of Chemistry, University of Milan, Milan (Italy)

### EDUCATION AND TRAINING

Degree	Course of studies	University	year of achievement of the degree
Bachelor's Degree	Chemistry (L-27)	University of Padua, Italy	2013
Master's Degree	Chemistry (LM-54)	University of Padua, Italy	2016
Post-Graduate Research Fellowship	Coherent 2D Electronic Spectroscopy methods development	Universität Würzburg, Germany	2016
Post-Graduate Research Fellowship within the "SmartMatLab Project" funded by Fondazione Cariplo and Regione Lombardia	Synthesis, photoelectrochemical and spectroscopic characterization of semiconductor photocatalysts for solar fuels applications	University of Milan, Italy	2017
PhD	Chemistry	University of Milan	2021
Doctor Europaeus Title	Chemistry	University of Milan	2021
Visiting researcher in the	Development and	Institute of	2019



Laboratory for Molecular Engineering of Optoelectronic Nanomaterials (LIMNO)	photoelectrochemical and electrochemical investigation of novel metal oxide-based photoanodes for visible light-driven hydrogen production	Chemical Sciences and Engineering, École polytechnique fédérale de Lausanne (EPFL), Switzerland	
Postdoctoral researcher “tipo B” (L. 240/2010)	Development of photoactive materials for photocatalysis and photoelectrocatalysis	Department of Chemistry, University of Milan, Milan (Italy)	December 2020 - November 2022
Postdoctoral researcher “tipo B” (L. 240/2010)	Carbon dioxide conversion into energy-rich molecules with tailored catalysts	Department of Chemistry, University of Milan, Milan (Italy)	December 2022 - May 2023
Visiting researcher in the Laboratory for Molecular Engineering of Optoelectronic Nanomaterials (LIMNO) in the frame of the “Borsa di studio per l’Europa 2022, per la Chimica” funded by the Accademia Nazionale dei Lincei	Photoelectrochemical investigation of ternary oxide semiconductor-based heterojunctions for solar energy conversion	Chemical Sciences and Engineering, École polytechnique fédérale de Lausanne (EPFL), Switzerland	December 2022 - April 2023
Postdoctoral researcher “tipo A” (L. 240/2010)	Ternary oxide semiconductor-based heterojunction photoanodes for solar fuels production	Department of Chemistry, University of Milan, Milan (Italy)	June 2023 - present

## FOREIGN LANGUAGES

Languages	level of knowledge
English	B2

## AWARDS, ACKNOWLEDGEMENTS, SCHOLARSHIPS

Year	Description of award
2016	Post-Graduate Research Fellowship “Coherent 2D Electronic Spectroscopy methods development and application on supramolecular structures” Institut für Physikalische und Theoretische Chemie, Universität Würzburg, Germany
2017	Post-Graduate Research Fellowship entitled “Borsa di studio per il proseguimento della formazione dei giovani più promettenti” within the SmartMatLab Project “Characterization and testing of smart materials”, funded by Fondazione Cariplo and Regione Lombardia - Chemistry Department, University of Milan, Italy
2017	Scholarship funded by the Physical Chemistry Division of the Italian Chemical Society (SCI) to attend the XXVI National Congress of the Italian Chemical Society (SCI), Paestum, Italy, 10-14 September 2017



2017	Young Physico-Chemist Award 2017 for the Presentation “TiO <sub>2</sub> /BiVO <sub>4</sub> Heterojunction for Photoelectrochemical Water Splitting” at the XXVI National Congress of the Italian Chemical Society (SCI), Paestum, Italy, 10-14 September 2017
2018	Scholarship funded by the Interdivisional EnerChem Group of the Italian Chemical Society (SCI), to attend the 1 <sup>st</sup> Enerchem School, Firenze, Italy, 20-24 February 2018
2019	Scholarship funded by the Interdivisional EnerChem Group of the Italian Chemical Society (SCI), to attend the 2 <sup>nd</sup> Enerchem Congress, Padova, Italy, 12-14 February 2020
2021	Winner of the “Fondazione Oronzio e Niccolò De Nora” PhD Thesis Award assigned by the Electrochemistry Division of the Italian Chemical Society (1000 EUR)
2021	Winner of the “Giovanni Semerano 2021” PhD Thesis Award assigned by the Physical Chemistry Division of the Italian Chemical Society (500 EUR)
2021	Winner of a scholarship to attend the Italian Photochemistry Meeting funded by the Italian Photochemistry Group of the Italian Chemical Society, Torino, Italy, 16-18 December 2021
2022	Winner of a scholarship “borsa di studio per l’Europa 2022, per la Chimica” funded by the Accademia Nazionale dei Lincei (8000 EUR) to spend a research period abroad
2022	Winner of a scholarship to attend the Italian Photochemistry Meeting funded by the Italian Photochemistry Group of the Italian Chemical Society, Ferrara, Italy, 15-17 December 2022

