



Antonio Alessio Leonardi

Nationality: Italian **Date of birth:** 04/10/1992 **Place of birth:** Bari, Italy **Gender:**

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WORK EXPERIENCE

University of Messina - Italy, Messina

Associate Professor

[01/10/2024 - Current]

Associate Professor in **Experimental Condensed Matter Physics**(GSD 02/PHYS-03, SSD PHYS-03/A) at the **Department of Chemical, Biological, Pharmaceutical, and Environmental Science (ChiBioFarAm), University of Messina.**

His primary research focuses on **nanotechnology for nanomaterial and 2D material fabrication**, emphasizing **cost-effective and industrially compatible approaches**. He is also actively involved in **photonics research**, working on **quantum-confined and light-emitting silicon nanostructures**, as well as **light management in fractal structures**.

Another key area of his work is the development of **novel, highly sensitive and selective sensing platforms** based on **nanostructures**, with applications ranging from **biomedical diagnostics to environmental monitoring**.

CNR-DSFTM, URT LABSENS - Italy, Messina

Senior Research Associate (Primo ricercatore) - CNR

[01/09/2023 - 30/09/2024]

Senior Research Associate (Primo Ricercatore) at **URT LABSENS**, part of the **Department of Physical Science and Matter Technologies (DSFTM)** at the **Italian National Research Council (CNR)**. Actively involved in the **I-PHOQS project (CUP B53C22001750006)**, contributing to the development of a facility for fabricating innovative photonic sensing devices based on nanostructures.

Responsible for the development, implementation, and management of laboratories and equipment within the facility. Scientific contributions focus on the **synthesis, characterization, and testing of nanostructures** as advanced transducers for sensors targeting various applications.

University of Catania - Italy, Catania

Senior Research Fellow (Ricercatore RTDa)

[01/2022 - 08/2023]

Senior Research Fellow (Ricercatore RTDa) in the **Department of Physics and Astronomy** at the **University of Catania**, having secured two RTDa positions within the department.

Worked on a **PON Green project (REACT-EU)** focused on developing printable green inks based on 2D materials for smart packaging and coatings on recyclable polymers. This project was conducted in collaboration with **Bandera S.p.A.** and **Imperial College London**, with Prof. Felice Torrisi as Principal Investigator.

The research involved both physical and chemical exfoliation techniques for synthesizing 2D material inks, including graphene, graphene oxide, MoS₂, and MXenes (Ti₃C₂, Ti₂C, etc.). These inks were integrated into 2D material-polymer composites using industrial-scale methods such as twin-screw extrusion, as well as smart

coatings applied through cost-effective techniques like spray coating. The resulting materials demonstrated enhanced electrical and thermal conductivity, enabling **novel functionalities in recyclable polymer applications**.

University of Catania - Italy, Catania

Postdoc researcher

[02/12/2019 - 01/12/2021]

Postdoctoral Researcher for the **PON project ADAS+ (ARS01_00459)** at the **Department of Physics and Astronomy, University of Catania**, under the supervision of **Prof. Salvatore Mirabella**. The project focused on the development of **silicon-based sensors for automotive applications**.

His work involved the **chemical-physical synthesis of silicon nanowires**, optimizing their **morphological, optical, and electrical properties** for application as **optical and electrical sensors**. These sensors were designed for the detection of **toxic gases**, particularly **nitrogen dioxide (NO₂)**.

EDUCATION & TRAINING

Italian National License (ASN) as associate professor

Holds the **Italian National Scientific Qualification (ASN)** as **Associate Professor** in the following fields:

- **02/D1 – Applied Physics**, valid from **May 23, 2023, to May 23, 2034**
- **02/B1 – Experimental Condensed Matter Physics**, valid from **February 6, 2023, to February 6, 2034**

Ph.D. in Physics

University of Catania [11/2016 - 03/02/2020]

Address: Via S. Sofia 6495123, Catania (Italy) | **Final grade:** Menzione di lode | **Thesis:** Silicon nanowires: an outstanding building block for innovative applications

Ph.D. in Physics (XXXII ciclo) obtained on **February 3, 2020**, from the **University of Catania**, under the supervision of **Prof. Francesco Priolo** and **Dr. Alessia Irrera (CNR-IPCF, Messina)**.

