

Curriculum vitae di **Francesca Santoro**

Sottosettori ERC primari:

PE11_1 Engineering of biomaterials, biomimetic, bioinspired and bio-enabled materials

PE6_13 Bioinformatics, bio-inspired computing, and natural computing

LS5_18 Innovative methods and tools for neuroscience

PERSONAL DETAILS

Full Name: Francesca Santoro
Researcher unique identifier: Date of birth: 26.02.1986
Nationality: Italian
ORCID: [0000-0001-7323-9504](https://orcid.org/0000-0001-7323-9504)
[Website](#) | [LinkedIn](#) | [Google Scholar](#)

Education and key qualifications

2014 **PhD (Dr.-Ing.)**
Faculty of Electrical Engineering and Information Technology, RWTH Aachen & Institute of Biological Information Processing IBI-3 Bioelectronics, Forschungszentrum Jülich, Germany. Supervisor: Prof. Andreas Offenhäusser.
2010 **Master's Degree**
Biomedical Engineering, University of Naples Federico II, Italy.

Current positions

Since 2026 **Full Professor (W3)**, Chair of Neuroelectronics, Faculty of Electrical Engineering and Information Technology, RWTH Aachen, Germany.
Since 2026 **Director**, Institute of Biological Information Processing IBI-3 Bioelectronics, Forschungszentrum Jülich, Germany.
(as of May 1st)

Previous positions

2022 – 2025 **Associate Professor (W2)**, Faculty of Electrical Engineering & Computer Science, RWTH Aachen, Germany.
2022 – 2025 **Group Leader**, Neuroelectronic Interfaces Lab, Institute of Biological Information processing IBI-3 Bioelectronics, Forschungszentrum Jülich, Germany.
2017 – 2024 **Principal Investigator**, Head of Tissue Electronics Lab, Istituto Italiano di Tecnologia, Italy.
2014 – 2017 **Postdoctoral Scholar**, Department of Chemistry, Stanford University, USA.

RESEARCH ACHIEVEMENTS AND PEER RECOGNITION

I have extensive expertise in designing adaptive organic and hybrid materials for bioelectronic and neuromorphic interfaces, with a focus on understanding and engineering information processing, plasticity, and chemical signaling at the interface between living neural systems and electronic devices. My research centers on organic mixed ionic–electronic conductors, light-responsive polymers, and biofunctional membranes to develop neurohybrid platforms that integrate sensing, learning, and actuation at the biological interface. My expertise spans organic-semiconductor synthesis and processing, neuromorphic-device engineering based on organic electrochemical transistors and artificial synapses, advanced nano- and microfabrication, electrophysiology, optical stimulation, and multimodal characterization of cell–material interfaces, enabling the study and control of adaptive processes from molecular to tissue scales. This work has led to methodological and materials advances reported in more than 90 peer-reviewed publications, many in high-impact journals. I have a well-established profile in organic bioelectronics and neuromorphic biomaterials, with original contributions to the mechanistic understanding and development of artificial synapses based on organic mixed conductors, as well as to the chemical and optical regulation of synaptic plasticity (FS02, FS03, FS05, FS08, [Matrone et al., Advanced Materials Technologies, 2023](#), [Baroni et al., Materials Horizons, 2025](#)). I have also provided conceptually new structural and functional insight into how living cells interact with artificial nanostructures, establishing foundational principles for intracellular biointerfaces (FS01, FS04, FS06, FS07, FS09, FS10, [Santoro et al., ACS Nano, 2014](#); [Dipalo et al., Nano Letters, 2018](#); [Dipalo et al., Advanced Biosystems, 2019](#)). My scientific standing is further demonstrated by my active participation in international collaborative projects (*i.e.*,

DAAD bilateral projects, Doctoral Networks) and research consortia, as well as by frequent invited talks and contributions to international conferences and workshops in bioelectronics, neuromorphic engineering, and neurotechnology (e.g., MRS, GRC, Nature Conferences; detailed information can be found below). Through these activities, I contribute to defining a long-term research vision aimed at moving bioelectronics beyond passive sensing toward adaptive, learning interfaces, with relevance for fundamental neuroscience, neuroprosthetics, and bio-inspired computing.

