

Fabio Miletto Granozio

Curriculum vitae

ADDRESS

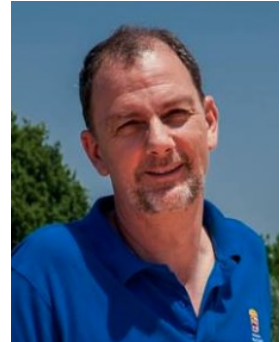
Dr. Fabio Miletto Granozio

<http://www.spin.cnr.it/index.php/people/46-researchers/39-miletto-granozio-fabio.html>

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Brief summary of my scientific activity

My research focuses on the properties and applications of complex correlated oxide systems exhibiting different functionalities, with special interest on their interfaces. My approach is based, since the earliest times, on the capability of designing and synthesizing samples suitable for my research in the form of epitaxial films and heterostructures.

While the early stages of my career have been mostly dedicated to high-Tc superconductivity and to magnetic materials, recent years have largely been devoted to the study of 2-dimensional electron gases living at oxide interfaces (“oxide 2DEGs”), e.g., in the now-famous $\text{LaAlO}_3/\text{SrTiO}_3$ system. Based on control of film growth, my group has contributed to the understanding of oxide 2DEGs, also demonstrating the capability to engineer their properties by chemical substitutions or by adding intermediate epitaxial layers. Examples include: the $\text{LaGaO}_3/\text{SrTiO}_3$ system, where the properties of $\text{LaAlO}_3/\text{SrTiO}_3$ were for the first time replicated in a different material; the $\text{LaAlO}_3/\text{EuTiO}_3/\text{SrTiO}_3$, in which we showed for the first time an electron-field tunable spin polarization of carriers, coexisting with superconductivity; the understanding on photoconductivity in this system, based on comparing samples of different chemical composition, different thickness and different crystallinity; the formation of freestanding $\text{LaAlO}_3/\text{SrTiO}_3$ membranes for the fabrication of superconducting and quantum circuits.

The growth and characterization laboratory (called MODA) that I set up over 10 year ago is shortly described in the section “More details on scientific activity”. Samples are partially analysed in real-time experiments, partially in situ through advanced surface science techniques, partially in the transport lab of my group and partially through external collaborations.

The scientific topics addressed in my career are described in the section “Publication”. The latest trends cover two complementary fields:

- a) Experiments performed on my samples at large scale facilities. Although this has always been a side activity of my research, I recently substantially improved my expertise by spending two months as visiting scientist at the Swiss Light Source, Paul Scherrer Institute, in January and February 2017. Some papers from such activity are already published (n.117, 115, 113 in the publication list) but most, including the ones prepared as leading author, are still submitted or in preparation.

- b) Fabrication or self-formed, freestanding, micron-size, superconducting $\text{LaAlO}_3/\text{SrTiO}_3$ heterostructures. We investigate these samples both as potential, gate-tunable circuit elements for superconducting circuits on semiconductor substrates or chips, and as systems in which unprecedented strain states, and strain gradients, can be achieved in oxides. A first paper was published one month ago (on *Adv. Funct. Mat.*, n. 116 in the publication list) and several are under review or in preparation.

The projects I have been leading are described in the “Fundraising” section. It is worth mentioning that in years 2014-2018 I have been running as PI a very large network project, a so-called COST Action, named “Towards Oxide-based Electronics” (TO-BE). TO-BE included over 350 participants from 29 EU countries. TO-BE meetings, training schools, funded missions, and dissemination initiatives have acted as a backbone structuring the network of EU laboratories working on oxides. One of the final outputs was the preparation as leading author and guest editor of an Oxide Technology Roadmap (*Appl. Surf. Science* 482, 1 (2019)), today a highly influential paper, based on the statistics regarding citations and downloads. This experience further enriched my portfolio of collaborations, further trained my leadership and communication skills, and increased my personal visibility in the community.

EDUCATION AND EMPLOYMENTS

- Starting from Oct. 15, 2020, Research Director (Direttore di Ricerca) for the SPIN Institute of the Consiglio Nazionale delle Ricerche (CNR SPIN), Naples Unit.
- March 1st, 2020 – Oct. 15, 2020, *Senior Scientist* (Primo ricercatore) for the SPIN Institute of the Consiglio Nazionale delle Ricerche (CNR SPIN), Naples Unit.
- 2004 – March 1st, 2020. *Research Scientist* for the SPIN Institute of the Consiglio Nazionale delle Ricerche (CNR SPIN), Naples Unit.
- 1999- 2004, *Research Scientist* for the Istituto Nazionale Fisica della Materia,
- November 1995, May 1997: *Post-doc* position at CEA Grenoble, FR
- May 1997 – September 1999: *Post-doc* in Naples under INFM (Istituto Nazionale per la Fisica della Materia) and University Federico II,
- November 1995: *PhD in Physics* assigned by the University “Federico II” of Naples. PhD Thesis title “Epitaxial YBCO films for grain boundary Josephson junctions”
- January 1991, *Master (“Laurea”) Degree in Physics* by the University Federico II” of Naples with score 110/110 cum laude.

