

Alessandro Kovtun

FORMATION

2022 Associate Professor National Scientific Qualification (FIS02/B1)

2017 PhD in Physics and Nanoscience, Modena and Reggio Emilia University.

2012 Master degree in Physics, Parma University (110/110 cum laude)

2010 Bachelor degree in Physics, Parma University (110/110 cum laude)

WORK EXPERIENCE

2022-now Permanent Researcher (Ricercatore III livello), Consiglio Nazionale delle Ricerche, Bologna, Istituto per la Sintesi Organica e la Fotoreattività

2020-2021 Post-Doc, Graphene Flagship Core 3 project. Consiglio Nazionale delle Ricerche, Bologna, Istituto per la Sintesi Organica e la Fotoreattività

2017-2020 Post-Doc, Graphene Flagship Core 2 project. Consiglio Nazionale delle Ricerche, Bologna, Istituto per la Sintesi Organica e la Fotoreattività

2013 Research and Development Product Engineer. Kemet Electronics Italia spa

2012 Junior Research Assistant. European Synchrotron Radiation Facility Grenoble, France

RESEARCH ACTIVITY

My main research field is surface science of 2D materials. I mainly study the chemical and physical properties of graphene based materials as Graphene Oxide, reduced Graphene Oxide, Exfoliated graphite and graphene. My research activities can be divided in periods:

Period 2022-2025

I am Principal Investigator for the PRIN project 20223CWFZT, Vertically Oriented Graphene Assembled Nanostructures for WATER purification (VOGA'N WATER). Total Budget 267k€. I have obtained the maximum national score during the evaluation procedure of this project (100/100). September 2023-September 2025. The goal of the project is to produce an innovative GO membrane with high permeability and high adsorption performance. The membrane will be produced by using sol gel (developed by L. Malfatti at UNISS) and control the spatial orientation by using atmospheric plasma (A. Patelli at UNIPD).

Period 2018-2022

I have studied the adsorption mechanisms of different organic molecules on graphene based materials in the framework of different EU project at ISOF-CNR. In particular the study of the adsorption and the surface properties of Graphene Oxide, used as active material in water purification. The combination of intercalation and adsorption has been revealed as the main mechanisms in operative filters for different organic molecules.

In the framework of Chemsense project and in collaboration with Prof. Chiara Zanardi (UNIMORE), I have studied the chemical properties of GO functionalised with Dopamine for electrochemical detection of NADH and GO functionalised with Chitosan for detection of Glucose, these two studies are the evolution of the seminal work on chemical structure of GO and electrochemically reduced GO, where the role of different functional groups of GO/RGO was accurately studied and the correlation between sensing properties and specific functional group founded. The role of different functional groups in GO was also investigated for the understanding of the chemical mechanism of site-selective Alkylation of Thiophenes

with Alcohols and the Allylic and Allenylic Dearomatization of Indoles, in collaboration with UNIBO. I have studied the chemical modification of GO in mixed matrix was studied for solar cell technology or for heat dissipation paraffin based suspension. In all these studies I have investigated the chemical structure modification of Graphene Oxide by using XPS.

In the contest of charge transport of 2D material I was in charge of two WP in Graphene Flagship Horizon 2020 project Core 3, where I study the electrical properties of 2D materials for aerospace and automotive application, GBoard and GICE.

Period 2013-2018.

Most of my scientific work during the Ph.D was focused on creation of an effective and broadly used procedure for accurately estimate the oxidation degree (O/C ratio) of graphene based materials independently from substrate and thickness, this goal was achieved by a new fitting method of C 1s XPS peak, that use the asymmetric pseudo-voigt line-shape for the sp² aromatic carbon. This protocol has significantly improved the accuracy of measured O/C ratio respect to the previously reported values in literature. This results was achieved in the framework of the Graphene Flagship program Core 1, as published in the subsequent comparative study of different graphene based material commercially available, where we have described the best procedure for an effective classification of main properties: oxidation degree (XPS), surface area (Gas adsorption), lateral size (Granulometry), and apparent density. The importance of correct XPS quantification on different substrate and conditions was pointed out by other published work on functionalization of graphene based materials.