FS01. Publication on biomimetic microstructures guiding early neuronal development

Claudia Latte Bovio, Esther Matamoros, Valentina Mollo, Anna Mariano, Valeria Criscuolo, Francesca Santoro*. "How neuromorphic microstructures control *in vitro* early-stage neuronal outgrowth". *Advanced Science*, Under revision.

My role: lead author/project supervisor. **Significance for the current proposal:** demonstration that microstructure shape and density act as instructive cues, regulating neuronal behavior through nanoscale protein-mediated interactions at the neuron–material interface.

FS02. Publication on biocompatibility of n-type conjugated polymers

Claudia Latte Bovio, Paola Campione, Han-Yan Wu, Qifan Li, Ana De La Fuente Durán, Alberto Salleo, Simone Fabiano*, Graziana Maria Lucia Messina*, Francesca Santoro*. "Evaluation of the Biocompatibility of Poly(benzimidazobenzophenanthroline) (BBL) Polymer Films with Living Cells." *Small* **21**, 2404451 (2025). <https://doi.org/10.1002/smll.202404451>

My role: lead author/project supervisor (shared with S. Fabiano and G.M.L. Messina). **Significance:** first systematic biocompatibility assessment of BBL, a high-performance n-type organic mixed conductor, addressing a critical bottleneck for its use in bioelectronic and neuromorphic devices.

FS03. Publication on closed-loop neuromorphic platforms

Ugo Bruno, Daniela Rana, Chiara Ausilio, Anna Mariano, Ottavia Bettucci, Simon Musall, Claudia Lubrano, and Francesca Santoro*. "An Organic Brain-Inspired Platform with Neurotransmitter Closed-Loop Control, Actuation and Reinforcement Learning." *Materials Horizons* **11**, 2865 (2024). <https://doi.org/10.1039/D3MH02202A>

My role: lead author/project supervisor. **Significance:** realized a closed-loop neuromorphic system integrating sensing, actuation, and learning mediated by neurotransmitters.

FS04. Publication on dynamic biointerfaces

Luca Terenzi, Ziyu Gao, Mehdi Ravandeh, Chiara Fedele, Lasse Hyldgaard Klausen, Claudia Latte Bovio, Arri Priimagi, and Francesca Santoro*. "Engineering Lipid-Based Pop-up Conductive Interfaces with PEDOT: PSS and Light-Responsive Azopolymer Films." *Advanced Healthcare Materials* **13**, 2303812 (2024). <https://doi.org/10.1002/adhm.202303812>

My role: lead author/project supervisor. **Significance:** demonstrated light-triggered dynamic biointerfaces, enabling reversible mechanical and electrical coupling with living cells.

FS05. Publication on azobenzene neuromorphic devices

Federica Corrado, Ugo Bruno, Mirko Prato, Antonio Carella, Valeria Criscuolo, Arianna Massaro, Michele Pavone, Ana B. Muñoz-García, Stiven Forti, Camilla Coletti, Ottavia Bettucci* and Francesca Santoro*. "Azobenzene-Based Optoelectronic Transistors for Neurohybrid Building Blocks." *Nature Communications* **14**, 6760 (2023). <https://doi.org/10.1038/s41467-023-41083-2>

My role: lead author/project supervisor (shared with O. Bettucci). **Significance:** introduced light-controlled neuromorphic transistors based on azobenzene chemistry, enabling optical programming of plasticity in organic bioelectronic devices.

