Curriculum vitae of Dr. Mauro Moglianetti, D. Phil. (Oxon)

LinkedIn: https://www.linkedin.com/in/mauromoglianetti/

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ORCID: 0000-0003-0747-7963, Scopus H-index (May. 2023): 17. Citations: 966.

Average citation per article: 31.2 "Total impact factor (sum of the impact factor of the journals)": 255.1 (an average of 8.5 per article)

EDUCATION

2005 – 2010 **University of Oxford (United Kingdom)**

DPhil (PhD) Degree in Physical Chemistry under the supervision of Dr. S. Titmuss and R.K.Thomas

Thesis title: "Polymer-surfactant mixtures confined at the air/liquid and solid/liquid interfaces"

1996 – 2003 **University of Bologna (Italy)**

Master's degree in chemistry (*110/110*)

Thesis title: "Crystallisation and structure of biologic macromolecules: amelogenin and diantina 30". Supervisor: Prof. A. Ripamonti, Prof G. Falini. The thesis research has been made in collaboration with Univ. Southern California.

MAIN WORK EXPERIENCES

2022 – now **Italian Institute of Technology, IIT,** Venice (Italy)

Senior researcher/ Group leader in the Centre for Cultural heritage technology (CCHT)

- **Supervisor of postdoctoral scholars and PhD students**
- **CCHT leader for Technology Transfer** (responsible of the IP protection policy and of the strategy for research commercialization)
- **CCHT leader in startups ideation and launching**
- **Responsible of the management of several European projects**

Research areas: production and application of antibacterial, enzymatic, and bio-derived (cellulose, polymeric) nanoparticles in cultural heritage preservation, design of composite nanomaterials based on graphene and 2D materials, nano-enabled art works diagnostics, nano-enabled anticounterfeiting systems.

2019 – 2022 **HiQ-Nano startup company,** Lecce and Genova (Italy)

CEO and co-founder

- Leader in the strategic, legal and financial areas
- Successfully led HiQ-Nano in raising **Venture Capitalists investment (Progress Tech Transfer)** and in securing **the financial and business support of Qatar SportsTech/ StartupBootCamp (**SAFE/ Equity round process)
- **Inventor** of the patent behind the project and **IP and business intelligence** responsible
- **Successful in securing several competitive European projects**

2013 - 2020 **Italian Institute of Technology, IIT,** Lecce and Genova (IT).

Senior postdoctoral position/ Team leader (director: Pier Paolo Pompa)

- **PI** of the **technology transfer project and Startup creation**
- **Supervisor and mentor** of PhD and master students
- **Inventor** of several patents
- **Lead and Corresponding author** of several publications
- **Responsible of the TEM and Bio-Nano facilities**
- **Responsible of the submission and management of several European projects**

Research areas: new synthetic methods for the controlled growth of plasmonic and catalytic nanoparticles, biomedical and energy applications of the nanomaterials by exploiting the new features obtained by the new synthetic protocols, nano-enabled point-of-care diagnostics, nano-enabled colorimetric read-out, nano-diagnostics.

2010 - 2013 **Massachusetts Institute of Technology, MIT** (USA)

École polytechnique fédérale de Lausanne - EPFL (CH)

Postdoctoral position. Materials science and Engineering Department (Director: Prof. Francesco Stellacci)

- **Scientific and teaching responsibility** of PhD and master students
- **Responsible of the team dedicated to the development of innovative techniques** for the characterization of the presence of nanodomains on nanoparticles surface.
- **Responsible of** Small Angle **X-ray Scattering** and Small Angle **Neutron** Scattering (SAXS and SANS) and Neutron Reflectivity (NR) experiments.

- Successful in establishing SANS AND NR as key techniques in nanoparticles characterization and application.

Research areas: nanotechnology and materials chemistry. Hybrid nanoparticles synthesis and characterization by scattering techniques (SAXS, SANS, NR).

ADDITIONAL WORK EXPERIENCES

March 2022 – July 2022

National Research Council (CNR)

- **Fixed-term Researcher position. CNR, ISMN**

Research areas: Nanomaterials for Lab-on-a-chip.

2009 - 2010

Ludwig Maximilian University, LMU, Physics Department, Munich

Forschungs-Neutronenquelle Heinz Maier-Leibnitz, FMR II

- **Reaserch assistant,** Physics Department/ Refsans

2005 - 2009

University of Oxford

- **Student representative**, Wolfson college (Oxford), Finance committee
- **Teaching assistant** of Physical Chemistry Experiments Module for undergraduate students

2004 - 2005

University of Ancona (Physics Department)

- **Research Assistant** in the field of protein folding/unfolding by Small angle X-ray and Neutron scattering.