During the final part of my PhD I have studied, mainly at UNIMORE and Chalmers Technical University (3 weeks visiting researcher), the charge transport of Reduced Graphene Oxide (RGO), by measuring and analyzing the 2/4 probe resistivity as function of temperature, from room temperature down to 4 K. I have proposed a unique model that explain the transport properties for thin single sheet and thin film based on Efros-Shklovskii Variable Range Hopping.

INVITED TALKS

2019 GraphIn. Madrid 21-22 February Talk: “Benchmarking of Graphene-based materials: real commercial products vs. ideal graphene”

2018 European Conference on thermally and electrically Conductive Polymers and composites: from lab to market – 2ND EDITION. Torino 23 October Talk: “Benchmarking of Graphene-based materials: real commercial products vs. ideal graphene”

TALKS

2023 FisMat Conference, Milano, Italy, 4-8 September, “Using blue light for covalent patterning of graphene: a new approach for realization of microarray sensors”.

2023 Conference Chem2Dmat, Bologna, Italy, 15-18 May “Covalent surface functionalization of graphene based materials controlled by blue light”

2022 Conference DSCTM, Catania, Italy 26-28 October “X-Ray Photoelectron Spectroscopy: a unique tool to understand the chemical structure of nanomaterial.”

2022 44th International Conference on Coordination Chemistry, ICC2020, Rimini-Italy 28 August - 2 September 2022. “Mechanistic interpretation of carbocatalysed synthesis of 2,3-disubstituted quinolines via Povarov multicomponent reaction revealed by ssNMR and XPS”

2022 Graphene2022 International Conference Aachen-Germany, 05-08 July “Visible-Light Assisted Covalent Surface Functionalization of graphene based materials with Arylazo sulfones”.

2021 Graphene2021, Grenoble (Fr), 26-29 October. "Charge Transport in van der Waals Thin Films, the case of Reduced Graphene Oxide from single flake to thin film".

2021 Chem2Dmat, Bologna August 31-September 3,. "Graphene Oxide as promoter for chemical reactions monitored by X-Ray Photoelectron Spectroscopy",

2019 FISMAT 2019. Catania Sept. 30 Oct 4. Talk:" Electronic transport in 2D membranes: reduced graphene oxide thin films"

2019 Workshop New Opportunities for Material Science at ESRF Bologna Dec. 12. Talk "Surface science of graphene-metal interfaces: Challenges and opportunities"

2018 Materials, Italian National Conference on Materials Science and Technology. Bologna, October 22-26. Talk: "Charge transport in reduced graphene oxide thin films: role of the structural (dis)order"

2017 Conference DSCTM 2017. Alghero Oct. 19-20. Talk: "Charge transport behavior of reduced graphene oxide: understanding the mechanism from single sheet to thin film"

2017 Graphene Week. Athene sept. 24-29. Talk: "XPS quantification of the oxidation degree in Graphene Based material, development of the accuracy and precision"

2012 Beam line Review of ID28, European Synchrotron Radiation Facilities, Grenoble 20 Nov. Talk: "Sub-meV monochromatisation of hard X-Rays: a novel optical scheme"

EUROPEAN PROJECTS & PROPOSALS

2023-2025 Participation as Principal Investigator to PRIN2022 project "Vertically Oriented Graphene Assembled Nanostructures for WATER purification" (VOGA'N WATER). Total Budget 267k€. ISOF CNR

2020-2023 Participation as researcher to PRIN2017 project "New Approaches in Nanocarbo-catalysis for organic transformations (NANOCARBO-CAT)". 2017W8KNZW. ISOF CNR

2021 Main proposer "Solid State Nuclear Magnetic Resonance investigation on Graphene Oxyde-Assisted Povarov reaction". 200 operative hours at Magnetic Resonance Center (CERM), University of Florence. Grant n. ITA002.