FUNDRAISING

- *April 2020* Approval of a proposal for setting up a time-of-flight ARPES laboratory based on an ultrafast laser source, intended to become later a full PLD-ARPES (pulsed laser deposition and angle-resolved photoemission spectroscopy) laboratory. The laboratory will be part of the “*Laboratory for micro/Nano Devices and systems (LAND)*” a “research hub facility” to be set up in Naples by CNR. Foreseen amount as a first step: **€ 500**
- *April 2020 to Oct 2022*, Unit leader (representing the CNR-SPIN Institute) within the national PON project BEST4U “High efficiency bi-facial solar cells”, and task leader of the Task “Photoferroelectrics”. Total amount for the Unit, **€ 100** including cofunding
- *Sept. 2019 to Sept 2022*, Unit leader (representing the Naples Unit of the CNR-SPIN Institute) within the National PRIN Project “TWEET – Towards ferroelectricity in two dimensions”. Total amount for the Unit, **€ 250** including cofunding
- *April 2014 to April 2018*, Principal Investigator (Chair) of the *COST Action MP1308 TO-BE “Towards Oxide-Based Electronics”* active under H2020. The Action included over 350 registered participants from 29 different EU countries. The overall EU funding exceeded **€ 600**.

- *Sept. 2010 to Sept 2014. Workpackage leader for the programme: "MAMA: unlocking research potential for multifunctional advanced materials and nanoscale phenomena" funded within FP7/Capacities, Grant Agreement No. 264098. While the project was headed by the Salerno Unit of CNR-SPIN, under the coordination of Mario Cuoco, I have been in charge of managing about **one half of the grant** that was devoted to the Naples Unit. The overall EU funding exceeded **k€ 2.400***
- *Years 2007 to 2009. P.I. of the project "Study of precursors dynamics and of growth mechanisms in pulsed laser deposition of epitaxial thin films", granted by Regione Campania **k€ 20***
- *Years 2003 to 2006. Scientist in charge for the participation of CNR-INFM to the "Centro di Competenza Nuove Tecnologie" of Regione Campania, managing a grant exceeding **k€ 1.800***

INSTITUTIONAL RESPONSIBILITIES

- *January 2010 to 30 June 2011. "**Responsabile di Unità**" of the Naples Unit of CNR-SPIN as delegate of the CNR-SPIN Director prof. Ruggero Vaglio.*
- *Year 2009. **Director of INFM-Coherentia** as delegate of the CNR-INFM Director Elisa Molinari. The INFM-Coherentia personnel included 15 units of tenured Researchers and over 50 associated professors. INFM-Coherentia was structured in three units (Naples, Salerno and Rome) and was awarded by INFM an institutional budget of about € 200.000 in year 2009. *Coherentia was stopped within a national rearrangement of Italian Research System that merged the former INFM Institute into CNR.**
- *Years 2002 to 2009. **Leader of the Research Activity (or "Commessa")** "Deposition and diagnostics of thin films of innovative materials", first under Coherentia INFM and then under CNR SPIN.*

ORGANIZATION OF SCIENTIFIC EVENTS

*In the course of the **last 10 years**, I contributed, in most cases in a leading role, in the organization of **15 scientific events**. Some examples of participation to conference scientific committees are also reported.*

Conferences organised as TO-BE Action Chair (average audience: about 120 participants)

- Final Meeting of the TO-BE COST Action, Sant Feliu de Guixols, ES, 12-14 March 2018
- 2017 Fall Meeting of the TO-BE COST Action, Riga, LV, 11-13 September, 2017
- 2017 Spring Meeting of the TO-BE COST Action, Luxembourg, 3-5 April, 2017
- 2016 Fall Meeting of the TO-BE COST Action, Ljubiana, SI, 28-30 September, 2016
- 2016 Spring Meeting of the TO-BE COST Action, Warwick, UK, 6-8 April, 2016
- 2015 Fall Meeting of the TO-BE COST Action, organised as EMRS symposium "Towards Oxide-Based Electronics" Warsaw, PL, 15 – 18 September, 2015
- 2015 Spring Meeting of the TO-BE COST Action, Aveiro, PT, 30th March – 2nd April 2015
- 2014 Fall Meeting of the TO-BE COST Action, Rome, Italy, 22-23 September, 2014

Organization of other conferences and workshops, also as Conference Chair

- Symposium organiser for the CMD2020GEFES 2020 Conference, originally planned in Madrid, Aug. 31 to Sept. 4, 2020 and then held online. Name of the live-streamed symposium ("colloquium") "Oxide heterostructures and interfaces: from fundamentals to applications".
- Conference Chair for the conference "MAMA-Trend: Trends, challenges and emergent new phenomena in multi-functional materials" Sorrento , May 13-16, 2013.

- Symposium organiser for the Symposium *Magneto-transport, spin electronics and magnonic crystals* within the conference JEMS 2012 (Joint European Magnetic Symposia) Parma, Sept, 9-14, 2012
- Conference Chair for the conference "MAMA-SYNT": *"Synthesis and design of multi-functional materials and heterostructures"* Villa Campolieto, Ercolano, Oct. 24-26, 2011
- Symposium organiser for the symposium named *"In situ studies of the structure-property relation of evolving thin films and interfaces"* within the 2010 MRS Fall Meeting.
- Local member of Programme Committee and organiser for the conference "FOX E - Functional Oxides for Electronics", Massa Lubrense, Sorrento (NA), March 25-27, 2009.

