

CV of FABIO BISCARINI

● PERSONAL INFORMATION

Researcher unique identifier(s): ORCID 0000-0001-6648-5803; RESEARCHER ID: I-6814-2012; SCOPUS ID: 7006255174; GOOGLE SCHOLAR ID: DH-hqZ0AAAAJ

Date of birth: 15 April 1962

Nationality: Italy

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● EDUCATION

1993 PhD in Chemistry, Chemistry Department, University of Oregon, USA

1986 Laurea in Industrial Chemistry, Faculty of Industrial Chemistry, Department of Physical and Inorganic Chemistry, Alma Mater - Università di Bologna, Italy

● CURRENT POSITIONS

2013 – Professor of Chemistry, Life Sciences Department, Università di Modena e Reggio Emilia (UNIMORE), Modena, Italy

2017 – 2019 Research Associate, Center for Translational Neurophysiology-Italian Institute of Technology, Ferrara, Italy

2019 – Senior Scientist, Organic Neuroelectronics research line, Head
Center for Translational Neurophysiology-Italian Institute of Technology, Ferrara, Italy

● PREVIOUS POSITIONS

2010 – 2013 Research Director, ISMN, CNR, Bologna, Italy

2002 – 2010 Senior Scientist, Institute for the Study of Nanostructured Materials (ISMN), CNR, Bologna, Italy

1996 – 2001 Research Scientist, Istituto di Spettroscopia Molecolare (ISM), CNR, Bologna, Italy

1994 – 1996 Postdoc, Istituto di Spettroscopia Molecolare (ISM) and Istituto LAMEL, CNR, Bologna, Italy

1991 – 1993 Graduate Student, Molecular Biology, Chemistry Dept, Univ. of Oregon, Eugene (OR), USA

1989 – 1990 Graduate Student, Chemistry Dept, Univ. of New Mexico, Albuquerque (NM), USA

● FELLOWSHIPS AND AWARDS

2017 – Socio, Accademia Nazionale delle Scienze, Lettere ed Arti, Modena.

2012 Premio Sapio Industria 2012 for the project “Multifunctional Tags for traceability, anti-counterfeit, and security”, Sapio SpA, Italy.

2008 EU Descartes Award 2007 for the project “SynNanoMotors”, European Commission.

2004 – Fellow of the Royal Society of Chemistry (FRSC) upon nomination by Sir Harold Kroto.

1991 – 1992 Institute of Molecular Biology Research Fellow, University of Oregon, USA.

● SUPERVISION OF GRADUATE STUDENTS AND POSTDOCTORAL FELLOWS

2017 – 2 Postdocs/ 1 PhD student/ 2 Master students, IIT Ferrara.

2013 – 6 Postdocs/ 8 PhD students/ 12 Master students, Life Sciences Dept., UNIMORE
1994 – 2012 22 Postdocs / 20 PhD Students + 8 international PhD students seconded for shorter periods/ 12 Master students, CNR-ISM and ISMN Bologna

● TEACHING ACTIVITIES

As full professor at Università di Modena e Reggio Emilia, Italy:

2017 – Advanced Topics of Soft Matter, Master in Industrial Biotechnologies
2014 – Nanobiotechnologies, Master in Industrial Biotechnologies and PhD in Molecular & Regenerative Medicine
2013 – Chemistry, Bachelor in Biotechnology and Biology
2004 – 2012 Contract Professor – Nanotechnologies of Multifunctional Materials, Master in Chemistry of Materials and Photochemistry, Università di Bologna.