2020-now Participation as researcher to FLAGHERA project "Graphene cOmposites FOR advanced drinking WATER treatment (GO-FORWATER)". 825207. ISOF CNR

2020-now Participation as researcher to Graphene Flagship Horizon 2020 project Core 3 "Graphene Enhanced filters for water purification (GRAPHIL)". 881603. ISOF CNR

2020-now Participation as task Responsible to Graphene Flagship Horizon 2020 project Core 3 "Graphene-based, Thermoelectric Ice Protection System (GICE). 881603. ISOF CNR

2020-now Participation as task Responsible to Graphene Flagship Horizon 2020 project Core 3 "Using graphene and layered materials to develop integrated, copper-free car dashboards (G+BOARD). 881603. ISOF CNR

2018-2020 Participation as researcher to Graphene Flagship Horizon 2020 project Core 2 "ChemSens, developing sensors to be placed on the skin for medical applications. 785219. ISOF CNR

2018-2020 Participation as researcher to Graphene Flagship Horizon 2020 project Core 2 "Weargraph, developing wearable energy generators. 785219. ISOF CNR

2013-2018 Participation as researcher to Graphene Flagship Horizon 2020 project Core 1. 696656. ISOF CNR and Modena Reggio Emilia University (Financial of PhD grant)

APPLIED RESEARCH PROJECTS

2020 Principal Investigator “Preliminary study on reduction process of Graphene Oxide by combining innovative approaches”. Financial support Tetrapak. Budget 10.000 €

PATENTS

2021 WO2020099954 Method for the treatment of a porous substrate - IT 102018000010402, PCTIB2019058300, US Patent App. 17/292,596. CNR and Medica spa

2020 IT 102020000026726 METHOD FOR THE TREATMENT OF WATER. Submitted to “Ufficio italiano brevetti e marchi”.

AWARDS

2015 Premio Carla Cauletti. Financial support for participation to Scuola della Società Italiana di Luce di Sincrotrone XIII.

2022 (assigned 2020) Financial support for participation to International Conference on Coordination Chemistry (ICCC2020), now moved to ICC2022

TEACHING ACTIVITY

2021-2025 Adjunct Professor of General Physics (Fisica STAA11 - 6 CFU - 48 hours) – Bachelor Program in Food and Agricultural science and technology. Modena and Reggio Emilia University

2019-2024 Theoretical and practical workshop on XPS for the course “Material Physics and Nanoscience (MANO)” for master students in Physics, 12 hours. Bologna University

2019 Didactic Tutor for Physics (Fisica 1A Mechanics and fluid dynamics) for bachelor students in Physics, 30 hours. Project “Lauree-Scientifiche-Fisica”. Modena and Reggio Emilia University

2017 Didactic Tutor for Physics (Fisica 1A Mechanics and fluid dynamics) for bachelor students in Physics, 30 hours. Project “Lauree-Scientifiche-Fisica”. Modena and Reggio Emilia University

2016 Didactic Tutor for Physics (Fisica 1A Mechanics and fluid dynamics) for bachelor students in Physics, 23 hours. Project “Lauree-Scientifiche-Fisica”. Modena and Reggio Emilia University

2015 Didactic Tutor for Structure of Matter for bachelor students in Physics, 30 hours. Project “Lauree-Scientifiche-Fisica”. Modena and Reggio Emilia University

2014 Didactic Tutor for Physics for bachelor students in Pharmaceutical and Chemical Science, 30 hours. Modena and Reggio Emilia University

PUBLICATIONS from Scopus (29/07/2024)

56 articles in peer reviewed journals, 1030 citations, h-index 17

personal website: https://www.isof.cnr.it/kovtun_alessandro/

full publication list: scholar.google.it/citations?user=8zklsLMAAAAJ&hl=it

Selected PUBLICATIONS

1. **Electrochemical Functionalization of Graphene at the Nanoscale with Self-Assembling Diazonium Salts**

Z. Xia, F. Leonardi, M. Gobbi, Y. Liu, V. Bellani, A. Liscio, A. Kovtun, R. Li, X. Feng, E. Orgiu, P. Samori, E. Treossi, V. Palermo
ACS Nano, 10 (2016) 7125-7134