His research focused on the development of **innovative sensors based on silicon nanowires (Si NWs)**. Initially, he worked on the **fabrication and characterization** (morphological, structural, and optical) of these nanostructures, optimizing their properties for **sensing platforms** based on the **room-temperature photoluminescence** of Si NWs.

In addition to sensing applications, he explored **photronics applications**, investigating **light trapping in 2D fractal arrays** of bare or decorated Si NWs. His work also extended to the **observation and characterization of coherent Raman backscattering** effects in these fractal arrays.

Master's Degree in Physics

University of Catania [10/2014 - 07/2016]

Address: Via S. Sofia 6495123, Catania (Italy) | **Final grade:** 110/110 e lode | **Thesis:** Sensore biologico basato su nanofili di silicio

Master's Degree in Physics (obtained on **June 21, 2016**) with a specialization in **Experimental Condensed Matter Physics**, including additional coursework in **biophysics and sensing applications**.

Master's thesis: "**A Biological Sensor Based on Silicon Nanowires**" (**Sensore biologico basato su nanofili di silicio**), supervised by **Prof. Francesco Priolo**, in collaboration with **CNR-IPCF Messina, CNR-IMM Catania University, and the University of Bari**.

In this work, he was the first in the literature to report an **optical sensor based on the light emission of silicon nanowires** for the **highly sensitive detection of C-reactive protein (CRP)**, a key biomarker for **cardiovascular diseases**, demonstrating its potential for **saliva-based detection**.

Bachelor's Degree in Physics

Università di Catania [10/2011 - 27/11/2014]

Address: Via S. Sofia 6495123, Catania (Italy) | **Final grade:** 110/110 e lode | **Thesis:** Effetti e Applicazioni del riscaldamento ottico di nanoparticelle di oro

Bachelor's Degree in Physics (obtained on **November 27, 2014**).

Bachelor's thesis: "**Effects and Applications of the Optical Heating of Gold Nanoparticles**" (**Effetti e Applicazioni del riscaldamento di nanoparticelle di oro**), supervised by **Prof. Giovanni Piccitto**.

In this project, he studied **localized surface plasmon resonance (LSPR) oscillations** through **simulation work using COMSOL Multiphysics**, focusing on **hyperthermal localization effects** for **biomedical applications**.

Visiting periods

Visiting Scholar & Honorary Researcher Experience

- **Visiting Researcher** at the **Department of Chemistry, University College London**, in the research group of **Prof. Giovanni Volpe**.
- **Visiting Scholar** (over 5 months) at the **Department of Electrical and Computer Engineering & Photonics Center, Boston University**, in the research group of **Prof. Luca Dal Negro**.
- **Honorary Researcher** at the **Molecular Sciences Research Hub, Department of Chemistry, Imperial College London** in the research group of **Prof. Felice Torrì**.
- **Visiting Researcher** in several national research laboratories of **CNR** and national **Universities**

National and International collaborations

Italian Research Institutions & Universities

- **CNR-IMM Messina:** Dr. Alessia Irrera, Dr. Barbara Fazio, Dr. Katia Buonasera, Dr. Gianni Pezzotti Escobar
- **CNR-IPCF:** Dr. Onofrio Maragò, Dr. Antonino Foti, Dr. Pietro Gucciardi, Dr. Maria Grazia Donato, Dr. Sebastiano Trusso
- **CNR-IMM, Catania University:** Dr. Giorgia Franzò, Dr. Maria Miritello, Dr. Giuliana Impellizzeri, Dr. Massimo Zimbone
- **University of Catania:** Prof. Francesco Priolo, Prof. Maria José Lo Faro, Prof. Paolo Musumeci, Prof. Felice Torrì
- **University of Florence:** Prof. Massimo Innocenti, Prof. Diederik Wiersma
- **University of Bari:** Prof. Luisa Torsi, Prof. Gerardo Palazzo, Prof. Nicola Cioffi, Prof. Rosaria Anna Picca
- **University of Palermo:** Prof. Patrizia Livreri
- **Politecnico di Milano:** Prof. Nicola Coluccelli, Prof. Dario Polli, Prof. Giulio Cerullo