Jan. 2004 – June 2004

"Biochem" Laboratory srl (Bologna)

- **Chemical Analyst**

LANGUAGE SKILLS

Italian	Native
English:	Fluent, C2
French:	Intermediate level, B2/C1
German:	Beginner level

ARTIFICIAL INTELLIGENCE and IT SKILLS

- AI and machine learning application in diagnostics and anticounterfeiting
- Extensive knowledge of Microsoft Office, EndNote, Igor Pro
- Programming experience: Pascal, Turbopascal, Basic, Igor Pro (C-like programming language)

BUSINESS MANAGEMENT AND ADMINISTRATION

- Startup business management and administration, innovation management, product management, legal tools for biotech startups
- Fundraising and investors relations
- Market analysis, marketing, social media and marketplace analysis

RESEARCH AND INNOVATION GRANTS

- Supercol, ITN European grant, HiQ-nano, SuperCol: Rational design of super-selective and responsive colloidal particles for biomedical applications, EU, ID 860914, Sum: €261K (2020-2024)
- SbD4Nano, European grant, HiQ-Nano, ID: 862195, Sum: €160K (2019-2022)
- Venture Capitalist investment: Progress Tech Transfer, €350K, (2019)
- Invitalia, Brevetti+: €45K, (2020)
- Accelerator program (Qatar Sports tech, Start-up Bootcamp): $150K (2019).
- 30 days of X-ray and neutron beamtime, equivalent to more than €300K.

TEACHING EXPERIENCE

- Supervision of more than 15 master students for their master thesis.

- Co-supervision of 3 PhD students
- Undergraduate course for materials engineering at EPFL as tutor
- Teaching assistant at Physical Chemistry Experiments Module for undergraduate students

NAMES AND ADDRESSES OF REFERENCES

Francesco Stellacci, Professor at EPFL (CH), email: francesco.stellacci@epfl.ch

Robert K. Thomas, FRS, Emeritus Professor at Oxford University, robert.thomas@chem.ox.ac.uk

Pier Paolo Pompa, PI/ director at Italian Institute of Technology, Pierpaolo.Pompa@iit.it

ANNEX I

ACADEMIC RESULTS (Patents, publication, talks, seminars and schools)

PATENTS

ID number	title	assignee	Inventors	priority date	publication date
WO-2017103807-A1	Method for the synthesis of metal nanoparticles in aqueous environment without the use of shape directing agents	IIT	Mauro Moglianetti, Pier Paolo Pompa	15/12/15	22/06/17
WO-2018172904-A1	Method for determining the antioxidant capacity of a biological sample and related kit	IIT	Mauro Moglianetti, Pier Paolo Pompa	21/03/17	27/09/18
WO-2019021336-A1	Method for imaging a biological sample and corresponding probe	IIT	Roberto Marotta, Tiziano Catelani, Mauro Moglianetti, Elisa De Luca, Pier Paolo Pompa	28/07/17	31/01/19
WO2019175749A1	Method for determining the antioxidant capacity of a biological sample and related kit	IIT	Deborah Pedone, Mauro Moglianetti, Pier Paolo Pompa	13/03/18	19/09/19
WO-2021094891-A1	Process for the production of ultra-small Pt nanocrystals with high	IIT	Valentina Mastronardi, Mauro Moglianetti,	11/11/19	20/05/21

	percentage of {111} surface domains		Pier Paolo Pompa		
WO-2020212839-A1	Process for the synthesis of mesoporous platinum nanoparticles in an aqueous environment	IIT	Mauro Moglianetti, Deborah Pedone, Pier Paolo Pompa	17/04/19	22/10/20
IT102020000015460	Metodo anticontraffazione e kit per l'attuazione di tale metodo	IIT	Mauro Moglianetti, Deborah Pedone, Pier Paolo Pompa	26/06/20	

Publications

§ Role as corresponding author

1) G. Guidetti, R. Zanini, G. Franceschin, M. Moglianetti, T. Kim, N. Cohan, L. Chan, J. Treadgold, A. Traviglia, F. G. Omenetto, Proceedings of the National Academy of Sciences, 2023, 120, e2311583120.
2) E. Mazzotta, T. Di Giulio, V. Mastronardi, R. Brescia, P. P. Pompa, M. Moglianetti§ C. Malitesta, Microchimica Acta, 2023, 190, 425.
3) D. Nelli, V. Mastronardi, R. Brescia, P.P. Pompa, M. Moglianetti, R. Ferrando, Hydrogen Promotes the Growth of Platinum Pyramidal Nanocrystals by Size-Dependent Symmetry Breaking, Nano Letters, 23(2023) 2644-50.
4) Mastronardi, V.; Magliocca, E.; Gullon, J. S.; Brescia, R.; Pompa, P. P.; Miller, T. S.; Moglianetti, M.§ Ultrasmall, Coating-Free, Pyramidal Platinum Nanoparticles for High Stability Fuel Cell Oxygen Reduction. *ACS Applied Materials & Interfaces* **2022**, DOI:10.1021/acsami.2c07738.
5) Mastronardi, V.; Kim, J.; Veronesi, M.; Pomili, T.; Berti, F.; Udayan, G.; Brescia, R.; Diercks, J. S.; Herranz, J.; Bandiera, T., Moglianetti, M.§ Green chemistry and first-principles theory enhance catalysis: synthesis and 6-fold catalytic activity increase of sub-5 nm Pd and Pt@Pd nanocubes. *Nanoscale* **2022,** *14* (28), 10155.
6) Moglianetti, M.; § Pedone, D.; Morerio, P.; Scarsi, A.; Donati, P.; Bustreo, M.; Del Bue, A.; Pompa, P. P. Nanocatalyst-Enabled Physically Unclonable Functions as Smart

Anticounterfeiting Tags with AI-Aided Smartphone Authentication. ACS Applied Materials & Interfaces 2022, DOI:10.1021/acsami.2c02995.