## TRAINING OR RESEARCH ACTIVITY

During my Master Thesis I had the chance to approach the field of 2D Electronic Spectroscopy, with the aim to reveal the quantum coherent mechanisms acting during the ultrafast relaxation dynamics of molecular systems in the femtosecond time scale, possibly involved in the control of energy transfer processes both in natural and artificial photosynthetic systems. I focused my attention on BODIPYs dyes as model systems, a great example of biomimetic light-harvesters thanks to their structural analogy to the half-porphyrins, the artificial equivalent of chlorophylls. After my graduation, I continued working on 2D Electronic Spectroscopy for six months during a fellowship finalized to the development of new set up and methods to be applied in supramolecular structures.

With the achievement of a “borsa di studio per il proseguimento della formazione dei giovani più promettenti” funded by Fondazione Cariplo, in the group of Prof. Elena Selli at the University of Milan, I extended my research interests to the development of metal oxide-based semiconductors for solar energy conversion into clean fuels, and to photoelectrochemistry as fundamental class of characterization techniques, fruitfully collaborating with the SmartMatLab centre. Within the six months fellowship, I learnt how to prepare thin films of metal oxide materials, mostly optically transparent to allow their potential implementation in PEC tandem devices, by means of the easily processable spin coating technique followed by thermal treatment; particularly, I grasped how to manage the synthesis parameters in strict relationship with the resulting photoelectrochemical (PEC) performance of the electrodes. In this way I synthesized and investigated metal oxide materials both as such and in heterojunction systems, focusing my attention on the most studied WO<sub>3</sub>, TiO<sub>2</sub> and BiVO<sub>4</sub> n-type semiconductors. I tested the performance of the prepared electrodes as photoanodes for solar water oxidation by means of a series of PEC techniques in a three-electrode configuration cell, with the final goal to employ them in the overall water splitting reaction, in combination with a cathode material, in a tandem cell. Among the different techniques employed, I devoted special attention to Linear Sweep Voltammetry (LSV) tests performed under standards conditions, *i.e.* AM 1.5 G solar simulated light (1 sun), allowing to check the photocurrent density generated by the material during a scan of linearly increasing applied potential, and Incident Photon to Current Efficiency (IPCE) analysis, in order to evaluate the solar conversion efficiency of the electrode in terms of photocurrent recorded at each single wavelength, under a fixed applied potential. The stability of the electrodes was also checked by means of chronoamperometric (CA) tests where the photocurrent produced at a fixed applied potential was monitored over prolonged time under 1 sun irradiation. Moreover, I also performed photocatalytic tests in a different set up without taking advantage of the external bias, to check the intrinsic photocatalytic reduction capability of the investigated materials towards methyl viologen, a



well-known molecular probe whose reduction potential is close to that of water reduction, as effective method to evaluate the relative reducing power of a series electrodes of interest.

During my three years PhD in Chemistry in the same research group, under the supervision of Dr. Maria Vittoria Dozzi, I dealt with a project concerning the development, through the synthesis parameterization and optimization supported by the application of a series of characterization techniques, of several metal oxide-based photoanodes for solar water oxidation. Specifically, I focused on the implementation of three different families of ternary oxides, *i.e.* bismuth vanadate, copper tungstate and spinel ferrite semiconductor photoanodes. In the first two cases ( $\text{BiVO}_4$  and  $\text{CuWO}_4$ ), I investigated the doping with Mo as effective strategy to improve the charge transport properties of the film and, in the specific case of  $\text{CuWO}_4$ , also to extending the visible light harvesting capability of the material through the narrowing of the bandgap energy. Moreover, the heterojunction of  $\text{BiVO}_4$  with the wider bandgap  $\text{TiO}_2$  oxide was studied with the aim to exploit the visible light harvesting capability of  $\text{BiVO}_4$  and the superior reduction power of the higher in energy  $\text{TiO}_2$  conduction band, in the same photoanode system. Finally,  $\text{ZnFe}_2\text{O}_4$  as prototype photoanode material of the spinel ferrites class was thoroughly investigated in collaboration with the group of Prof. Kevin Sivula at the EPFL of Lausanne during my 7 months stay, to understand the strict correlation occurring between crucial parameters such as the spinel structural disorder and the film crystallinity, both correlated to the annealing temperature, the film morphology, the thickness of the absorbing layer and the presence of oxygen vacancies induced by a post-synthesis hydrogen treatment, on the PEC performance, with the final goal to improve the remarkably poor charge separation of these materials. The investigated films were prepared via spin coating or chemical bath deposition to tune the film morphology from planar to nanostructured, respectively. A comprehensive characterization study of all prepared electrodes was performed by means of structural (XRD, XPS, Raman), morphological (FESEM, AFM), optical (UV-Vis absorption), photocatalytic (molecular probes photoreduction) and PEC (LSV, CA, IPCE, cyclovoltammetry (CV) and Internal Quantum Efficiency (IQE)) techniques. Furthermore, I took advantage of the combination of electrochemical techniques such as Electrochemical Impedance Spectroscopy (EIS) and photo(electro)chromic experiments, with Transient Absorption Spectroscopy, to reveal the energetics of the investigated metal oxides and, in particular, the presence of intra bandgap states acting as recombination centers and/or intermediates for the water oxidation reaction, thus playing a pivotal role on the observed PEC performance. In particular, Transient Absorption Spectroscopy was also applied with the aim to monitor the charge carrier dynamics occurring in the picosecond time scale in both individual and composite photoanodes, which is a direct indication of the efficiency of photogenerated charge separation in the bulk of a semiconductor material.