International Collaborations

- **University College London:** Prof. Giorgio Volpe
- **Boston University & Photonic Center:** Prof. Luca Dal Negro
- **Integrated Circuit Advanced Process R&D Center (ICAC):** Prof. Henry H. Radamson
- **Sorbonne University, Laboratoire Kastler Brossel:** Prof. Sylvain Gigan
- **Austrian Institute of Technology:** Prof. Wolfgang Knoll
- **Imperial College London:** Dr. Felice Torrì

Industry Collaborations

- **STMicroelectronics**
- **Costruzioni Meccaniche Luigi Bandera**
- **Fondazione Bruno Kessler (FBK)**
- **Vishay**

CONFERENCES & SEMINARS

1. Silicon Nanowires Array: From Photonics to Sensing, I symposium, E-MRS 2018, Strasburg FRA
2. Silicon Nanowires: The route from synthesis towards applications, SIF 106° congress 2020, Milan ITA
3. Silicon Nanowires: A building block for future technologies, SPIE Nanoscience + Engineering (OP21N), SPIEE 2021, San Diego USA

4. Advancing sensing technologies: label-free fluorescent sensors based on silicon nanowires, Nanoinnovation 2023, Roma ITA
 5. Label-free Optical Biosensors based on Silicon Nanowires, G symposium, E-MRS 2024, Strasburg FRA
 6. Silicon Nanowire for advanced photonics and sensing technologies, FisMat 2025, Venice ITA
 7. 2D fractal array of Si NWs for photonics and sensing applications, SPIEE Optics + Photonics 2025, San Diego USA
1. A new generation of label-free optical sensors based on silicon nanowires, **FisMat** 2017, Trieste
 2. Ultrasensitive Label-free Optical Biosensors based on Silicon Nanowires, G symposium, **E-MRS** 2018, Strasburg
 3. Silicon nanowires array: from photonics to sensing applications, NM03 symposium, **MRS** 2018, Boston
 4. Label-free luminescent biosensors based on silicon nanowires, **FisMat** 2019, Catania
 5. Cost-effective spray coating of graphene ink for smart antifog substrates in sustainable greenhouse application, **E-MRS** 2023 Strasburg.
 6. Light-Emitting Si NWs as a Novel Sensing Platform for SARS-CoV-2 Detection, **Eurosensors** 2023, Lecce
 7. 2D Fractal Silicon Nanowires for Photonic Applications, I Symposium, **E-MRS** 2024 Strasburg.
1. 2018 – **Conferenza Nazionale dei Sensori** CNS 2018, Poster.
 2. 2018 – **E-MRS Spring Meeting**, Strasburg, 3 Posters.
 3. 2018 – **Scuola internazionale di fisica “Enrico Fermi”** corso 204 in “Nanoscale quantum optics”, Poster.
 4. 2019 – **Conventional and High-Energy Spectroscopies for inorganic, organic, and biomolecular Surfaces and interfaces** (CHESS) School 2019, Florence.
 5. 2021 – **2nd symposium on extracellular vesicles**, Italian extracellular society (EVIta), Il Ciocco Barga.
- Materials 2016 Catania.

Event committee 4th International Electronic Conference on Processes - Sustainable Process Design, Engineering, Control and Systems Innovation (ECP 2025), 20-22 October 2025, Turin ITA

PUBLICATIONS

Bibliometrics indices

More than 50 scientific works on international impacted journals.

- h-index= 17, more than 850 citations
- Google Scholar: <https://scholar.google.com/citations?user=1ywYNdQAAAAJ&hl=it>
- Scopus ID: 57200572935
- ORCID: 0000-0001-7723-4356

PROJECTS

- **Operative Unit Leader, URT LABSENS, DSFTM CNR** in the **SOFIA Project**: “*Sensori Ottici Flessibili Innovativi Altamente Sensibili*” funded by the **Italian Ministry of Defense, PNRM 2022 (CIG ZB93D5C051)**. Budget: **€1.2M**