7) Ragusa, E.; Mastronardi, V.; Pedone, D.; Moglianetti, M.; Pompa, P. P.; Zunino, R.; Gastaldo, P., Cham, 2023; p 95.
8) Ragusa, E.; Zunino, R.; Mastronardi, V.; Moglianetti, M.; Pompa, P. P.; Gastaldo, P. Design of a Quantitative Readout in a Point-of-Care Device for Cisplatin Detection. IEEE Sensors Letters 2022, 6 (11), 1.
9) Mastronardi, V.; Moglianetti, M.; Ragusa, E.; Zunino, R.; Pompa, P. P. From a Chemotherapeutic Drug to a High-Performance Nanocatalyst: A Fast Colorimetric Test for Cisplatin Detection at ppb Level. Biosensors **2022**, 12 (6), 375.
10) Perrelli, A.; Fatehbasharzad, P.; Benedetti, V.; Ferraris, C.; Fontanella, M.; De Luca, E.; Moglianetti, M.; Battaglia, L.; Retta, S. F. Towards precision nanomedicine for cerebrovascular diseases with emphasis on Cerebral Cavernous Malformation (CCM). *Expert Opinion on Drug Delivery* **2021,** *18* (7), 849.
11) Mazzotta, E.; Di Giulio, T.; Mastronardi, V.; Pompa, P. P.; Moglianetti, M.; Malitesta, C. Bare Platinum Nanoparticles Deposited on Glassy Carbon Electrodes for Electrocatalytic Detection of Hydrogen Peroxide. *ACS Applied Nano Materials* **2021,** *4* (8), 7650.
12) Hornberger, E.; Mastronardi, V.; Brescia, R.; Pompa, P. P.; Klingenhof, M.; Dionigi, F.; Moglianetti, M.; Strasser, P. Seed-Mediated Synthesis and Catalytic ORR Reactivity of Facet-Stable, Monodisperse Platinum Nano-Octahedra. *ACS Applied Energy Materials* **2021,** *4* (9), 9542.
13) Moglianetti, M.[§]; Pedone, D.; Udayan, G.; Retta, S. F.; Debellis, D.; Marotta, R.; Turco, A.; Rella, S.; Malitesta, C.; Bonacucina, G.; De Luca, E.; Pompa, P. P. Intracellular Antioxidant Activity of Biocompatible Citrate-Capped Palladium Nanozymes. *Nanomaterials* **2020**, *10* (1). https://doi.org/10.3390/nano10010099.
14) Pedone, D.; Moglianetti, M. [§]; Lettieri, M.; Marrazza, G.; Pompa, P. P. Platinum Nanozyme-Enabled Colorimetric Determination of Total Antioxidant Level in Saliva. *Anal. Chem.* **2020**, *92* (13), 8660–8664.
15) Mastronardi, V.; Udayan, G.; Cibecchini, G.; Brescia, R.; A. Fichthorn, K.; Paolo Pompa, P.; Moglianetti, M. [§] Synthesis of Citrate-Coated Penta-Twinned Palladium Nanorods and Ultrathin Nanowires with a Tunable Aspect Ratio. *ACS Appl. Mater. & Interfaces* **2020**, *12* (44), 49935–49944. https://doi.org/10.1021/acsami.0c11597.
16) Franco-Ulloa, S.; Tatulli, G.; Bore, S. L.; Moglianetti, M.; Pompa, P. P.; Cascella, M.; De Vivo, M. Dispersion State Phase Diagram of Citrate-Coated Metallic Nanoparticles in Saline Solutions. *Nat. Commun.* **2020**, *11* (1), 1–10.
17) Donati, P.; Moglianetti, M.; Veronesi, M.; Prato, M.; Tatulli, G.; Bandiera, T.; Pompa, P. P. Nanocatalyst/Nanoplasmon-Enabled Detection of Organic Mercury: A One-Minute Visual Test. *Angew. Chemie Int. Ed.* **2019**, *58* (30), 10285–10289.