FS06. Publication on biomimetic synapses

Claudia Lubrano, Ugo Bruno, Chiara Ausilio, and Francesca Santoro*. "Supported Lipid Bilayers Coupled to Organic Neuromorphic Devices Modulate Short-Term Plasticity in Biomimetic Synapses." *Advanced Materials* **34**, 2110194 (2022). <https://doi.org/10.1002/adma.202110194>

My role: lead author/project supervisor. **Significance:** demonstrated that biomembranes actively regulate synaptic dynamics, introducing lipid bilayers as functional components in neuromorphic architectures.

FS07. Publication on neuronal outgrowth control

Laura Matino, Anna Mariano, Chiara Ausilio, Raghav Garg, Tzahi Cohen-Karni, and Francesca Santoro*. "Modulation of Early Stage Neuronal Outgrowth through Out-of-Plane Graphene." *Nano Letters* **22**, 8633 (2022). <https://doi.org/10.1021/acs.nanolett.2c03171>

My role: lead author/project supervisor. **Significance:** established 3D graphene architectures as active regulators of neuronal development, linking device geometry to biological function.

FS08. Publication on biohybrid synapses

Scott T. Keene, Claudia Lubrano, Setareh Kazemzadeh, Armantas Melianas, Yaakov Tuchman, Giuseppina Polino, Paola Scognamiglio, Lucio Cinà, Alberto Salleo*, Yoeri van de Burgt*, Francesca Santoro*. "A

Biohybrid Synapse with Neurotransmitter-Mediated Plasticity.” *Nature Materials* **19**, 969 (2020). <https://doi.org/10.1038/s41563-020-0703-y>

My role: lead author/project supervisor (shared with A. Salleo and Y. van de Burgt). **Significance:** first demonstration of an artificial synapse in which neurotransmitters directly modulate device plasticity, establishing chemical signaling as a functional degree of freedom in neuromorphic biointerfaces.

FS09. Publication on vertical nanostructures

Michele Dipalo, Allister F McGuire, Hsin-Ya Lou, Valeria Caprettini, Giovanni Melle, Giulia Bruno, Claudia Lubrano, Laura Matino, Xiao Li, Francesco De Angelis, Bianxiao Cui, Francesca Santoro*. “Cells Adhering to 3D Vertical Nanostructures: Cell Membrane Reshaping without Stable Internalization.” *Nano Letters* **18**, 6100 (2018). <https://doi.org/10.1021/acs.nanolett.8b03163>

My role: lead author/project supervisor. **Significance:** overturned the paradigm that nanostructure–cell coupling requires penetration, demonstrating membrane reshaping without internalization, a key concept for safe intracellular biointerfaces.

FS10. Publication in on nanoscale cell–material interfaces

Francesca Santoro*, Wenting Zhao, Lydia-Marie Joubert, Liting Duan, Jan Schnitker, Yoeri van de Burgt, Hsin-Ya Lou, Bofei Liu, Alberto Salleo, Lifeng Cui, Bianxiao Cui*. “Revealing the Cell–Material Interface with Nanometer Resolution by Focused Ion Beam/Scanning Electron Microscopy.” *ACS Nano* **11**, 8320 (2017). <https://doi.org/10.1021/acsnano.7b03494>

My role: lead author/project supervisor (shared with B. Cui). **Significance:** provided unprecedented nanometer-scale visualization of the cell–material interface, enabling mechanistic understanding of membrane deformation and adhesion on nanostructured biointerfaces.

Overall publication record: total 94 | 1st author 7 | last author 43 | citations 4523 total (Google Scholar) | h-index 38

Journals include *Chemical Reviews* (2×, IF 55.8), *Nature Reviews Materials* (2×, IF 86.2), *Advanced Materials* (2×, IF 26.8), *Nature Communication* (5×, IF 15.7), *ACS Nano* (5×, IF 16.1), *Advanced Science* (2×, IF 14.1), *Materials Horizons* (3×, IF 14.36), *Nature Protocols* (2×, IF 16), *Nature Nanotechnology* (2×, IF 34.9).