Participation

- **Senior Research Associate (Primo Ricercatore)** in the **I-PHOQS Project**: “*Integrated Infrastructure Initiative in Photonic and Quantum Science*” (WP1, P.I. Dr. A. Irrera).
- **Senior Research Associate (Primo Ricercatore)** in the **I-PHOQS Project**: Participation in **WP2** (P.I. Dr. B. Fazio).
- **Project Participant, SAMOTHRACE**: “*Sicilian Micronanotechnology Research and Innovation Center*”. (WP3: Environment, P.I. Prof. Nunzio Tuccitto; Task 3: Reducing electronic waste, P.I. Prof. Felice Torrissi).
- **Senior Research Fellow** in the **PON Green Project**: “*Development of Green Printable Inks Based on 2D Materials and Nanostructures for Recyclable and Smart Packaging*” (sviluppo di inchiostri green stampabili a base di materiali 2D e nanostrutture per imballaggi riciclabili e intelligenti), D.M. n. 1062 10/08/2021, PON Green - REACT-EU (P.I. Prof. Felice Torrissi).

- **Postdoctoral Researcher** in the **PON ADAS+ ARS01_00459 Project**: “Automotive Sensing Devices”, in collaboration with **STMicroelectronics** and other industrial partners (P.I. Prof. Salvatore Mirabella).
- **Project Participant DCM.AD006.045**: “Nanotechnologies for Photonics, Biomedical, and Sensing Applications” (2019-2020).
- **Project Participant DCM.AD003.352**: “Nanostructures for Sensing, Photonics, and Energetics” (2020-2021).

[01/01/2022 - 31/12/2024]

- **Team Leader** for the activity “**Innovative Sensors**” at **URT LABSENS, DSFTM CNR**, Messina.
- **Senior Research Associate (Primo Ricercatore, II Livello CNR)** at **URT LABSENS, Department of Physical Science and Matter Technologies (DSFTM)** Italian National Council of Research (CNR), in the **Integrated Infrastructure Initiative in Photonic and Quantum Science (I-PHOQS)** project.
- **Senior Research Fellow (Ricercatore RTDa 02/B1 - Experimental Physics of Matter)** at the **Department of Physics and Astronomy "Ettore Majorana"** University of Catania, in the **PON GREEN Project** (D.M. 1062/2021), focusing on the “*Development of Green Printable Inks Based on 2D Materials and Nanostructures for Recyclable and Smart Packaging*” (Sviluppo di inchiostri green stampabili a base di materiali 2D e nanostrutture per imballaggi riciclabili e intelligenti). The project is in collaboration with **Bandera S.p.A.** and **Imperial College London** (CUP: E65F21002600005).

LANGUAGE SKILLS

Mother tongue(s): Italian

English

LISTENING: C2 **READING:** C2 **WRITING:** C1

SPOKEN PRODUCTION: C1

SPOKEN INTERACTION: C1

SKILLS

COMSOL MULTIPHYSICS | Microsoft Office | Knowledge of C, Python and Matlab programming languages | Research and analytical skills | Strategic Planning | Problem Solving | Good listener and communicator | Team-work oriented | Photoshop | Labspec | ImageJ | SIMNRA | Windows | Ubuntu | MacOS | NAS | Cloud apps | Critical thinking | Decision-making | Responsibility | Organizational and planning skills | Analytical skills | Presenting | Outlook

EDITORIAL AND REFEREE ACTIVITY

Editorial activity

- **Academic Editor**, Journal of Nanotechnology, Wiley (ISSN 1687-9511)
- **Member of the Topic Advisory Panel** of the international journal **Nanomaterials**, MDPI (ISSN 2079-4991)

Guest editor activity

- **Guest Editor**, Special Issue “*Nanomaterials and 2D Materials Based on Semiconductors and Metals*” of the international journal **Nanomaterials**, MDPI (ISSN 2079-4991)
- **Guest Editor**, Special Issue “*Advances on the Application of Nanomaterials and 2D Materials for Sensors, Solar Cells, Microelectronics, and Optoelectronics*” of the international journal **Molecules**, MDPI (ISSN 1420-3049)
- **Guest Editor**, Special Issue “*Nanomaterials Based on IV-Group Semiconductors and Metals*” of the international journal **Nanomaterials**, MDPI (ISSN 2079-4991)
- **Guest Editor**, Special Issue “*Nanomaterials Based on IV-Group Semiconductors and Metals: Second Edition*” of the international journal **Nanomaterials**, MDPI (ISSN 2079-4991)

Peer Review Activity

Referee for international impacted journals, including:

IEEE Journal of the Electron Devices Society, Journal of Physics and Chemistry of Solids, Molecules,

UNIVERSITY TEACHING ACTIVITY

Assistant professor

- **Assistant Professor in Physics (Fisica FIS/07), Dentistry Bachelor's Degree**, University of Catania, from the academic year 2019-2020 to 2023.
- **Assistant Professor in Physics (Fisica FIS/07), Medicine and Surgery Master's Degree**, University of Catania, from the academic year 2021-2022 to 2023.