18) Turco, A.; Moglianetti, M. § (shared first author); Corvaglia, S.; Rella, S.; Catelani, T.; Marotta, R.; Malitesta, C.; Pompa, P. P. Sputtering-Enabled Intracellular X-Ray Photoelectron Spectroscopy: A Versatile Method to Analyze the Biological Fate of Metal Nanoparticles. *ACS Nano* **2018**, *12* (8), 7731–7740.
19) Gatto, F.; Moglianetti, M.; Pompa, P. P.; Bardi, G. Platinum Nanoparticles Decrease Reactive Oxygen Species and Modulate Gene Expression without Alteration of Immune Responses in THP-1 Monocytes. *Nanomaterials* **2018**, *8* (6), 392.
20) De Luca, E.; Pedone, D.; Moglianetti, M.; Pulcini, D.; Perrelli, A.; Retta, S. F.; Pompa, P. P. Multifunctional Platinum@BSA-Rapamycin Nanocarriers for the Combinatorial Therapy of Cerebral Cavernous Malformation. *ACS Omega* **2018**, *3* (11), 15389–15398. https://doi.org/10.1021/acsomega.8b01653.
21) Moglianetti, M. §; Solla-Gullón, J.; Donati, P.; Pedone, D.; Debellis, D.; Sibillano, T.; Brescia, R.; Giannini, C.; Montiel, V.; Feliu, J. M.; Pompa, P. P. Citrate-Coated, Size-Tunable Octahedral Platinum Nanocrystals: A Novel Route for Advanced Electrocatalysts. *ACS Appl. Mater. Interfaces* **2018**, *10* (48), 41608–41617. https://doi.org/10.1021/acsami.8b11774.
22) Gatto, F.; Cagliani, R.; Catelani, T.; Guarnieri, D.; Moglianetti, M.; Pompa, P.; Bardi, G. PMA-Induced THP-1 Macrophage Differentiation Is Not Impaired by Citrate-Coated Platinum Nanoparticles. *Nanomaterials* **2017**, *7* (10), 332. https://doi.org/10.3390/nano7100332.
23) Pedone, D.; Moglianetti, M.; De Luca, E.; Bardi, G.; Pompa, P. P. Platinum Nanoparticles in Nanobiomedicine. *Chemical Society Reviews*. Royal Society of Chemistry August 21, 2017, pp 4951–4975. https://doi.org/10.1039/c7cs00152e.
24) Guarnieri, D.; Melone, P.; Moglianetti, M.; Marotta, R.; Netti, P. A.; Pompa, P. P. Particle Size Affects the Cytosolic Delivery of Membranotropic Peptide-Functionalized Platinum Nanozymes. *Nanoscale* **2017**, *9* (31), 11288–11296. https://doi.org/10.1039/c7nr02350b.
25) Moglianetti, M. §; De Luca, E.; Pedone, D.; Marotta, R.; Catelani, T.; Sartori, B.; Amenitsch, H.; Retta, S. F.; Pompa, P. P. Platinum Nanozymes Recover Cellular ROS Homeostasis in an Oxidative Stress-Mediated Disease Model. *Nanoscale* **2016**, *8* (6), 3739–3752. https://doi.org/10.1039/c5nr08358c.
26) Reguera, J.; Ponomarev, E.; Geue, T.; Stellacci, F.; Bresme, F.; Moglianetti, M. § Contact Angle and Adsorption Energies of Nanoparticles at the Air–Liquid Interface Determined by Neutron Reflectivity and Molecular Dynamics. *Nanoscale* **2015**, *7* (13), 5665–5673.
27) Moglianetti, M. §; Ponomarev, E.; Szybowski, M.; Stellacci, F.; Reguera, J. Co-Precipitation of Oppositely Charged Nanoparticles: The Case of Mixed Ligand Nanoparticles. *J. Phys. D. Appl. Phys.* **2015**, *48* (43), 434001.
28) Moglianetti, M.; Ong, Q. K.; Reguera, J.; Harkness, K. M.; Mameli, M.; Radulescu, A.;

Kohlbrecher, J.; Jud, C.; Svergun, D. I.; Stellacci, F. Scanning Tunneling Microscopy and Small Angle Neutron Scattering Study of Mixed Monolayer Protected Gold Nanoparticles in Organic Solvents. *Chem. Sci.* **2014**, *5* (3), 1232–1240.

29) Ong, Q. K.; Reguera, J.; Silva, P. J.; Moglianetti, M.; Harkness, K.; Longobardi, M.; Mali, K. S.; Renner, C.; De Feyter, S.; Stellacci, F. High-Resolution Scanning Tunneling Microscopy Characterization of Mixed Monolayer Protected Gold Nanoparticles. *ACS Nano* **2013**, *7* (10), 8529–8539.
30) Moglianetti, M.; Webster, J. R. P.; Edmondson, S.; Armes, S. P.; Titmuss, S. A Neutron Reflectivity Study of Surfactant Self-Assembly in Weak Polyelectrolyte Brushes at the Sapphire− Water Interface. *Langmuir* **2011**, *27* (8), 4489–4496.
31) Moglianetti, M.; Webster, J. R. P.; Edmondson, S.; Armes, S. P.; Titmuss, S. Neutron Reflectivity Study of the Structure of PH-Responsive Polymer Brushes Grown from a Macroinitiator at the Sapphire− Water Interface. *Langmuir* **2010**, *26* (15), 12684–12689.
32) Moglianetti, M.; Campbell, R. A.; Nylander, T.; Varga, I.; Mohanty, B.; Claesson, P. M.; Makuška, R.; Titmuss, S. Interaction of Sodium Dodecyl Sulfate and High Charge Density Comb Polymers at the Silica/Water Interface. *Soft Matter* **2009**, *5* (19), 3646–3656.
33) Moglianetti, M. Polymer Surfactant Mixtures Confined at the Air/Water and Solid/Water Interfaces. Oxford University 2009.
34) Moglianetti, M.; Li, P.; Malet, F. L. G.; Armes, S. P.; Thomas, R. K.; Titmuss, S. Interaction of Polymer and Surfactant at the Air− Water Interface: Poly (2-(Dimethylamino) Ethyl Methacrylate) and Sodium Dodecyl Sulfate. *Langmuir* **2008**, *24* (22), 12892–12898.