Peer recognition

Conference invitations

- 4 keynote talks: TERMIS (2026), Workshop on Neuroengineering: AI in Neuroscience (2025), Micro and Nanoengineering Conference (2023), Mediterranean Conference on Medical and Biological Engineering and Computing Conference (2023).
- >80 invited talks, including GRC Organic Electronics (upcoming 2026), GRC Neuroelectronics (2026), Nature Conference ‘Translational Biomaterials’ (2026), MRS (2019-2026), SPIE ‘Organic Devices and Bioelectronics’ (2022, 2025), TERMIS (2025), GRC Bioelectronics (2024), BioEI (2018, 2023), Nature Conference ‘2D Materials’ (2023), GRC Organic Electronics (2022).
- 12 contributed talks, 25 department seminars, 4 posters presentations.

Project leadership (selected)

- ERC Starting Grant BRAIN-ACT (awarded 2020, 2022–2026, PE8) (€1.8M, coordinator).
- ITN Doctoral Network FADOS (2025–2029) (€350k, partner).
- Marie Skłodowska-Curie Postdoctoral Fellowships BioKIN and STRELECOID (2024, 2022) (€350k, supervisor).
- Helmholtz Excellence Network, Avanti (2024) (€200k, coordinator).
- DFG GRK Mechanobiology (2024–2028) (€380k, partner).
- DAAD Australia-Germany Joint Research Cooperation Scheme (2024) (€24k, coordinator).
- Seal of excellence: MSCA Postdoctoral Fellowship (2024); ERC PoC (2024).
- Exploratory Research Space, RWTH Aachen (2022–2025, 4 projects) (€200k, partner).
- Tenure Track Startup Package, Istituto Italiano di Tecnologia (2017) (€1.5M, coordinator).

Awards & Honors

- Enrico Toti Award for Engineering and Technology (2025).
- Unstoppable Women – Italy (yearly, 2020–2025).
- Distinguished Invited Speaker, MRS Spring Meeting (2024).
- Early Career Award, German Academy of Sciences Leopoldina Academy (2022).

- Interstellar Initiative, New York Academy of Sciences (2022).
 - Breakthrough of the Year in Engineering & Technology, Falling Walls (2021).
 - Inspiring Fifty Europe (2022); Inspiring Fifty Italy (2021).
 - National Innovation Prize for Female Entrepreneurship (2021).
 - Distinguished Alumna, University of Naples Federico II (2021)
 - MIT Technology Review Under 35 Innovator of the Year (2018, Italy & Europe).
 - Italia Giovane Award (2018).
- Materials Horizons* Emerging Investigator (2024); Rising Stars in *Neuromorphic Computing and Engineering* (2024), *Advanced Materials* (2022) and *Journal of Materials Chemistry* (2018).

Supervision of graduate students and postdoctoral fellows

Since 2017: 4 PhD students graduated, 12 current PhD candidates, 10 postdocs supervised, 1 researcher, 2 current researchers, 2 current postdocs, 16 Master's theses supervised, 5 current Master's theses, 3 Bachelor's thesis supervised.

ADDITIONAL INFORMATION

Other contributions to the research community

Teaching

2022 – present Head of the teaching area, Neuroelectronic Interfaces, RWTH Aachen (Tissue Electronics, Organic Bioelectronics, Neuroengineering & Neurotechnology lectures, seminars, practical laboratory).

Memberships and committees (as nominated or otherwise noted)

- **Material Research Society (MRS):** Member (since 2013), General Chair (upcoming Fall Meeting- Boston, 2027), Organizing Committee of Symposia on Neuromorphics and Bioelectronics (Boston, Seattle, San Francisco, Hawaii) (2021–2026).
- **IEEE and international events:** Track Co-Chair FLEPS (2026), Scientific Committee ICNCE (2026), Track Co-Chair, IFETC (2024), Technical Committee, IEEE MEMS, IEDM (2023), Member Women in EDS committee (since 2023), Organizing Committee, InnoLae (since 2022), Scientific Coordinator, Umbrella Symposium (2024).
- **Industry and innovation:** Judge, Falling Walls (2022), Member, Technology Forum Life Sciences (since 2019); Advisor, Is it Fresh GmbH (2018–2020).
- **Research networks:** Co-Founder and member - SIGN (Network of Italian Scientist in Germany) (since 2023), Member - ERC grantees Italy (since 2022), Co-Chair and Leadership Team Member SURPAS (Stanford Postdoctoral Association) (2014–2017), Co-Founder Bay Area Postdoctoral Network (2016–2017), Member – ISSNAF (Italian Scientists and Scholars in North America Foundation) (2015–2017).