Organisation in the role of TO-BE Action Chair of Training Schools

- School "Technologies for Oxide Electronics", Sant Feliu de Guixols, ES, 15-17 March 2018
- International School of Oxide Electronics ISOE2015, October 2015, Cargèse, FR, 12-24 October 2015. The school was co-organised between CNRS and the TO-BE Action.

Scientific committee member for conferences and workshops (some examples from recent year)

- Oxide Superconducting Spintronic Workshop OSS2018 Amalfi SA, Italy, April 11-13, 2018
- International School of Oxide Electronics, Cargese, FR, April 11 - 21, 2017
- ESAS winter school "Novel frontiers in superconducting electronics: from fundamental concepts and advanced materials towards future applications" Pozzuoli (Italy), December 12 – 16, 2016
- UFOX Workshop "Unveiling complex phenomena in Functional OXides", University of Fisciano, Salerno, Italy, 7 to 8 July 2016
- CMD 2016 (Condensed Matter Division (CMD) of the European Physical Society, Groningen, Sept 5-9), Symposium "2-Dimensional Electron Systems in Complex Oxides"
- Symposium O, Fundamentals of oxide heterostructures, 2015 EMRS Spring Meeting

INVITED TALKS AT CONFERENCES, TALKS IN MAJOR INSTITUTIONS, LECTURES AT TRAINING SCHOOLS

In the course of last 10 years I gave about 30 invited talks at conferences, workshops and training schools. The list below regards the period 2010- 2019, including some invited talks foreseen in next months.

- ECOS: International Workshop on electric control of spin transport and spin to charge interconversion, Milan, Italy, on January 22 – 23, 2020, title *"Self-formed LaAlO₃/SrTiO₃ micro-membranes hosting a 2D electron gas"*
- FISMAT2019, Session "Nanostructures and Nanotechnologies", Catania, IT, *talk to be given on* Sept. 30 – Oct. 4, 2019
- HUAWAI Vision Forum, London, Sept. 24-25, 2019, title "Towards Oxide Electronics"
- ICCGE-19, Keystone, CO, US, *talk to be given on* July 28 - August 2, 2019. Symposium on Epitaxy of complex oxides
- Fusion Conference, 4th Functional Oxide Thin Films for Advanced Energy and Information Technology Conference, Lisbon PT, *talk to be given on* July 17-20, 2019
- EMRS Spring Meeting, Nice, FR, May 27-31, 2019, Symposium on Synthesis, processing and characterization of nanoscale multi functional oxide films VII, title *"Freestanding oxide heterostructure membranes produced by disruptive strain relaxation"*
- Conference SuperFOX Superconductivity and Functional Oxides, 13-15 September 2018, Fisciano, Salerno, Italy, title *"Formation mechanism and atomic engineering of 2-dimensional electron gases at oxide interfaces"*.
- Conf. Wolte-13, 13th Workshop on Low Temperature Electronics, September 10 – 13, 2018 in Sorrento, Italy, title *"Emergent oxide memory devices"*.