During my research period as a visiting PhD student in the group of Prof. Sivula at the EPFL of Lausanne, where I worked on the engineering of  $\text{ZnFe}_2\text{O}_4$  photoanodes through a comprehensive investigation of the structural, morphological and electronics parameters crucially affecting their PEC performance, I had the opportunity to acquire new skills in the photoelectrochemistry field, particularly in the acquisition, processing and interpretation of EIS data, as well as to approach the Intensity Modulated Photocurrent Spectroscopy, a powerful frequency-domain electrochemical technique to track the charge transfer and recombination processes affecting the photoelectrode performance working in operando conditions. Moreover, this internship period was a great opportunity to interface with an international community, pioneering in the PEC field.

In the last years as a postdoc researcher in the group of Prof. Selli at the University of Milan I deepened the study of the intrinsic properties of the most interesting ternary oxide materials as single photoabsorber electrodes, specifically  $\text{Mo}^{6+}$  doped  $\text{BiVO}_4$ ,  $\text{CuWO}_4$ ,  $\text{CuW}_{0.5}\text{Mo}_{0.5}\text{O}_4$  and  $\text{H}_2$  doped  $\text{ZnFe}_2\text{O}_4$ , as well as of the heterojunction systems resulting from the proper combinations between them. Particularly, I focused on the disentanglement of the bulk and surface effects of the different modification strategies employed, such as n-type doping with metal cations, reductive treatment in hydrogen atmosphere, surface deposition of co-catalyst layers such as  $\text{MoO}_x$ , and heterojunctions building on each electrode performance. To this aim and thanks to the fruitful collaboration with the group of Prof. Sivula at the EPFL of Lausanne, where I have the chance to spend 5 more months as a visiting postdoc researcher in the frame of the scholarship entitled “”, and financed by the Accademia Nazionale dei Lincei, I have gained more experience in the use of the most advanced spectroelectrochemical techniques based on both voltage and light modulation methods, such as electrochemical impedance spectroscopy (EIS) and intensity modulated photocurrent/photovoltage spectroscopy (IMPS/IMVS), as powerful diagnostic tools to unequivocally decouple, in operando, the bulk and surface processes occurring at the electrode/water interface and



affecting the photoanodes performance, by their respective time constants. Through this peculiar investigation, in coupling with complementary advanced spectroscopic tools such as transient absorption to track charge transfer and recombination processes, made available thanks to the further collaboration with the group of Prof. Cerullo at the Polytechnic University of Milan, I was able to point at strategies to identify and overcome the main semiconducting materials limitations towards solar water oxidation. The appropriate coupling of the optimized visible light active ternary oxides has finally led to the implementation of functional heterojunctions between them or with other wide band gap binary oxides providing the appropriate staggered band alignment at the semiconductor/semiconductor interfaces. In this way, ternary oxides-based heterojunction systems like  $\text{CuWO}_4/\text{BiVO}_4$  and  $\text{CuW}_{0.5}\text{Mo}_{0.5}\text{O}_4/\text{BiVO}_4$ , or hybrid heterojunction systems like  $\text{WO}_3/\text{BiVO}_4$ ,  $\text{WO}_3/\text{Mo doping:BiVO}_4$  and  $\text{TiO}_2/\text{Mo doping:BiVO}_4$  have been also assembled and investigated by means of a comprehensive PEC study aiming at extending the visible photoactivity of the single counterparts and enhancing their photogenerated charge carriers separation.