Participation to international CONFERENCES

1) Oral presentation at ACS Fall 2019 National Meeting & Exposition in San Diego, CA, August 25 - 29, 2019. PAPER ID: 3198342, PAPER TITLE: Citrate-coated, size-tunable octahedral platinum nanocrystals: Novel route for advanced electrocatalysts, DIVISION: Division of Colloid and Surface Chemistry, SESSION: Nanomaterials, Present in the ABSTRACTS OF PAPERS OF THE AMERICAN CHEMICAL SOCIETY. Vol. 258. 1155 16TH ST, NW, WASHINGTON, DC 20036 USA: AMER CHEMICAL SOC, 2019.
2) Poster presentation at ACS Fall 2019 National Meeting & Exposition in San Diego, CA, August 25 - 29, 2019. Title: "Palladium nanoparticles as ROS scavengers". Present in the ABSTRACTS OF PAPERS OF THE AMERICAN CHEMICAL SOCIETY. Vol. 258. 1155 16TH ST, NW, WASHINGTON, DC 20036 USA: AMER CHEMICAL SOC, 2019.

3) Oral presentation at ACS Fall 2019 National Meeting & Exposition in San Diego, CA, August 25 - 29, 2019. PAPER ID: 3198346, PAPER TITLE: Sputtering-enabled intracellular X-ray photoelectron spectroscopy (SEI-XPS): New lab-based technique to investigate the biological fate of metal nanoparticles, DIVISION: Division of Colloid and Surface Chemistry, SESSION: Biomaterials & Biointerfaces. Present in the ABSTRACTS OF PAPERS OF THE AMERICAN CHEMICAL SOCIETY. Vol. 258. 1155 16TH ST, NW, WASHINGTON, DC 20036 USA: AMER CHEMICAL SOC, 2019.
4) Oral Presentation at the 256th ACS National Meeting in Boston, MA, August 19-23, 2018. PAPER ID: 2985041, PAPER TITLE: Highly engineered platinum nanoparticles as multifunctional active nanocarriers integrating the function of high-performance antioxidant drugs, DIVISION: Division of Colloid and Surface Chemistry. SESSION: Nanomedicines: From Fundamentals to Applications. Present in the ABSTRACTS OF PAPERS OF THE AMERICAN CHEMICAL SOCIETY. Vol. 256. 1155 16TH ST, NW, WASHINGTON, DC 20036 USA: AMER CHEMICAL SOC, 2018.
5) Oral Presentation at the CLINAM Conference in Basel, CH, June 26-29, 2016. PAPER ID: 2985041, PAPER TITLE: "Biocompatible Platinum Nanoparticles Restore Physiological Ros Homeostasis In A Real Experimental Model Of A Human Cerebrovascular Disease". Present in the Conference proceedings available at: "https://clinam.org/wp-content/uploads/2021/10/low-res-Clinam-Proceedings-2016-complete.pdf"
6) Poster presentation at 2014 MRS Spring Meeting & Exhibit April 21-25, 2014 in San Francisco, USA. Title: "Small Angle Neutron Scattering as a new technique to characterize nanodomains on Mixed Monolayer Protected Gold Nanoparticles" ID: # 1867928
7) Gordon Conference, Noble metal Nanoparticles, Mount Holyoke College MA, USA, June 2012, Poster contribution
8) Gordon Conference, Noble metal Nanoparticles, Mount Holyoke College MA, USA, June 2010, Poster contribution
9) FMR-II workshop, Burg Rothenfels, Germany, June 2009, Poster contribution
10) M4 Colloids, Bath University, Bath, UK, July 2008, Poster contribution
11) Marie Curie Research Training Network SOCON Meeting, Durham, UK, September 2008, oral contribution
12) "Surfaces and Interfaces in Soft Matter and Biology - The Impact and Future of Neutron Reflectivity" in honour of Bob Thomas, ILL, Grenoble, France, May 2008, oral contribution
13) Marie Curie Research Training Network SOCON Meeting, Stockholm, Sweden, September 2007, oral contribution
14) 81st ACS Colloid and Surface Science Symposia, University of Delaware, Newark, USA, June 2007, oral contribution
15) Marie Curie Research Training Network SOCON Meeting, Budapest, Hungary, Sept. 2006, oral contribution
16) 56th annual Nobel Laureate Lindau Meeting, Lindau, Germany, June 2006, oral contribution
17) Summer School of the Marie Curie Research Training Network SOCON- Self-Organisation under Confinement, Orsay, France, June 2006, oral contribution

LIST OF SUMMER SCHOOLS ATTENDED

Budapest spring school on Neutron Scattering Techniques (April 2005), Paris summer school on Colloid and Surface Chemistry (June 2006), Stockholm summer school on Colloid and Surface Chemistry for Bio-interface (Sept. 2007)