- Conf. TCM2018, 7th international Symposium on Transparent Conductive Materials, Chania, 14-19, October 2018, title *"Magnetism, membranes and voltage/light induced memory effects in 2-dimensional electron gases at oxide interfaces"*.
- Conf. CIMTEC 2018, 14th Int. Ceramic. Congress, Symposium CK "Functional Magnetic Oxides", Perugia IT, June 8-14, 2018, title *"Engineering the functional properties of 2-dimensional electron gases at oxide interfaces"*.
- Workshop "5th International Workshop on Complex Oxides", Capri, IT, 20-24 May, 2018, title *"Charge Transfers Across Oxide Interfaces Hosting a 2-Dimensional Electron Gas"*.
- Conf. "Smart Materials and Surfaces", Paris, FR, 24-28 April 2017, *"2-Dimensional electron gases at oxide interfaces"*.
- Conf. "Superstripes", Ischia, IT, 4-10 June, 2017, *"2-Dimensional electron gases at oxide interfaces"*.
- Workshop "QUO VADIS", organized by PSI, 16-20 January 2017, title *"2-Dimensional electron gases at oxide interfaces: reversible non-volatile switch under field effect and light"*.
- Workshop "Nanoselect NOE", Organised by ICMA, 21-26 June, 2016, Sant Feliu de Guixols, title *"2D electron gases at oxide interfaces"*
- Workshop "Technologically Relevant Quantum Materials", Padriciano, IT, 19-20 December 2016, title *"2-Dimensional electron gases at oxide interfaces: reversible non-volatile switch under field effect and light"*
- Conf. "Transparent Conducting Materials- TCM", Crete, GR, 9-13 October 2016, title *"2-Dimensional electron gases at oxide interfaces: non-volatile, electrical and optical resistive switching"*
- Satellite TCM Workshop "Wirox", Crete, GR, 9 October 2016, title *"COST Action TO-BE: Towards Oxide-Based Electronics"*
- Conference Superstripes, Ischia, June 23-28, 2016, *Abrupt, non-volatile metal-insulator transition in oxide interfaces controlled by gate voltage and light"*,
- Photon Science Seminars of the Paul Scherrer Institute, June 24, 2016, title: *"2D electron gases at oxide interfaces"*
- Symposium L, EMRS Fall Meeting, Warsaw, Sept 15, 2015, title *"Towards oxide-based electronics"*,
- Superstripes Conference, Ischia, June 14, 2015, title *"About superconductivity and magnetism in oxide interfaces"*,
- Symposium SS, 2015 MRS Spring Meeting, San Francisco, April 8, 2015, title *"Building a Band Diagram for Oxide Interfaces Hosting a 2D Electron Gas"*,
- Symposium "Synthesis, Processing and Characterization of Nanoscale Multi Functional Oxide Films V, within the European Materials Research Society Spring Meeting, title *"Addressing oxygen and cation nonstoichiometry in the growth of 2-DEGs at oxide interfaces"*, Lille, May 12, 2015.
- Symposium "Multifunctional Oxides" within the MS&T (Materials Science and Technology) Conference, Pittsburg 12-16 Ottobre, 2014. Title *"Addressing the Origin of Conductivity in Two Dimensional Electron Gases at Oxide Interfaces"*
- SIF Conference (Italia Physical Society), Pisa, Italy, Sept. 22-26, 2014. Title: *"Addressing the origin of conductivity in two dimensional electron gases at oxide interfaces"*.
- International School of Physics and Technology of Matter, Otranto (LE), Sept. 15 – 19, 2014. Title: *"Pulsed laser deposition with real-time growth monitoring for atomically controlled fabrication of oxide heterostructures"*.
- SPS (Swiss Physical Society) Annual Meeting, Friburg, June 30 – July 2, 2014. Title: *"Addressing the Origin of Conductivity in Two Dimensional Electron Gases at Oxide Interfaces"*
- Meeting of the PSI Spectroscopy Group, Flumsemberg, March 7-11, 2013. Title: *"Electrostatics and photoresponse of oxide-based polar-nonpolar interfaces"*
- Symposium K: Oxide Interfaces within the 2010 MRS Fall Meeting, Hynes Convention Center, 01 Dec. 2010, Boston MA. Title *"Advanced Spectroscopies on Novel Conducting Interfaces."*
- Presentation of CNR-INFM Coherentia under request of the CNR-INFM Director Elisa Molinari for the CNR Evaluation Panel. Title: *"The CNR-INFM Coherentia national laboratory"*

In the course of the last 5 years I gave nearly 30 talks under invitation of major international institutions.

Institutions in which I have been delivering lectures under invitation in last 5 years include: *Forschungszentrum Jülich* (PGI Seminar), *Twente University*, Mesa Institute, Inorganic Materials Science Department, NL; *Kavli Institute of Nanoscience*, Delft University of Technology; *Cornell University* Department of Materials Science and Engineering, NY, US; *Stanford University* Physics Department, CA, US; *University of Pittsburg "PITT"*, PS, US; *Oak Ridge National Lab*, TN, US; *Technical University of Denmark – DTU* (several times), DK; *Unitè Mixte CNRS-Thales*, Paris, FR; *Max Planck Institute Stuttgart*, DE; *Chalmers University of Technology*, SE; *ICMAB Institut de Ciència de Materials de Barcelona*, ES; *IMDEA Madrid Institute for Advanced Studies of Materials*, ES; *LIST Luxembourg Institute for Science and Technology* LU, *Tuebingen University* (twice, both at Physics and Chemistry Department) DE; *IFW Dresden*, DE; *Paul Scherrer Institute* (several times) CH, *Institute of Electronic Structure and Laser IESL FORTH* Crete, GR; *JSI - Institut "Jozef Stefan"* Ljubliana, SI;

COMMISSIONS OF TRUST

Evaluation of funding applications for different international institution

- 2019 Department of Energy (US)
- 2018 ETH Zurich Postdoctoral Fellowship Program (CH)
- 2017 COST, EU Cooperation in Science and Technology. Evaluator of new COST Action applications
- 2016 Swiss National Foundation SNF(CH)
- 2013, University of Warwick, Research Development Fund Strategic Awards 2013/14 (UK),
- 2009. Dutch Technology Foundation STW, Programme STW "Perspectief - Building on Transient Plasmas (BTP) 2009 STW (NL)

Evaluator for the assignment of research/academic positions

- 2018, Researcher Position for Nanomaterials for Energy Applications at DTU Energy, Technical University of Denmark, DK
- 2017, Senior Researcher for Chemical Coatings of Energy Materials, Technical University of Denmark
- 2015, Oavlönad Docent position, Chalmers University of Technology

Board member of scientific institutions

Board member in years 2005 and 2006 for the "Centro di Competenza Nuove Tecnologie" of Regione Campania a Consortium of public research institutions endowed with 25M€ of budget from Regione Campania.

Referee for scientific journals

Regular activity as a referee for several highly ranked journals of major publishing groups, including Nature (Nature Communication), Wiley (Advanced Materials series), ACS (Nanoletters), APS (Phys. Rev. Lett) and more.