Lecturer roles

- **Lecturer for "Laboratory Activities"** (50 hours) in the **"Laboratory of Physics III"** course (9 CFU) for the **Bachelor's Degree in Physics (L30)** University of Catania, academic year 2021/2022.
- **Lecturer for "Physics"** (2 CFU) in the **"Physics, Statistics, and Informatics"** course for the **Nursery Bachelor's Degree** University of Catania, academic year 2022/2023.
- **Lecturer for "Physics"** (4 CFU) in the **"Physics and Chemistry"** course for the **Physical Education and Sport Science Bachelor's Degree** University of Catania, academic year 2022/2023.
- **Lecturer for "Micro and optoelectronic devices"** (6 CFU) course for the **Master Degree in Physics**, University of Messina, academic year 2025/2026.
- **Lecturer for "Nanophysics and nanotechnology"** (6 CFU) course for the **Master Degree in Chemistry**, University of Messina, academic year 2025/2026.

Academic activities in PhD programs

- **Member of the PhD program committee in Physics at the University of Messina**

Invited lecturer in PhD courses

- **Invited Lecturer, Chemistry Department, University of Bologna**, during Ph.D. seminars on *"Nanoscience for Medicine and the Environment"* presenting *"Silicon Nanowires: An Overview on the Field and Sensing Applications Based on Photoluminescence"* **Bologna, 2022.**
- **Invited Lecturer, Chemistry Department, University of Bologna**, during Ph.D. seminars on *"Nanoscience for Medicine and the Environment"* presenting *"Silicon Nanowires: An Overview on the Field and Sensing Applications Based on Photoluminescence"* **Bologna, 2023.**
- **Invited Lecturer, Chemistry Department, University of Bologna**, during Ph.D. seminars on *"Nanoscience for Medicine and the Environment"* presenting *"An Overview on Label-Free Sensors Based on Light-Emitting Si NWs"* **Bologna, 2024.**

TECHNOLOGICAL TRANSFER

Patents

- Patent "Silicon Photonic Crystal", IT102022000020172, EP4595173A1, WO2024069606A1
- Patent "Method of manufacturing a silver dendrite platform for biomedical applications" , IT10202200002014EP4593765A1, WO2024069605A1
- Patent "Rivestimento antiappannamento" , IT102023000028431

COMMUNICATION AND INTERPERSONAL SKILLS

Scientific outreach activities

Event Organization and Outreach Activities

- MedNight 2025 – Organizing Staff
- MedNight 2024 – CNR Staff
- European Sharper Night 2022 & 2021– EPS-YM Staff

- **European Sharper Night 2020**– Responsible for the virtual space of **EPS-YM** and **interviewer** during the event, which was later reported on **YouTube**: [Watch the event](#) .
- **European Sharper Night 2019**– Responsible for the **EPS-YM stand** and **invited speaker** for the presentation of *From Microelectronics to Photonics (Dalla microelettronica alla fotonica)* , presented at the **Speaker Corner** of the event.
- **Project Scientific Degrees (Lauree Scientifiche) - PLS 2018-2022**– Conducted **experimental activities** at the **Scanning Electron Microscopy Laboratory** for visiting students at the **Department of Physics**, University of Catania.
- **Open Day of Physics 2018-2022**– **Presenter** of the **experimental condensed matter laboratories** at the **Department of Physics**, University of Catania.

Leadership Roles and Contributions

- **EPS-YM Catania Section**: Served as **President** and **Vice President** for several years, actively promoting **Physics** within and outside the university, including contributions to the section's activities. **Notable article**: [New from the EPS Young Minds Section in Catania](#) .
- **OSA - Messina Section**: Member for several years and **Vice President** of the **Optical Society of America (OSA) Messina Section** (now **Optica**). Focused on **promoting Physics** and organizing various student events at the **CNR-IPCF** in Messina.