INVITED SEMINARS AT ACADEMIC INSTITUTIONS AND RESEARCH CENTERS

1) Verona University, Seminar, 21th April 2023
2) Ca' Foscari University of Venice, Seminar, 22nd March 2023
3) Workshop Polimi in Venice, talk, 26th Sept. 2022
4) University College London, UCL, Chemical Engineering Department, Seminar, 24th June 2022
5) University College London, UCL, Chemical Engineering Department, Industry Lecture series, 21st March 2022
6) University College London, UCL, Chemical Engineering Department, Industry Lecture series, 23rd March 2021
7) University College London, UCL, AdReNa Group Seminar, 16th July 2018
8) Constellium, Aluminium multinational company, Grenoble (FR), 2013
9) IBM, Zurich (CH), 2012
10) Debiopahrm, Martigny (CH), 2011
11) ESRF (European Synchrotron), November 2010
12) LMU University, Munich (Germany), February 2009
13) Lund University, Lund (Sweden), October 2008

ANNEX II

LIST OF 5 PUBLICATIONS WITH MAJOR FINDINGS HIGHLIGHTED

1. Mastronardi, V.; Magliocca, E.; Gullon, J. S.; Brescia, R.; Pompa, P. P.; Miller, T. S.; Moglianetti, M.§ Ultrasmall, Coating-Free, Pyramidal Platinum Nanoparticles for High Stability Fuel Cell Oxygen Reduction. ACS Applied Materials & Interfaces 2022, DOI:10.1021/acsami.2c07738 10.1021/acsami.2c07738.

The surface arrangement and size of metal catalysts are both known to be critically important in defining their catalytic selectivity, kinetics and stability for numerous reactions, including oxygen reduction (ORR) at Pt. The mass activity of Pt for the ORR is known to exhibit a maximum at a particle size of around 3 nm, and different facets, which can be defined by particle shape, have been shown to offer enhanced reaction rates and operational lifetimes. Unfortunately, to date nobody has been able to produce small Pt nanoparticles with shape control, combining these benefits. Similarly, people have struggled to define nanoparticle shape using a simple aqueous method with low toxicity chemicals that do not intrinsically poison the catalysts produced, hindering industrialisation. Finally, nobody has investigated the impact of (big or small) Pt particle shape control on the ORR in real fuel cell systems, a highly challenging electrochemical environment where many catalysts struggle, but one that must be overcome before Pt catalysts can be commercialised.

In this paper we describe a scalable synthesis of ultra-small (3.4 nm) citrate-coated Pt pyramidal nanoparticle catalysts with an unprecedented and high percentage of high quality {111} facets and total absence of any unwanted coatings post processing. All achieved via an aqueous, low temperature and fast process using precursors with significantly reduced toxicity and potential for environmental harm than comparative methods, a significant breakthrough. These pyramidal Pt catalysts are then shown to offer significantly enhanced stability under accelerated stress condition as cathode catalysts in full polymer electrolyte fuel cells, both compared to non-faceted equivalents and highly optimised commercial Pt/C catalysts, while providing equivalent current and power densities. We therefore clearly demonstrate that shape control to promote the {111} face of Pt catalysts can have a real-world impact within fuel cells, with significant implications for their industrial application potential.

Specific achievements include:

- The obtained nanomaterials are completely new; the pyramidal shape combined with the ultra-small (~3 nm) size have never been reported in literature for a monometallic material.
- The synthetic method does not require polymeric directing agents or surfactant molecules, which are difficult and costly to remove and highly detrimental in catalytic processes. It can also be easily scaled up, as it is simple, low temperature, ‘one-pot’ and

fast. Moreover, it can be considered to be sustainable and have low environment impact, as it requires only water as a solvent and sodium citrate as capping and reducing agent whilst only using an irrelevant amount of sodium borohydride as non-biogenic reagent.

- The action of sodium citrate and controlled oxidative etching are combined to act as directing agents, through a synergistic process. This is a significant breakthrough, as the reagents do not per se directly impart any shape, in the synthetic protocols present in the literature.
- These catalysts are shown to offer significantly enhanced durability in full polymer electrolyte membrane fuel cells, while providing equivalent current and power densities of commercial catalysts, due to the surface structure.
- This new material has been tested using standardised US Department of Energy (DoE) accelerated stress tests in full fuel cells, rather than ex situ using rotating disk electrode tests. This is a very challenging electrochemical environment, but the only one where the benefits of any ORR electrocatalyst can be truly revealed for this application.

The above factors underline that this work has significant implications for both fundamental material synthesis and applied catalysis. It clearly demonstrates that highly active and stable, yet complex, catalysts for important industrial electrocatalytic process can be produced simply, cleanly and at volume.

Role: Last and corresponding author.

2. Mastronardi, V.; Udayan, G.; Cibecchini, G.; Brescia, R.; A. Fichthorn, K.; Paolo Pompa, P.; Moglianetti, M. **§** Synthesis of Citrate-Coated Penta-Twinned Palladium Nanorods and Ultrathin Nanowires with a Tunable Aspect Ratio. *ACS Appl. Mater. Interfaces* **2020**, *12* (44), 49935–49944. https://doi.org/10.1021/acsami.0c11597.