Finally, within my three years PhD and postdoc activity I practised myself in the tutoring of Bachelor's and Master's students for their thesis laboratory in the research group of Prof. E. Selli, as well as in the practicum laboratories scheduled during the Chemistry Bachelor's Degree, Industrial Chemistry Bachelor's Degree and Biotechnology Bachelor's Degree Courses at the University of Milan.

## PROJECT ACTIVITY

Year	Project
2014-2016	Title: "Novel photocatalytic materials based on heterojunctions for solar energy conversion" Project Code: 2013-0615 Funding Institution: Fondazione Cariplo - bando materiali avanzati 2013. Principal Investigator: Prof. Elena Selli, Università degli Studi di Milano (UniMi) Role: Participant.
2014-2017	Title: "Laboratorio multifunzionale e centro di formazione per la caratterizzazione e la sperimentazione preapplicativa di smart materials - SmartMatLab Centre" Project Code: 2013-1766 Principal Investigator: Prof. Elena Selli, Università degli Studi di Milano (UniMi) Funding Institution: Fondazione Cariplo and Regione Lombardia Role: Participant.
2017-2020	Title: "Solar driven chemistry: new materials for photo- and electro-catalysis (SMARTNESS)" Project Code: PROT20157FZLH. PRIN 2015 Funding Institution: Ministero dell'Istruzione, dell'Università e della Ricerca, MIUR. Principal investigator: Prof. Gianfranco Pacchioni, University of Milano-Bicocca Principal local Investigator: Prof. Elena Selli, Università degli Studi di Milano (UniMi). Role: Participant
2019-2022	Title: "Multielectron transfer for the conversion of small molecules: an enabling technology for the chemical use of renewable energy (MULTI-e)" Project code Prot. 20179337R7, PRIN 2017. Funding Institution: Ministero dell'Istruzione, dell'Università e della Ricerca, MIUR. Principal investigator: Prof. Gabriele Centi, University of Messina Principal local Investigator: Prof. Gian Luca Chiarello, Università degli Studi di Milano (UniMi) Role: Participant
2022-2025	Title: "Carbon dioxide conversion into energy-rich molecules with tailored catalysts (CO2ENRICH)" Project code Prot. 2021-0664 Funding Institution: Cariplo Foundation Principal investigator: Prof. Maria Vittoria Dozzi, Università degli Studi di Milano (UniMi) Role: Participant
2023-2025	Title: "Charge Transfer dynamics in Photoactive Materials for Solar Energy Conversion (CHARM)". MIUR PRIN 2022" Project code Prot. 20227TKTMY. MIUR PRIN 2022. Funding Institution: Ministero dell'Istruzione, dell'Università e della Ricerca, MIUR. Principal investigator: Prof. Prof. Giovanni Pacchioni, University of Milano Bicocca





Principal local Investigator: Dott. Ivan Grigioni, Università degli Studi di Milano (UniMi) Role: Participant
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## CONGRESSES AND SEMINARS

Date	Title	Place
2017	XXVI National Congress of the Italian Chemical Society (SCI) Poster presentation entitled: “TiO <sub>2</sub> /BiVO <sub>4</sub> Heterojunction for Photoelectrochemical Water Splitting” Authors: <b>A. Polo</b> , I. Grigioni, M. V. Dozzi and E. Selli	Paestum, Italy
2017	Italian Photochemistry Meeting (IPM) 2017 Oral presentation entitled: “TiO <sub>2</sub> /BiVO <sub>4</sub> Heterojunction for Photoelectrochemical Water Splitting”. Authors: <b>A. Polo</b> , I. Grigioni, M. V. Dozzi and E. Selli	Perugia, Italy
2018	1 <sup>st</sup> EnerChem School of the Italian Chemical Society (SCI) Poster presentation entitled: “Molybdenum Doped BiVO <sub>4</sub> Photoanodes for Oxygen Evolution”. Authors: <b>A. Polo</b> , I. Grigioni, M. V. Dozzi and E. Selli	Firenze, Italy
2018	10 <sup>th</sup> European Meeting on Solar Chemistry and Photocatalysis: Environmental Applications (SPEA 10) Short oral and poster presentation entitled: “Photo(electro)catalytic characterization of Molybdenum Doped BiVO <sub>4</sub> -based Photoanodes for Oxygen Evolution”. Authors: <b>A. Polo</b> , I. Grigioni, M. V. Dozzi and E. Selli	Almeria, Spain
2019	UK-Italian joint meeting on Photochemistry 2019 Poster presentation entitled: “CuW <sub>1-x</sub> Mo <sub>x</sub> O <sub>4</sub> as efficient visible light harvester for photoelectrochemical water oxidation” Authors: <b>A. Polo</b> , C. Nomellini, I. Grigioni, M. V. Dozzi, <u>E. Selli</u>	Lipari, Italy
2019	7 <sup>th</sup> International Conference on Semiconductor Photochemistry (SP7) Short oral and poster presentation entitled: “Novel ternary metal oxide-based materials for extended visible-light photoactivity: the case of molybdenum doped copper tungstate” Authors: <b>A. Polo</b> , C. Nomellini, I. Grigioni, M. V. Dozzi, E. Selli	Milan, Italy
2020	2 <sup>nd</sup> Enerchem Congress funded by the Interdivisional EnerChem Group of the Italian Chemical Society (SCI) Oral presentation entitled: “Engineering of performance-boosting hydrogenation on ZnFe <sub>2</sub> O <sub>4</sub> photoanodes: effects of thickness and thermal annealing temperature” Authors: <b>A. Polo</b> , F. A. Boudoire, C. R. J. Lhermitte, N. Guijarro, P. A. Schouwink, M. V. Dozzi, K. Sivula	Padova, Italy
2021	30 <sup>th</sup> International Conference on Photochemistry (ICP) Oral presentation entitled “Bulk and interfacial charge transfer effects of molybdenum doping in BiVO <sub>4</sub> photoanodes for solar water oxidation”. Authors: <b>A. Polo</b> , M.V. Dozzi, I. Grigioni, E. Selli	Virtual meeting
2021	30 <sup>th</sup> International Conference on Photochemistry (ICP) Oral presentation entitled “CuWO <sub>4</sub> -based photoanodes for efficient visible light exploitation”	Virtual meeting