● ORGANISATION OF SCIENTIFIC MEETINGS

Since 1996 Biscarini organised, and was member of organising committees in, more than 20 conferences, workshops and scientific meetings. Highlighted conferences:

2019 Chair, 1st Workshop on Organic Neuromorphic Devices, Ferrara, IT; > 50 attendees.
2017 Chair, “From Colloids to Toxicology in the Nano-era”, Modena, IT > 30 attendees.
2016 Chair, “Workshop in Memoriam of Carlo Taliani”, Bologna, IT > 100 attendees
2015 Chair, 1st Workshop of Org. Bioelectron. in Italy (Orbitaly 2015), Modena, IT; >50 attendees.
2014 Chair, X International Conference in Organic Electronics (ICOE 2014), Modena, and Satellite Workshop and Schools, IT; > 160 attendees.
2005 Co-organiser, VIII-Europ. Conf. on Molecular Electronics, Bologna, IT; >150 attendees.
2003 Co-organiser, “EU-China Workshop on Multifunctional Materials by Design”, Bologna, IT; >100 attendees.

● INSTITUTIONAL RESPONSIBILITIES

2018 – 2019 President, Master Course on Industrial Biotechnologies, UNIMORE, Italy
2015 – Elected Member of the Academic Senate, UNIMORE, Italy
2014 – 2019 Head of Dept. Research Committee, Life Sciences Dept., UNIMORE, Italy
2005 – 2013 Head of Nanotechnology Research Division, ISMN, CNR, Italy
2008 – 2010 Steering Committee Member, Dept. of Molecular Design, CNR, Italy

● COMMISSIONS OF TRUST

2004 – 2008 Editorial Board, Chemical Society Reviews, Royal Chemical Society, UK
2002 Consultant for the NSF-Nano-manufacturing Program.
2004 Consultant expert of the European Commission - IST Call.
2005, 2012, 2016 Referee for the National Evaluation of Science CIVR, ANVUR.
2011 – Reviewer of proposals of ERC Starting Grant 4th Call, FNRS Belgium, AS Poland, Germany (Minerva Foundation-MPG), Swiss National Science Foundation, Israeli National Science Foundation, Japan Society for the Promotion of Science (JSPS), KAUST (Saudi Arabia), FIRB Giovani (Italy), European Universities in France (Strasbourg, Bordeaux), Switzerland (ETH, EPFL) and Italy (Padua (CARIPARO), Trento (RESTATE), Cosenza (Regional Funds)).

- **MEMBERSHIPS OF SCIENTIFIC SOCIETIES**

- 2010 – Biophysical Society.
- 2008 – Società Chimica Italiana.
- 2008 – American Chemical Society.
- 2004 – Royal Society of Chemistry, Fellow of the upon invitation by Sir Harold Kroto.
- 2003 – European Microscopy Society.
- 2002 – Materials Research Society.
- 1996 – Italian Society for Electron Microscopy (SIME) now SISM.
- 1996 – 2000 Secretary of the Group of Scanning Probe Microscopy and Board Member of SIME.
- 1996 – 1998 Member of the Polymer Division, American Chemical Society.

- **MAJOR COLLABORATIONS**

- Prof. F. Zerbetto, modelling of ion-pi interactions, Dip. Chimica “G. Ciamician”, Univ. di Bologna, IT.
- Prof. D. De Leeuw, neural signals transduced with organic electronics, MPI for Polymer Res., Mainz, DE.
- Prof. H. L. Gomes, transient and impedance measurements in bioelectronics, Univ. do Algarve, Faro, PT
- Prof. R. García, advanced SPM techniques applied to EGOFET sensors, CSIC Madrid, ES.
- Prof. Y. Geerts, new conjugated materials for bioelectronics, Univ. Libre de Bruxelles, BE.
- Prof. P. Samorì, self-assembled monolayers for organic biosensors, Univ. de Strasbourg, FR.
- Prof. M. Berggren, organic biosensors of cytokines printed on a card, Linköping Univ., SE.

- **CAREER BREAKS**

- 1987 – 1988 National service as Lieutenant of Mechanized Infantry, Italian Army.