DISSEMINATION AND CONTACT TO INDUSTRY

In Sept. 2019 I have been invited by Huawei to their Vision Forum, held in London, to give a talk about oxide electronics. Discussion about possible collaborations stopped during the COVID-19 pandemic.

The Oxide Technology Roadmap, stems from the TO-BE COST Action I chaired. Besides providing a self-analysis of the global community working on oxides on the technological outputs of our research, aims to have an impact as a major dissemination tool. My ambition is that this document can be used worldwide by scientists as a tool helping them to foster both privates and public investments in oxide-based science and technology. Citation and download statistics confirm that the Oxide Technology Roadmap is becoming an influential paper.

Contacts with industry during my career include medium and big companies, as STMicroelectronics (IT and FR), IBM Zurich (CH), and SINTEF (NO) and smaller company as TSST BV (NL), SolMates BV (NL), Organic Spintroics (IT), Acreo (SE) and ChromoGenics (SE).

AWARDS

- 2017 Received “*abilitazione*” (habilitation) for Full Professorship in the Italian University System.

GUEST EDITOR ACTIVITY

- Applied Surface Science: Towards Oxide-Based Electronics: a Roadmap, Guest Editor and leading/corresponding author Appl. Surf. Sci **482**, 1 (2019)
- MRS Bulletin, Dec 2013, Special issue on Functional Oxide Interfaces, Guest Editor
- MRS Symposium Proceedings, Volume “Advances in Spectroscopy and Imaging of Surfaces and Nanostructures”, Volume 1318, Cambridge University Press

FILED PATENTS

- Sept. 2020 – A patent named “Process for fabricating free-standing membranes of perovskite LAO/STO heterostructures” was submitted in (*Domanda di brevetto per invenzione industriale N° 102020000020317 a nome CONSIGLIO NAZIONALE DELLE RICERCHE*) Inventors: Fabio Miletto Granozio and Alessia Sambri. The patent is related to the paper Adv. Funct. Mater. 2020, 1909964 DOI 10.1002/adfm.201909964 also published in Sept. 2020
- Year 1997 - Patent named “Tecnica di realizzazione di giunzioni ad effetto Josephson realizzate mediante la crescita di un film biepitassiale di YBCO su un substrato di SrTiO₃ (110) (*Josephson junctions fabrication technique based on a bi-epitaxial YBCO film on a (110) SrTiO₃ substrate*)”. Patent number: IT1276587; Publication date: 1997-11-03; Inventors: Miletto Granozio Fabio; Di Chiara Sandro; Lombardi Floriana; Tafuri Francesco; Valentino Massimo; Filed by: Consiglio Nazionale Ricerche (IT)

EDUCATION, EVALUATION AND SUPERVISION OF STUDENTS AND EARLY CAREER INVESTIGATORS.

Courses for undergraduate and master students

As being hired by CNR, a non-academic institution, teaching is not part of my regular duties. Therefore, in spite of being fully confident in my teaching skills and of having been fully engaged in the course of my activity into education and career development of young scientists, my list of given university courses is not as long as for colleagues hired at universities.

I gave some courses based on an external contract with University Federico II of Naples. Details are reported below:

- 100 hours 1st-year course on Mechanics and Thermodynamics (“Fisica I”) for the Faculty of Engineering, Degree in Informatics Engineering, University “Federico II” on year 2000, based on a one-year professorship contract from the University “Federico II”.
- 48 hours (6 ECTS) Master course in English, named “Solid State Physics”, for the Master in Mathematical Engineering, University “Federico II”, Napoli, March-June 2019
- An equivalent course this year was suspended due to the COVID-19 pandemic

Despite not working for a University Institution, I dedicated a large fraction of my career to the education, evaluation and career development of students and young researchers, as clarified below.

Tutoring of Master students:

- Davide Maccariello (*now R&D Physicist at Saint-Gobain Research Paris*): thesis title “Gas elettronici all’interfaccia

tra ossidi isolanti”, date 18/06/2009

- Emilia Esposito: thesis title “Crescita di film sottili epitassiali di manganiti per ablazione laser impulsata”, date 21/03/2007
- Aldo Oropallo: thesis title “Deposizione e caratterizzazione delle proprietà strutturali, magnetiche e di trasporto di film sottili epitassiali di $\text{La}_{0,67}\text{Sr}_{0,33}\text{MnO}_3$ ”, date 24 marzo 2004
- Fortuna Bevilacqua, (*now Scientist at ST Microelectronics, Naples*) thesis title “Film sottili epitassiali di CaRuO_3 : proprietà strutturali ed elettroniche”, date 14/03/2001

Tutoring (“Relatore) of PhD Students:

- Dr. Mohammed Riaz (*now Associate Professor in Pakistan*), “Transport Properties of Transition Metal Oxide Thin Films and Interfaces under Light Irradiation”, PhD School: Dottorato di Ricerca in Fisica Fondamentale ed Applicata, dell’Università di Napoli Federico II <http://www.fedoa.unina.it/8951/>,
- Dr. Milan Radovic (*now Scientist at PSI, CH and Adjunct Professor at DTU, DK*), “Low dimensional Ti-oxide based structures: surfaces, interfaces and ultrathin films of SrTiO_3 and TiO_2 ”, PhD school “Tecnologie Innovative per Materiali, Sensori e Imaging” della Università di Napoli Federico II, http://www.fedoa.unina.it/3474/1/Radovic_Milan.pdf,
- Dr. Alessia Sambri (*now Scientist at CNR, IT*), tesi dal titolo “Pulsed laser deposition of complex transition metal oxides: plume expansion and film growth”, PhD school “Tecnologie Innovative per Materiali, Sensori e Imaging” della Università di Napoli Federico II <http://www.fedoa.unina.it/2036/>;
- Dr. Fabrizio Ricci (*Now Project Manager at Pirelli LABS*), “Studio della struttura e delle superfici di film epitassiali di ossidi complessi”, PhD School Dottorato Di Ricerca in Fisica Fondamentale ed Applicata, XIV Ciclo,

Supervised post-docs

- Dr. Anita Guarino, 18 month contract starting on 01/10/2017,
- Dr. Alessia Sambri (*now Scientist at CNR, IT*), 12 month contract starting on 01/01/2016,
- Dr. Alessia Sambri, 12 month contract starting on 01/02/2015,
- Dr. Musa Mutu Can (*now Associate Professor in Turkey*), 12 month contract starting on 03/11/2013,
- Dr. Amit Kumar Khare (*now Associate Professor in India*), 17 month contract started on 20/05/2013,
- Dr. Emiliano Di Gennaro (*now Associate Professor in Naples*), 30 month contract stated on 01/03/2011, Italy
- Dr. Paolo Perna (*now Scientist at IMDEA, Madrid, ES*), 6 months contract started on 01/03/2008,

Participation to international PhD Committees.

- Dalal Fadil, L’université de Caen Normandie. 2011. Supervisor : Dr. Laurence Mechin.
- Nicolina Tuzla, Chalmers University of Technology, Goteborg, SE. Supervisor Prof. Eva Olsson
- Uwe Treske, Fakultät Mathematik und Naturwissenschaften der TU Dresden, 2015. Supervisor: Prof. Bernd Büchner.
- Eduard Lesne, Université Pierre et Marie Curie. 2015. Supervisor: Prof. Agnes Barthelemy.
- Felix Trier, Technical University of Denmark, 2016. Supervisor: Prof. Nini Pryds.
- Mateusz Scigaj, Universitat Autònoma de Barcelona, 2016. Supervisor: Prof. Gervasi Herranz.
- Dennis Valbjørsson, Technical University of Denmark, 2017. Supervisor: Prof. Nini Pryds.
- Merlin von Soosten, Technical University of Denmark, 2019, Supervisor: Prof. Nini Pryds.

Evaluator for the appointment of candidates to permanent research/academic positions

- 2018, Researcher Position for Nanomaterials for Energy Applications at DTU Energy, Technical University of Denmark, DK
- 2017, Senior Researcher for Chemical Coatings of Energy Materials, Technical University of Denmark
- 2015, Oavlönad Docent position, Chalmers University of Technology

Organization of Training Schools.

Within the TO-BE COST Action, I prompted and followed as Action Chair the organization of two training schools:

- ISOE2015, International School of Oxide Electronics 2015 (a 12 days school), 12–24 October 2015, Cargèse, FR.

- International School “Technologies for Oxide Electronics”, a three days school, 15-17 March 2018: Sant Feliu de Guixols, ES.

I also was in the scientific committee of

- ISOE2017, International School of Oxide Electronics, April 11 - 21, 2017 Cargese, FR

Lectures given at International Training Schools.

- ISOE2015, International School of Oxide Electronics 2015, 12–24 October 2015, Cargèse. Speaker and organiser. Lecture named "2DEGs at oxide interfaces"
- School “New frontiers in down-scaled materials and devices: realization and investigation by advanced methods”, Otranto (Italy) 15–20 September 2014. Lecture named "Pulsed laser deposition with real-time growth monitoring for atomically controlled fabrication of oxide heterostructures".
- Training Course in the Physics of Strongly Correlated Systems, Vietri, IT, 2-13 October 2017. Three 2,5-hour lessons respectively named: 1) Growth of epitaxial thin films and heterostructures: physical mechanisms, deposition techniques, in-situ monitoring and strain effects; 2) Two-Dimensional electron gases at oxide interfaces; 3) Oxide Technology Roadmap: Discussion on the possible applications of oxide films and heterostructures.
- Lectures held at the MESA Institute, Inorganic Materials Science Group of Twente University (NL). In the week of November 12-16, 2018 I was invited to give four lectures, two at an advanced level and two at a tutorial level for PhD students. The two tutorial lectures were: “2-dimensional electron gases at oxide interfaces” (Nov. 13) and “Towards Oxide-Based Electronics: Possible applications of oxide films and heterostructures” (Nov. 15).

Activity as TO-BE Action Chair (April 2014 – April 2018) in favour of early stage researchers.

In the role of COST Chair, I had the institutional duty to get fully engaged in fostering the career of early career investigator (ECIs, the term used within COST for early stage researchers), with special attention to balancing genders and to supporting scientists from less science-intensive countries. Attention to ECIs has been crucial throughout the all TO-BE Action, including the selection of oral talks and to assigning support for participation to all TO-BE meetings.