	Authors: <u>M.V. Dozzi</u> , <b>A. Polo</b> , C. Nomellini, I. Grigioni, E. Selli	
2021	XXVII Congress of the Italian Chemical Society Invited oral presentation for the “Fondazione Oronzio e Niccolò De Nora 2021” PhD Thesis Prize of the Electrochemistry Division, entitled “Ternary Oxide Semiconductor Photoanodes for Solar Energy Conversion”. Author: <b>A. Polo</b>	Virtual meeting
2021	XXVII Congress of the Italian Chemical Society Invited oral presentation for the “Giovanni Semerano 2021” PhD Thesis Prize of the Physical Chemistry Division for the best PhD Thesis in Physical Chemistry, entitled “Effects of Mo <sup>6+</sup> doping on the performance of BiVO <sub>4</sub> photoanodes for solar water oxidation” Authors: <u>A. Polo</u> , M.V. Dozzi, I. Grigioni, F. Boudoire, C.R. Lhermitte, K. Sivula, E. Selli	Virtual meeting
2021	XXVII Congress of the Italian Chemical Society Oral presentation entitled “CuWO <sub>4</sub> -based photoanodes for solar energy conversion: effects of Mo <sup>6+</sup> doping and coupling with BiVO <sub>4</sub> ” Authors: <u>M.V. Dozzi</u> , <b>A. Polo</b> , G. Marra, E. Selli.	Virtual meeting
2021	XXVII Congress of the Italian Chemical Society Oral presentation entitled “WO <sub>3</sub> -BiVO <sub>4</sub> heterojunction: effects of WO <sub>3</sub> nanostructuring on photoelectrochemical performance” Authors: <u>C. Nomellini</u> , <b>A. Polo</b> , G. Marra, M.V. Dozzi, E. Selli.	Virtual meeting
2021	Giornate Italiane di Fotochimica Flash oral presentation entitled “CuWO <sub>4</sub> -based photoanodes for efficient visible light exploitation” Authors: <b>A. Polo</b> , M.V. Dozzi, I. Grigioni, E. Selli.	Virtual meeting
2021	Giornate Italiane di Fotochimica Flash oral presentation entitled “Nanostructured WO <sub>3</sub> photoanodes: effects on the coupled WO <sub>3</sub> -BiVO <sub>4</sub> system” Authors: <u>C. Nomellini</u> , <b>A. Polo</b> , M.V. Dozzi, E. Selli.	Virtual meeting
2021	Merck Young Chemists' Symposium 2021 of the Young Group of the Italian Chemical Society Oral presentation entitled “Copper molybdo-tungstate photoanodes for photoelectrochemical solar energy conversion” Authors: <b>A. Polo</b> , M.V. Dozzi, I. Grigioni, E. Selli	Rimini, Italy
2021	Merck Young Chemists' Symposium 2021 of the Young Group of the Italian Chemical Society Oral presentation entitled “WO <sub>3</sub> -BiVO <sub>4</sub> photoanodes: influence of the nanostructuring of the WO <sub>3</sub> underlayer” Authors: <u>C. Nomellini</u> , <b>A. Polo</b> , M.V. Dozzi, E. Selli.	Rimini, Italy
2021	Chemistry at the Surface: Key Aspects in Materials Design and Catalysis International Workshop Oral presentation entitled “Multifaceted role of Mo <sup>6+</sup> doping in BiVO <sub>4</sub> photoanodes for solar energy conversion” Authors: <b>A. Polo</b> , M.V. Dozzi, <u>E. Selli</u> .	Baveno, Italy
2021	Italian Photochemistry Meeting 2021 Flash oral presentation entitled “Multifaceted role of Mo <sup>6+</sup> doping in BiVO <sub>4</sub> ”	Torino, Italy