Current Grants

| <i>Project Title</i> | <i>Funding source</i> | <i>Amount (Euros)</i> | <i>Period</i> | <i>Role of the PI</i> |
|--|--|-----------------------|--------------------------|-----------------------|
| ICTYS: Optimization of novel value CHains for fish and seafood by developing an integrated sustainable approach for improved quality, safety and waste reduction | H2020-MSCA-RISE-2019 n. 872217 | 105,800 (for PI) | Jan. 2020 – Dec. 2024 | Partner |
| BORGES | H2020-MSCA-ITN-2017-ETN, GA no. 813863 | 532,000 (for PI) | Jan 2019- Dec 2022 | Supervisor |
| AMI - Antidrug-antibody and drug Molecular detection in Inflammatory diseases with organic electronics platform | ERANET-COFUND EuroNanoMed III | 234,000 (for PI) | Jan. 2018 – Dec. 2020 | Coordinator |
| SPM2.0 - Scanning probe microscopies for nanoscale fast, tomographic and composition imaging | H2020-MSCA-ITN-2016-ETN, GA no. 721874 | 258,061 (for PI) | Jan. 2017 - Dec. 2020 | Partner |
| NiFITY: New-Generation Nanostructured Fluorinated Materials for ¹⁹ F-MRI and their Biophysicochemical Interactions | MIUR-PRIN 2017 (UNIMORE) | 130,000 (for PI) | Nov 2019 – Oct 2022 | Partner |

Fabio Biscarini's last ten years record of accomplishments

Throughout my career, I pursued research that I considered innovative, searching always for complex and original problems. With time I developed a preference for problems where multidisciplinary approaches and interactions with scientists from other fields than chemistry (physics, materials sciences and engineering, biology and medicine) open the possibility to tackle complex problems and push the knowledge frontier significantly beyond the state of the art. For this, I explored many fields of science with theoretical and experimental approaches: from liquid crystals, to scanning probe microscopies, to thin film growth, to organic electronics, to nanotechnology. The last ten years marked a transition in my research career from materials science, organic electronics, and nanotechnology, that I mostly carried out at the National Council of Research (CNR) at the Institute for the Study of Nanostructured Materials from 1994 to 2012, to organic bioelectronics, neurotechnology and nanomedicine that are my current activities at UNIMORE in the Life Sciences Dept, from 2013, and organic neuroelectronics in vivo, that is my research line at the Center for Translational Neurophysiology of Istituto Italiano di Tecnologia (IIT). Relevant results obtained in the **areas of materials sciences, physics and chemistry** are described below.

- 1. Organic electronics**, where I demonstrated for the first time the low-dimensional nature of charge transport in organic field effect transistors (Phys. Rev Lett 2004). For understanding the mechanism of this result, I designed and built ultra-high vacuum (UHV) instrumentation for performing in situ real time experiments of organic semiconductor growth: for XRD structural characterization at synchrotron beam lines; for UHV STM and SPM, to monitor nucleation and early stages of growth of conjugated oligomers; and for electrical characterization during the growth of the organic semiconductor channel (PRL 2010). With this combined approach I was able to relate the dimension of the charge transport layer and thickness scaling of charge transport to morphological and structural transitions. Another early achievement was to show charge tunneling as a dominant mechanism of charge injection in OFETs. I proposed that OFET with source-drain electrodes functionalized with self-assembly monolayers (SAM) of homolog alkanethiols can be used as robust gauges to measure charge tunneling rates, thus bridging molecular and organic electronics. SAM OFETs were used to show odd-even effects in charge tunneling of alkanethiol SAMs, and study SAMs with conjugated cores and different chemistry at the end groups.
- 2. Nanotechnology of multifunctional materials**: based on my previous studies on self-organization, wetting and dewetting of solid thin films and solutions (in the framework of the research on rotaxanes that was received the Descartes Prize 2007 in 2008) I developed some original patterning techniques, both serial and parallel, based on driving self-organization of molecular and polymeric materials with external agents like patterned stamps and templates fabricated on the substrates. They were then applied to diverse materials, from metallic clusters, nanoparticles, discotic liquid crystals, conductive polymers, DNA, proteins and demonstrated to be useful to integrate ultra-thin highly ordered active OSC layers into transistors. These techniques, like Lithographically Controlled Wetting (LCW) formed the core of the patent portfolio that was then transferred to the startup company Scriba Nanotecnologie Srl (est. in 2005) to manufacturing anti-counterfeit tags. One of these inventions, a time temperature integrator based on wetting/dewetting transitions motivated the award of the Sapio Industry Prize in 2012.