Reviewing and evaluator activities

- **Steering and examination committees**

Steering Committees: Jülich Workshop on Neurotechnology and Neuroengineering (since 2025), MEA Meeting (since 2024), Neuromorphic Organic Devices (NOD, since 2023), BioEI (since 2022). | **Advisory Boards:** Institute of Neuroscience Marseille (since 2024). | **PhD Committees:** Reviewer and Committee Member – RWTH Aachen (since 2022), Politecnico di Torino, UC San Diego, Università di Modena (2025), TU Delft, EPFL, University of Modena (2024), TU Eindhoven, University of Bologna (2024, 2025), University of Palermo (2023), Opponent – Linköping University (2022). | **Examination Committee:** Faculty of Electrical Engineering and Information Technology, RWTH Aachen (since 2022). | **Selection and Search Committees:** Campus Biomedico Roma (2025), Forschungszentrum Jülich (2025), RWTH Aachen 2024, Università Sant'Anna Pisa (2022).

- **Editorial and grant review**

Editorial Roles: **Guest Editor** – *Advanced Electronic Materials* (2025), *Materials Horizons* (2024); *Neuromorphic Computing and Engineering* (2023), *Frontiers in Electronics* (2022). | **Journal Boards:** **Executive Advisory Board** – *Advanced Electronic Materials* (since 2025) **Associate Editor** - *APL Bioengineering* (since 2023); **Associate Editor** – *Frontiers in Nanobiotechnology*, *Frontiers in Neuroscience*, *Frontiers in Electronics*, *PLOS One* (since 2016).

Grant Reviewer: ERC, DAAD, DFG, EU (2025, 2024); Knut and Alice Wallenberg Foundation (2023); ISSNAF Awards (2022), RWTH Fellowships (since 2022), Carl Zeiss Stiftung (2025)

Peer-Reviewer: Advanced Materials family (Wiley), *Nano Letters*, *ACS Nano*, *MRS Communications*, *IEEE Transactions on Biomedical Circuits and Systems*, *Lab on Chip*, Nature journal family (Springer), *Science Advances*, *Trends in Biotechnology*, *Nanoscale*, *Materials Horizons*, *Nanoscale Horizons*.

Selected outreach activities and mentoring

- **Science outreach:** Speaker and mentor in Italian high and middle schools (2× Naples 2025, Bolzano 2024), Organizer, Il Panariello Napoletano (2018–present), Open Day, Forschungszentrum Jülich (2022). | **Public Engagements:** TEDxTorino (2019), Web Marketing Festival – Women in Tech (2021), Pint of Science, Naples (2018). | **STEM Advocacy:** Eureka, Funziona! (2019), Live Robotica (2019), Silicon Valley Tour (2015–2017). | **Research management:** Speaker, Wiley Research Day (2025).

Selected videos, international press releases and dissemination: [Wikipedia](#), [Leopoldina](#), [Helmholtz](#), [Falling Walls](#), [ASBMB](#), [Documentary of Foreign Affairs Ministry](#), [TEDxTorino](#), [MITunder35](#), [MITUnder35France](#), [Ansa](#), [Talent Harbour](#), [Researchers' Night](#), [University of Naples](#), [IlRiformista](#), [Scientific American](#), [Sky Italia](#), [Kurier](#), [Advanced Science press release](#). | **Selected initiatives for sustainability and STEM advocacy:** [Heroes](#), [RadioKissKiss](#)