Two training schools were organised, as reported above. The first training school was mostly dedicated to fundamental science aspects, while the second school was intended to provide information about the actual potential of oxides in present and future technologies.

An important initiative implemented during the TO-BE Action, in order to help ECIs increasing their international experience, was to fund 50 scientific missions (called STSMs) from home to host institutions of different countries. 40 beneficiaries were ECIs. Access to funding was made possible through calls open twice or three times a year. Some statistics on the impact of the TO-BE Action in this respect are reported here <http://to-be.spin.cnr.it/statistics/>.

MORE DETAILS ON SCIENTIFIC ACTIVITY

Major scientific interests

- Growth and characterization of oxide interfaces hosting a 2-dimensional electron gas.
- Growth mechanisms of epitaxial thin films and heterostructures of electronic and energy materials
- Study of the pulsed laser deposition process
- Novel materials and heterostructures for electronics and energy.
- Prototypes of spintronic and electric field devices
- Photoconductivity in oxide films
- Field effect devices
- Science and applications of transition metal oxides.
- Magnetism and superconductivity in materials and interfaces
- Photon-based spectroscopies in the whole IR – VIS – UV – X range
- Fabrication and characterization of oxide bilayer membranes

Activity at large scale facilities

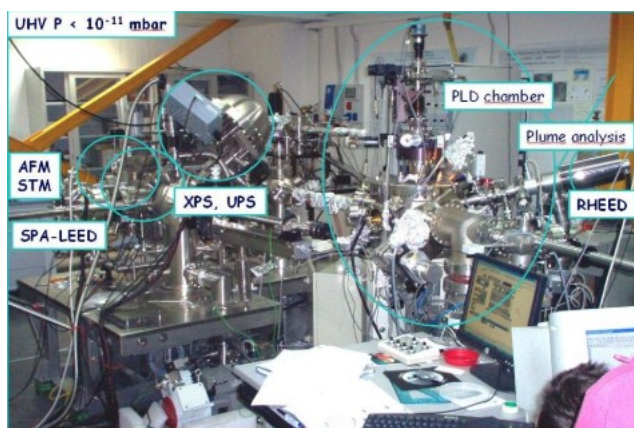
Visiting Scientist for two months, January and February 2017, working at the ARPES beamlines ADRESS and SIS.

PI of several successful beamtime applications at ESRF, ELETTRA, SLS and SINQ. Experimental techniques included (angle resolved) photoemission, x-ray absorption with different variants (XAS, XLD, XMCD, EXAPF), X-ray diffraction and neutron reflectometry.

The MODA laboratory

This lab was designed and purchased by myself and set up by myself with the help of some colleagues. It was funded by the grant I was managing in the framework of the participation of CNR-INFN to the "Centro di Competenza Nuove Tecnologie" of Regione Campania.

MODA stands for "Modular facility for Oxide Growth and Analysis". MODA was designed, purchased and setup by myself in years 2004-2006 while being responsible of a large grant from Regione Campania. MODA is a complex UHV apparatus allowing for the fabrication of epitaxial thin films with real-time control of the growth process and for the in-situ characterization of the structural, electronic and chemical properties of as-grown films by a number of complementary surface sensitive techniques. A UHV distribution chamber is employed to transfer the samples



between the load-lock fast entry, the pulsed laser deposition chamber and the analysis chambers.

In brief, MODA allows for:

- Pulsed laser deposition (PLD) growth of complex oxides films and multilayers. The PLD chamber includes full automation of deposition process, due to the software control of sample holder, laser pulses, gate valves, target carousel, deposition temperature and deposition pressure.
- Real time monitoring of the transfer process of atoms, ions and molecules from the target to the film, in the form of a transient plasma ("plume"). To this aim, we perform fast imaging and spectroscopy of the plume optical emission at a time resolution scale of the order of 10-100ns.
- Real time monitoring of the film surface evolution of by high pressure RHEED (reflection high energy electron diffraction), operating up to 0.5 mbars.
- Variable angle photoemission analysed with an Omicron Hemispherical Analyser using a X-ray Mg, Al twin anode or a UV He lamp as excitation source.
- Spot Profile Analysis Low Energy Electron Diffraction (SPA-LEED)
- Variable Temperature UHV STM/AFM