2. **Accurate chemical analysis of graphene-based materials using X-ray photoelectron spectroscopy**
A. Kovtun, D. Jones, S. Dell'Elce, E. Treossi, A. Liscio, V. Palermo.
Carbon 143 (2019) 268-275,
3. **Benchmarking of graphene-based materials: real commercial products versus ideal graphene**
A. Kovtun, E. Treossi, N. Mirotta, A. Scidà, A. Liscio, M. Christian, F. Valorosi, A. Boschi, R.J. Young, C. Galiotis, I.A. Kinloch, V. Morandi, V. Palermo
2D Materials 6 (2019) 025006 ,
4. **Graphene oxide–polysulfone filters for tap water purification, obtained by fast microwave oven treatment**
A. Kovtun, M. Zambianchi, C. Bettini, A. Liscio, M. Gazzano, F. Corticelli, E. Treossi, M.L. Navacchia, V. Palermo, M. Melucci
Nanoscale 11 (2019) 22780-22787,
5. **Core-shell graphene oxide-polymer hollow fibers as water filters with enhanced performance and selectivity**
A. Kovtun, A. Bianchi, M. Zambianchi, C. Bettini, G. Ruani, F. Corticelli, L. Bocchi, F. Stante, M. Gazzano, T. D. Marforio, M. Calvaresi, M. Minelli, M. L. Navacchia, V. Palermo, M. Melucci
Faraday Discussion 227 (2020) 274-290,
Co-first author
6. **Multifunctional graphene oxide/biopolymer composite aerogels for microcontaminants removal from drinking water**
A. Kovtun, E. Campodoni, L. Favaretto, M. Zambianchi, A. Salatino, M. L. Navacchia, B. Casentini, V. Palermo, M. Sandri, M. Melucci
Chemosphere 259 (2020) 127501,
Co-first author
7. **Multiscale charge transport in van der Waals thin films: reduced graphene oxide as case study**
A. Kovtun , A. Candini, A. Vianelli, S. Dell'Elce, M. Gobbi, K. Kim, S. Lara-Avila, P. Samori, M. Affronte, V. Palermo, A. Liscio
ACS Nano 15 (2021) 2654–2667
8. **Defective graphene nanosheets for drinking water purification: adsorption mechanism, performance, and recovery**
S. Khaliha, TD Marforio, A. Kovtun, S. Mantovani, A. Bianchi, M.L. Navacchia, M. Zambianchi, L. Bocchi, N. Boulanger, A. Iakunkov, M. Calvaresi, A. V. Talyzin, V. Palermo, M. Melucci
FlatChem 29 (2021), 100283
9. **Visible-Light Assisted Covalent Surface Functionalization of rGO Nanosheets with Arylazo Sulfones**
Lorenzo Lombardi, Alessandro Kovtun, Sebastiano Mantovani, Giulio Bertuzzi, Laura Favaretto, Cristian Bettini, Vincenzo Palermo, Manuela Melucci, Marco Bandini
Chemistry–A European Journal 28 (2022) e202200333
Co-first author.
10. **Study and application of graphene oxide in the synthesis of 2,3-disubstituted quinolines via a Povarov multicomponent reaction and subsequent oxidation**
Samantha Caputo, Alessandro Kovtun, Francesco Bruno, Enrico Ravera, Chiara Lambruschini, Manuela Melucci, Lisa Moni
RSC Advances, 12 (2022) 15834
Co-first author.
11. **Adsorption of emerging contaminants by graphene related materials and their alginate**

composite hydrogels

Francesca Tunioi, Sara Khaliha, Sebastiano Mantovani, Antonio Bianchi, [Alessandro Kovtun](#), Zhenyuan Xia, Mohammad Sajad Sorayani Bafqi, Burcu Saner Okan, Vincenzo Palermo, Maria Luisa Navacchia, Manuela Melucci,
Journal of Environmental Chemical Engineering 11 (2023) 109566

12. **The Removal efficiency of Emerging Organic Contaminants, heavy metals and dyes: intrinsic limits at low concentrations**

Sara Khaliha, Derek Jones, [Alessandro Kovtun](#),* Maria Luisa Navacchia, Massimo Zambianchi, Vincenzo Palermo, Manuela Melucci
Environmental Science: Water Research & Technology 9 (2023) 1558-1565

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