In this paper we developed a novel synthesis of citrate-coated penta-twinned palladium nanowires and nanorods, characterized by tuneable length, high percentage of {100} facets whilst keeping 7 nm thickness, high surface quality and absence of unwanted coating, a breakthrough for applications in nanomedicine. Indeed, Pd nanowires achieve biocompatibility and interesting enzymatic properties.

There are several clear achievements in this paper:

- The mechanism of reaction is completely new as the shape and the size of the nanowires derive from the synergy of physical parameters and reagents. This new method does not require polymeric directing agents or sticky molecules, difficult to remove and highly detrimental in catalytic processes and biomedical applications.
- Strictly related to the above point, sodium citrate, bromide ions and controlled oxidative etching act as directing agents thanks to the synergy of the parameters. This is a breakthrough, as these reagents without the use of polymers and surfactants do not

impart any shape in the synthesis of palladium nanowires/ nanorods in the synthetic protocols present in the literature.

- The synthesis achieves tunability in length (from 38 nm to 470 nm), high percentage of {100} facets whilst maintain really low value of thickness (crucial point for maximizing surface to volume ratio) A complete characterization of the nanomaterial with TEM and HRTEM demonstrates the high quality of the surface of nanomaterials.
- The synthetic method has been scaled up with microwave technology and meets the requirements to be considered "green" as it requires only water as solvent and organic acids (such as citric and ascorbic) as capping and reducing acids.
- Interestingly, the absence of sticky molecules or toxic by-products guarantees the biocompatibility of the nanomaterials, while leaving the surface clean to perform enzymatic activities.

Role: Last and corresponding author.

3. Pedone, D.; Moglianetti, M. [§]; Lettieri, M.; Marrazza, G.; Pompa, P. P. Platinum Nanozyme-Enabled Colorimetric Determination of Total Antioxidant Level in Saliva. *Anal. Chem.* **2020**, *92* (13), 8660-8664.

In this work, we report for the first time the development of a novel detection scheme, based on the enzyme-mimetic properties of platinum nanoparticles combined to hydroxyl radical probes produced at the particle surface, for the non-invasive, instrument-free measurement of the total antioxidant level in saliva samples. Importantly, the proposed method was demonstrated to be sensitive to both Single Electron Transfer (SET) and Hydrogen Atom Transfer (HAT) reactions, a crucial feature to enable measuring all the physiologically relevant antioxidant species, unlike several state-of-the-art instrumental techniques. Thanks to the use of the platinum nanozymes, the methods provides a fast colorimetric response (5 min, ambient conditions operation) that can be evaluated via simple naked-eye or smartphone-based inspection, with same accuracy as instrumental techniques. The test was also validated in real samples of saliva from healthy volunteers, showing great potential for frequent non-invasive screenings.

These results represent a significant advance in the emerging fields of nanozymes and portable sensors.

Role: Second and corresponding author.

4. Moglianetti, M. [§] (shared first author); Turco, A.; Corvaglia, S.; Rella, S.; Catelani, T.; Marotta, R.; Malitesta, C.; Pompa, P. P. Sputtering-Enabled Intracellular X-Ray Photoelectron Spectroscopy: A Versatile Method to Analyze the Biological Fate of Metal Nanoparticles. *ACS Nano* **2018**, *12* (8), 7731–7740.

In this paper we present a breakthrough method based on two major points: sputtering performed directly on cells to gradually expose part the intracellular environment and XPS to provide semiquantitative information about metallic species and their oxidation state.

There are several key achievements in this paper:

- For the first time XPS combined with sputtering has been conceived, optimized and used to characterize the behaviour of metallic NPs within cells, directly measuring their internalization, stability/degradation, and oxidation state. This new methodology, called SEI-XPS, provides localization and semi-quantitative information about the amount of the metallic species internalized within cells. This overcomes the major limits of current lab-based techniques usually employed in nanomedicine/ nanotoxicology.
- Two model cases, silver nanoparticles and platinum nanoparticles of same size and coating, were investigated, giving a further proof of the ion release-related mechanism behind toxicity and cytocompatibility.
- The new method is easy-to-use and will become a standard technique in nanotoxicology/nanomedicine and in the rational design of metallic NPs for biomedical applications, given the availability of an XPS machine in any major university/ research center.

These findings are accompanied by TEM, STEM, viability tests and AFM measurements that further demonstrate and support the findings and the capability of the technique.

Role: First (shared) and corresponding author.

5. Moglianetti, M. [§]; Solla-Gullón, J.; Donati, P.; Pedone, D.; Debellis, D.; Sibillano, T.; Brescia, R.; Giannini, C.; Montiel, V.; Feliu, J. M.; Pompa, P. P. Citrate-Coated, Size-Tunable Octahedral Platinum Nanocrystals: A Novel Route for Advanced Electrocatalysts. *ACS Appl. Mater. Interfaces* **2018**, *10* (48), 41608–41617. https://doi.org/10.1021/acsami.8b11774.

In this paper, we describe a novel synthesis of platinum octahedral nanocrystals, which is able to combine very small particle size (7 nm) to excellent surface quality and absence of unwanted coatings, a breakthrough for applications in electrocatalysis. In particular, the 7 nm octahedra have been demonstrated to show superior performance in the electro-oxidation of formic acid, an important process in fuel cell technology.