	photoanodes for solar energy conversion”. Authors: <b>A. Polo</b> , M.V. Dozzi, I. Grigioni, F. Boudoire, C.R. Lhermitte, K. Sivula, E. Selli.	
2022	11 <sup>th</sup> European Meeting on Solar Chemistry and Photocatalysis: Environmental Applications (SPEA 11), Torino, Italy, 6-10 June 2022. Oral presentation entitled “Copper Molybdo Tungstate-based Heterojunction Photoanodes for Photoelectrochemical Solar Energy Conversion” Authors: <b>A. Polo</b> , M. V. Dozzi and E. Selli	Torino, Italy
2022	11 <sup>th</sup> European Meeting on Solar Chemistry and Photocatalysis: Environmental Applications (SPEA 11), Torino, Italy, 6-10 June 2022. Keynote entitled “Improved Photoelectrochemical Performance of BiVO <sub>4</sub> -based Photoanodes: Heterojunctions Formation and Doping with Mo <sup>6+</sup> ” Authors: <b>E. Selli</b> , M.V. Dozzi, I. Grigioni, <b>A. Polo</b>	Torino, Italy
2022	XLVIII Congresso Nazionale di Chimica Fisica, Genova, Italy, 4-7 July 2022. Oral presentation entitled “Molybdenum doped CuWO <sub>4</sub> -based heterojunction photoanodes for solar energy conversion” Authors: M. V. Dozzi, <b>A. Polo</b> and E. Selli	Genova, Italy
2022	XLVIII Congresso Nazionale di Chimica Fisica, Genova, Italy, 4-7 July 2022. Oral presentation entitled “Visible light sensitized TiO <sub>2</sub> photoanodes for solar water splitting: coupling with Molybdenum doped BiVO <sub>4</sub> ” Authors: <b>A. Polo</b> , Laura Vigni, M. V. Dozzi and E. Selli	Genova, Italy
2022	8 <sup>th</sup> EuChemS Chemistry Congress, Lisbon, Portugal, 28 August-1 September 2022. Oral presentation entitled “Ternary Metal Oxide-based Photoanodes for Solar Energy Conversion”. Authors: <b>E. Selli</b> , <b>A. Polo</b> , I. Grigioni, M.V. Dozzi.	Lisbon, Portugal
2022	Italian Photochemistry Meeting (IPM) 2022, Ferrara, Italy, 15-17 December 2022. Oral presentation entitled “Molybdenum doped BiVO <sub>4</sub> as visible light sensitizer for TiO <sub>2</sub> photoanodes in solar water splitting” Authors: <b>A. Polo</b> , Laura Vigni, M.V. Dozzi, E. Selli	Ferrara, Italy
2022	Italian Photochemistry Meeting (IPM) 2022, Ferrara, Italy, 15-17 December 2022. Oral presentation entitled “Implementation of copper tungstate-based photoanodes for solar energy conversion” Authors: <b>M.V. Dozzi</b> , <b>A. Polo</b> , E. Selli	Ferrara, Italy
2023	XLIX National Congress of Physical Chemistry, Torino, Italy, 4-7 September 2023. Oral presentation entitled “Multiple effects induced by molybdenum doping in highly performing BiVO <sub>4</sub> photoanodes: surface vs bulk properties” Authors: <b>A. Polo</b> , M.V. Dozzi, I. Grigioni, K. Sivula, E. Selli	Torino, Italy
2023	XLIX National Congress of Physical Chemistry, Torino, Italy, 4-7 September 2023. Keynote presentation entitled “Photo(electro)catalytic and time-resolved spectroscopy characterization of metal oxide semiconductor materials for	Torino, Italy