With the coordination of the first EU project in converging technologies, NMP BIODOT, in FP6, I moved towards biomedicine studied with technology platforms from materials sciences and nanotechnology. In this area, I published more than 50 papers in the past ten years. In the following I review the contributions to organic bioelectronics relevant to this ERC Synergy proposal. I was the first to demonstrate that conjugated thin films pentacene is non cytotoxic in vitro, stem cells and primary neurons can adhere on it, and stem cells can differentiated into neurons (Adv. Funct. Mater. 2008). I also showed how neural adhesion to OSC can be modulated through the nanoscale curvature of the thin films (Biophys. Jou. 2010). Neurons on pentacene OFETs can be stimulated and the signals transduced with EGOFET (PCCP 2013, J. Mat. Chem. B 2013).

In EGOFET biosensors, I introduced the specific recognition at the gate with the first EGOFET dopamine biosensor (Org. Electr. 2013), and cytokine biosensors^{3,6}. This architecture is now the most adopted for sensing, and has been applied in my group to several important biomarkers, small molecules, and even viruses. After developing the laser scan ablation for prototyping OSC electronics devices on biodegradable polymers (APL 2013), I demonstrated the electrocardiographic recording of flexible arrays of OECTs interfaced to human¹⁰. Latest achievements concern organic transducers and sensors with response of synapstor^{5,8}, fabricated on flexible foils in view of implantation. I showed the selective detection of dopamine with an organic synapstor, in the presence of major electro-chemical interferents⁴, and also with respect to its metabolites (Adv. Funct Mater. 2020).

During my career I authored **252 publications** of which more than **230 papers** in international peer-reviewed journals of high impact. The **bibliometric records** are reported with max and min indicators: total citations number is **>10500** and **h-index 61 from Google Scholar**, and **>8800** with **h-index 54 from Scopus (16/04/2020)**. I gave **6** keynote talks, **127** invited talks at conferences and workshops, **83** invited lectures at Universities, **27** lectures and mini-courses in Advanced Schools, and **16** dissemination talks on nanotechnology and nanomedicine to citizens and students from primary schools to high-schools. I **coordinated 12 research projects** out of competitive calls, of which **5 EC, 1 ESF, 1 ERANET**. I was CTO of the EU NMP Integrated project **NAIMO**, the first and largest EU initiative in

organic electronics in FP6, and a key partner in the LS project **ONE-P** in FP7. I have been PI in **22 collaborative projects**, of which **2 ESF** and **10 EC**.