There are several key achievements in this paper:

- The mechanism of reaction is completely novel, as the shape and the size of the nanocrystals are determined through a synergistic interaction of the reagents with the physical parameters of the reaction. This new method does not require classical shape-directing agents or sticky molecules, which are difficult to remove in post-synthesis and highly detrimental in catalytic processes. Interestingly, under our controlled conditions, sodium citrate and ascorbic acid are able to act as directing agents, unlike previous protocols reported in the literature. This is an important innovation, as the obtained nanocrystals exhibit "quasi-naked" surface with highly developed {111} facets.
- The method has been scaled-up to half a gram production per synthesis, and meets the requirements to be considered "green", since it requires only water as solvent and citric and ascorbic acids as capping and reducing acids.
- The superior performance of 7 nm octahedra in the electro-oxidation of formic acid are demonstrated. Indeed, the electrocatalytic activity of 7 nm octahedral nanocrystals is clearly enhanced compared to 10 nm and 18 nm counterparts, and this is extremely remarkable for practical applications (in terms of activity per surface area unit and, hence, cost of the material).

These results are accompanied by an accurate characterization of the nanomaterials with several cutting-edge techniques, such as TEM, SAED, HRTEM, XRD and electrochemical methods, which all demonstrate the excellent quality of the surface of nanocrystals both at single particle and bulk level.

Role: First and corresponding author.

ANNEX III

DETAILED STARTUP and TECHNOLOGY TRANSFER ACTIVITIES

I am motivated and passionate in having a positive impact on society and on people' lives with my research and technology transfer activities. In order to achieve the greatest results possible, I pay strong attention to the Intellectual Property Rights (IPR) Protection of my research. During my years as senior scientist, I achieved to be the first inventor of 4 patents and the co-inventor of 3 others as listed in the CV. Two of them are the basis of the iBlue project that has reached the go-to-market stage (please visit the marketplace at www.ibluelab.com).
I am also really interested in leading the innovation and the technology transfer activities. I have co-founded HiQ-Nano, a start-up company from the Italian Institute of Technology - IIT, born with the goal to develop innovative ideas and out-of-the-box approaches in the field of point-of-care diagnostics, home testing, and colorimetric assays. Moreover, I have assumed the role of CEO and I have driven the go-to-market journey. More in details, I have coinvented, patented and designed the iBlue concept, the first test to use nanozymes for a commercial user-oriented product. I have also managed the legal and financial process necessary to run the business. This has also allowed me to have a direct control of all the innovation pipeline and to deal with the issues associated.
The interest of the stakeholders, companies and consumers has allowed the company to move forward with the development. We have successfully raised money through an Italian venture capitalism fund, Progress tech transfer (€350K). Moreover, the Qatar Sportstech/ StartupBootCamp accelerator backed us with another investment ($150K).
HiQ-Nano has also secured major funding from European research projects to further contribute to the application of nanomaterials in the bio-nano sector. More in details, Supercol, ITN European grant, has been granted to HiQ-nano for an amount equal to €261K (for the period 2020-2024), together with SbD4Nano, another competitive European grant (Sum: €160K for the period 2019-2022).

iBlue project (www.ibluelab.com and app available from Apple store and Android sore: ibluelab)
The idea behind iBlue started after years of research in the field of nanomaterials for nanomedicine and nanodiagnostics. In particular, the candidate has dedicated his research interest on new enzymatic nanomaterials able to mimic natural enzymes, reaching high-level publications and international reputation in the field. From this world-class scientific expertise, the candidate filed two patents (n. 102017000030715 and 102018000003475, see below for details) and have started a strong development process that has led to a new product, iBlue.
At the moment, iBlue is not just a laboratory prototype, it is a ready-to-market product, and is on the stage of early field trials and market tests. The Technology Readiness Level (TRL) is 9. iBlue has a marketplace and an app. Please visit www.ibluelab.com.
As a general trend, diagnostics is urged to move from specialized laboratories to point-of-care and portable technologies to meet the challenges of health care time and cost management. Also for testing antioxidant activity, traditional methods are based on the use of instrumentation and, hence, they are not portable and require specialized personnel. Moreover, the majority of them are based on enzyme-based fluorimetric or colorimetric reactions. As a consequence, they are expensive and require laboratory settings/environment, expensive reagents, and special storage conditions. To solve this issue, nanomaterials have been proposed as enzyme alternatives, as they present many advantages, including easy and cost-effective production and purification, stability, high catalytic activity even at extreme conditions, and affinity to enzymatic substrates.

For the first time in the market, iBlue takes advantages of nanotechnology to create a portable and easy-to-use kit to evaluate antioxidants levels.

Uniqueness of iBlue

iBlue can overcome all the limitations of current technologies. It presents several advantages, including:

1. Portability (the test does not require specialized equipment)
2. Stability (iBlue is stable under normal room-temperature conditions)
3. Ease of quantification (the color change can be quantified visually with the naked eye) or by AI-powered smartphone app
4. Analysis is a simple process, requiring only addition of a sample
5. The method is sensitive, with performance characteristics comparable with conventional assays
6. Eco-friendly, non-toxic and non-harmful solutions
7. Potential applications for detection in remote locations and developing countries.