	solar energy conversion” Authors: <u>E. Selli</u> , M.V. Dozzi, I. Grigioni, <b>A. Polo</b>	
2023	XLIX National Congress of Physical Chemistry, Torino, Italy, 4-7 September 2023. Poster presentation entitled “Combined Effects of Mo <sup>6+</sup> -doping and TiO <sub>2</sub> -coupling on BiVO <sub>4</sub> Photoanodes” Authors: <u>S. Pezzoli</u> , L. Vigni, <b>A. Polo</b> , M.V. Dozzi, E. Selli	Torino, Italy
2023	8 <sup>th</sup> International Conference on Semiconductor Photochemistry, Strasbourg, France, 11-15 September 2023. Flash oral presentation entitled “Insights into the key performance limit factors of planar zinc ferrite photoanodes for solar water oxidation” Authors: <u>A. Polo</u> , C.R. Lhermitte, Y. Liu, N. Guijarro, M.V. Dozzi, E. Selli, K. Sivula	Strasbourg, France
2023	8 <sup>th</sup> International Conference on Semiconductor Photochemistry, Strasbourg, France, 11-15 September 2023. Poster presentation entitled “Ni(II)-doped copper tungstate thin film photoanodes for increased photoelectrochemical performances and charge separation efficiency” Authors: <u>A. Polo</u> , C. Nomellini, I. Grigioni, M.V. Dozzi, E. Selli	Strasbourg, France
2023	8 <sup>th</sup> International Conference on Semiconductor Photochemistry, Strasbourg, France, 11-15 September 2023. Keynote presentation entitled “Charge separation and trapping in photoactive semiconductors investigated by time-resolved photoluminescence and transient absorption spectroscopies” Authors: <u>E. Selli</u> , M.V. Dozzi, I. Grigioni, <b>A. Polo</b>	Strasbourg, France
2024	12 <sup>th</sup> European Conference on Solar Chemistry and Photocatalysis: Energy and Environmental Applications (SPEA), Belfast, Northern Ireland, United Kingdom, 17-21 June 2024. Oral presentation entitled “Molybdenum doped BiVO <sub>4</sub> as efficient photoanode material in solar water splitting” Authors: <u>A. Polo</u> , M.V. Dozzi, I. Grigioni, K. Sivula, E. Selli	Belfast, Northern Ireland
2024	12 <sup>th</sup> European Conference on Solar Chemistry and Photocatalysis: Energy and Environmental Applications (SPEA), Belfast, Northern Ireland, United Kingdom, 17-21 June 2024. Poster presentation entitled “Minimizing detrimental charge recombination paths in planar WO <sub>3</sub> -BiVO <sub>4</sub> heterojunctions: a systematic film thickness investigation” Authors: <u>A. Polo</u> , M.V. Dozzi, I. Grigioni, K. Sivula, E. Selli	Belfast, Northern Ireland

## PUBLICATIONS

Articles
<b>A. Polo</b> , M.V. Dozzi, G. Marra, K. Sivula, E. Selli “Copper tungstate photoelectrocatalytic efficiency improvement upon Mo <sup>6+</sup> for W <sup>6+</sup> substitution and coupling with BiVO <sub>4</sub> ” Sustainable Energy Fuels, accepted.
J. Abed, I. Grigioni, T. Kose, W. Alnoush, S. Park, <b>A. Polo</b> , B.-H. Lee, D. Sinton, D. Higgins, E. Sargent “Identifying structural stability challenges for catalysts in membrane electrode assembly electrolyzers during CO <sub>2</sub> reduction”, ACS Energy Letters, under revision.



I. Grigioni, <b>A. Polo</b> , C. Nomellini, L. Vigni, A. Poma, M.V. Dozzi, E. Selli "Nature of Charge Carrier Recombination in CuWO <sub>4</sub> Photoanodes for Photoelectrochemical Water Splitting", ACS Appl. Energy Mater. 2023, 6, 10020-10029; doi:10.1021/acsaem.3c01608
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I. Grigioni, <sup>‡</sup> <b>A. Polo</b> , <sup>‡</sup> M.V. Dozzi, L. Ganzer, B. Bozzini, G. Cerullo, E. Selli, "Ultrafast Charge Carrier Dynamics in CuWO <sub>4</sub> Photoanodes", J. Phys. Chem. C 2021, 125, 5692-5699; doi:10.1021/acs.jpcc.0c11607. <sup>‡</sup> I. Grigioni and <b>A. Polo</b> contributed equally
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## OTHER INFORMATION

Postdocs Counselor at the Department of Chemistry of the University of Milan
Counselor for the Senior Physical Chemistry Division of the Italian Chemical Society
Counselor for the Physical Chemistry Division of the Young Group of the Italian Chemical Society