Ten relevant publications in Organic Bioelectronics

1. M. Sensi, M. Berto, M. Di Lauro, C. A. Bortolotti, H. L. Gomes, M. Zoli, F. Zerbetto, L. Fadiga, **F. Biscarini**, Neuromorphic organic devices that specifically discriminate dopamine from its metabolites by non-specific interactions *Adv Funct Materials* accepted 15 April (2020).
2. Carli, S.; Bianchi, M.; Zucchini, E.; Di Lauro, M.; Prato, M.; Murgia, M.; Fadiga, L.; **Biscarini, F.** Electrodeposited PEDOT:Nafion Composite for Neural Recording and Stimulation. *Advanced healthcare materials* 2019, 8 (19), e1900765. DOI: 10.1002/adhm.201900765.
3. Berto, M.; Diacci, C.; D'Agata, R.; Pinti, M.; Bianchini, E.; Di Lauro, M.; Casalini, S.; Cossarizza, A.; Berggren, M.; Simon, D.; Spoto, G.; **Biscarini, F.**; Bortolotti, C. A. EGOFET Peptide Aptasensor for Label-Free Detection of Inflammatory Cytokines in Complex Fluids. *Adv. Biosys.* 2018, 2 (2), 1700072. DOI: 10.1002/adbi.201700072.
4. Giordani, M.; Berto, M.; Di Lauro, M.; Bortolotti, C. A.; Zoli, M.; **Biscarini, F.** Specific Dopamine Sensing Based on Short-Term Plasticity Behavior of a Whole Organic Artificial Synapse. *ACS Sens.* 2017, 2 (12), 1756–1760. DOI: 10.1021/acssensors.7b00542.
5. Di Lauro, M.; Berto, M.; Giordani, M.; Benaglia, S.; Schweicher, G.; Vuillaume, D.; Bortolotti, C. A.; Geerts, Y. H.; **Biscarini, F.** Liquid-Gated Organic Electronic Devices Based on High-Performance Solution-Processed Molecular Semiconductor. *Adv. Electron. Mater.* 2017, 3 (9), 1700159. DOI: 10.1002/aelm.201700159.
6. Casalini, S.; Bortolotti, C. A.; Leonardi, F.; **Biscarini, F.** Self-assembled monolayers in organic electronics. *Chemical Society Reviews* 2017, 46 (1), 40–71. DOI: 10.1039/C6CS00509H.
7. Berto, M.; Casalini, S.; Di Lauro, M.; Marasso, S. L.; Cocuzza, M.; Perrone, D.; Pinti, M.; Cossarizza, A.; Pirri, C. F.; Simon, D. T.; Berggren, M.; Zerbetto, F.; Bortolotti, C. A.; **Biscarini, F.** Biorecognition in Organic Field Effect Transistors Biosensors: The Role of the Density of States of the Organic Semiconductor. *Analytical chemistry* 2016, 88 (24), 12330–12338. DOI: 10.1021/acs.analchem.6b03522.
8. Desbief, S.; Di Lauro, M.; Casalini, S.; Guerin, D.; Tortorella, S.; Barbalinardo, M.; Kyndiah, A.; Murgia, M.; Cramer, T.; **Biscarini, F.**; Vuillaume, D. Electrolyte-gated organic synapse transistor interfaced with neurons. *Organic Electronics* 2016, 38, 21–28. DOI: 10.1016/j.orgel.2016.07.028.
9. Casalini, S.; Dumitru, A. C.; Leonardi, F.; Bortolotti, C. A.; Herruzo, E. T.; Campana, A.; Oliveira, R. F. de; Cramer, T.; Garcia, R.; **Biscarini, F.** Multiscale sensing of antibody-antigen interactions by organic transistors and single-molecule force spectroscopy. *ACS Nano* 2015, 9 (5), 5051–5062. DOI: 10.1021/acsnano.5b00136.
10. Campana, A.; Cramer, T.; Simon, D. T.; Berggren, M.; **Biscarini, F.** Electrocardiographic Recording with Conformable Organic Electrochemical Transistor Fabricated on Resorbable Bioscaffold. *Adv. Mater.* 2014, 26 (23), 3874–3878. DOI: 10.1002/adma.201400263.

Patents: 19 of which 17 with PCT extension.

Translation of research results into companies

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| 2005 | Co-founder of Scriba Nanotecnologie Srl, President and CEO now member of the Board: company develops anti-counterfeit tags, microfluidics; currently >5 full time employees. |
| 2009-2014 | Co-founder of Nano4bio, consultant: company developed smart Petri dishes. |
| 2019 | Co-founder of Organic Bioelectronics Srl; scientific advisor; company develops biosensors for point of care; full time employees N/A. |

Autorizzo al trattamento dati ai sensi del GDPR 2016/679 del 27 aprile 2016 (Regolamento Europeo relativo alla protezione delle persone fisiche per quanto riguarda il trattamento dei dati personali).
Autorizzo la pubblicazione sul sito istituzione del Politecnico di Milano (sez. Amministrazione Trasparente) in ottemperanza al D. Lgs n. 33 del 14 marzo 2013 (e s.m.i.).