PhD representative of the Doctorate Course in Chemistry for the XXXIII cycle
Speaker for the UNIMI podcast project organized by Radio 2 on the sustainability topic
Member of the organizing committee of the MeetMeOnChem event at the Chemistry Department of the University of Milan (2018 and 2019)
Member of the organizing committee of the International Conference on "Semiconductor Photochemistry (SP7)" held in Milan in September 2019
Member of the "Italian Chemical Society (SCI)" since 2017
Member of the "Gruppo Italiano di Fotochimica (GIF)" since 2019
Member of the European Photochemistry Association (EPA) since 2019
Member of the Gruppo Interdivisionale Catalisi (GIC) since 2021
Co-supervisor for the Bachelor's thesis of Sara Oregioni and Rebecca Dossena
Tutoring to Industrial Chemistry Bachelor's students in the Laboratory of "Physical Chemistry B" for the Bachelor's Degree in Industrial Chemistry, held by Prof. Maria Vittoria Dozzi, according to the "Incarico di collaborazione finalizzata al tutorato e ad attività integrative della didattica ai sensi dell'art. 45 Regolamento Generale d'Ateneo" - Chemistry Department - University of Milan - 2024 (24 hours)
Practicum in exercises in the Physical Chemistry I Course of the Industrial Chemistry Bachelor's Degree held by Prof. Gian Luca Chiarello and Prof. Antonella Gervasini, according to the "Incarico di collaborazione finalizzata al tutorato e ad attività integrative della didattica ai sensi dell'art. 45 Regolamento Generale d'Ateneo" - Chemistry Department - University of Milan - Oct. 2023- Jan. 2024 (20 hours)
Tutoring to Biotechnology Bachelor's students in the Metodi Chimici per le Biotecnologie Laboratory held by Dr. Maria Vittoria Dozzi (2022066_DISFEB), according to the "Incarico di collaborazione finalizzata al tutorato e ad attività integrative della didattica ai sensi dell'art. 45 Regolamento Generale d'Ateneo" - Chemistry Department - University of Milan - 2023 (24 hours)
Practicum in exercises in the Physical Chemistry I Course of the Industrial Chemistry Bachelor's Degree held by Prof. Elena Selli and Prof. Antonella Gervasini, according to the "Incarico di collaborazione finalizzata al tutorato e ad attività integrative della didattica ai sensi dell'art. 45 Regolamento Generale d'Ateneo" - Chemistry Department - University of Milan - Oct. 2022- Jan. 2023 (10 hours)
Tutoring to Biotechnology Bachelor's students in the Metodi Chimici per le Biotecnologie Laboratory held by Dr. Maria Vittoria Dozzi (Code ID: 1126/AA), according to the "Incarico di collaborazione finalizzata al tutorato e ad attività integrative della didattica ai sensi dell'art. 45 Regolamento Generale d'Ateneo" - Chemistry Department - University of Milan - 2022 (24 hours)
Practicum in exercises to Chemistry Bachelor's students in the Physical Chemistry 2 Course held by Prof. Elena Selli (Code ID: 1053/H), according to the "Incarico di collaborazione finalizzata al tutorato e ad attività integrative della didattica ai sensi dell'art. 45 Regolamento Generale d'Ateneo" - Chemistry Department - University of Milan - 2022 (20 hours)
Tutoring to Biotechnology Bachelor's students in the Metodi Chimici per le Biotecnologie Laboratory held by Dr. Maria Vittoria Dozzi (Code ID: 943/U), according to the "Incarico di collaborazione finalizzata al tutorato e ad attività integrative della didattica ai sensi dell'art. 45 Regolamento Generale d'Ateneo" - Chemistry Department - University of Milan - 2021 (24 hours)
Tutoring to Industrial Chemistry Bachelor's students in the Physical Chemistry - B - Laboratory" for the Bachelor's Degree in Industrial Chemistry held by Prof. Gian Luca Chiarello (Code ID: 765/B), according to the "Incarico di collaborazione finalizzata al tutorato e ad attività integrative della didattica ai sensi dell'art. 45 Regolamento Generale d'Ateneo" - Chemistry Department - University of Milan - 2020 (32 hours)
Tutoring to Chemistry Bachelor's students in the Physical Chemistry 2 Laboratory held by Dr. Mariangela Longhi and Dr. Maria Vittoria (Code ID: 668/O), according to the "Incarico di collaborazione finalizzata al tutorato e ad attività integrative della didattica ai sensi dell'art. 45 Regolamento Generale d'Ateneo" -



Chemistry Department - University of Milan - 2019 (38 hours)

Tutoring to Chemistry Bachelor's students in the Physical Chemistry 2 Laboratory held by Prof. Alberto Vertova (Code ID: 439/M), according to the "Incarico di collaborazione finalizzata al tutorato e ad attività integrative della didattica ai sensi dell'art. 45 Regolamento Generale d'Ateneo" - Chemistry Department - University of Milan - 2018 (36 hours)

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