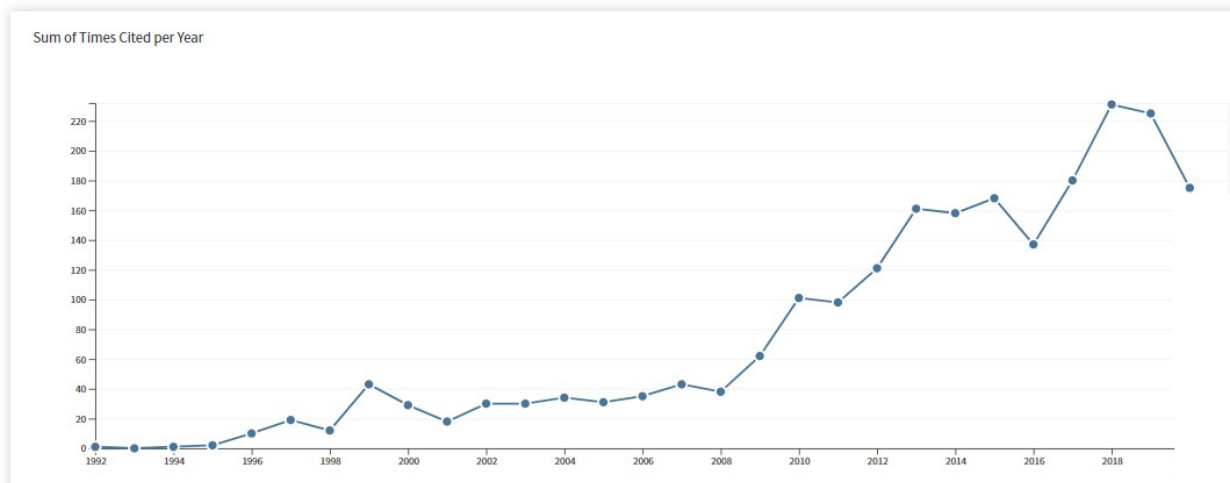
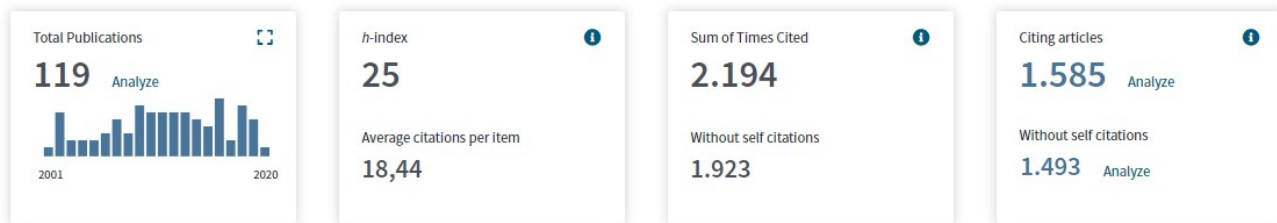
Samples produced within the PLD chamber are partly analysed in-situ within the MODA system, in part measured within the transport lab of my research group, also as a function of applied electric field and light irradiation, and in part analysed at large scale facilities or in international laboratories.

PUBLICATIONS

This final part of my CV has three sections:

- The first is a brief introduction in terms of standard citation metrics;
- In the second, a joined presentation of the research activities pursued in my career and of the related publications is reported. Highly cited publications are highlighted. Not all publications are reported, especially the older ones, and some might be reported twice, if relevant to two topics. A note will be added when papers are cited more than once.
- At the end of this document, a formal chronological publication list is reported.

General presentation and citation metrics



1.a Optimization and control of YBCO film structure and orientation

In this activity I was mostly accompanied by a colleague that has been coauthor of many of my papers, Umberto Scotti di Uccio, but I did most of the experimental work. When I do not appear as first author, it is because in my former group at early times author were named in alphabetic order.

The most relevant papers from this initial time are, with reference to the publication list, Refs 3, 9, 18, 27:

1.b Fundamental understanding of the YBCO nucleation process in thin film growth

A related activity concerning thin film growth was on purely theoretical nature, based on ab-initio computations and growth dynamics. This was before the time of DFT. Two fully theoretical papers were issued (I was first author with one coauthor) plus a third mixed of experiment and theory: with reference to the publication list, Refs 15, 17, 27:

1.c "Biepitaxial" grain boundary Josephson junctions based on a technique that I first invented as a PhD student

The main idea I had was to form artificial grain boundary based on the "biepitaxial" technique by altering the standard epitaxial relation between film and substrate through an extra seed layer. Partially (001) and partially (103) oriented films were obtained on (110) SrTiO₃. Furthermore, the in-plane orientation of the (001) layer could be selected by choosing the most suitable seed layer (either MgO or CeO₂). The grain boundary yielded good Josephson junctions suitable for many experiments. With the CeO₂ seed layer, so-called π -junctions were obtained. In this works I had the role of inventor of the technique and film growth and characterization expert, while my colleague Francesco Tafuri was the major expert on Josephson physics and devices.

The most relevant papers, with reference to the publication list, are Refs 20, 28, 38, 39, 40

Ref. 39 (Phys. Rev. Lett.) reports on an experiment that contributed confirming the d-wave nature of the superconducting order parameter based on the angular dependence of the Josephson critical current. I played a crucial role in properly matching the obtained angular dependence with theory predictions.

1.d Investigating fundamental properties of superconductors by optical and x-ray spectroscopies on epitaxial thin films.

With reference to the publication list, Refs 55, 58, 72, 80.

Ref. 58 is a seminal paper, one of the firsts demonstrating the potential of RIXS in measuring magnetic excitations in thin films.

2 - Oxide interfaces hosting 2D electron gases.

My activity of last decade has been largely focused on oxide interfaces, and in particular on those hosting a 2D electron gas, with the publication of over 30 papers on the topic. In all such publications I have been leading the group providing quite unique and thoroughly characterised samples, finding collaborators able to perform innovative characterizations and contributing to the data analysis and paper writing with my expertise in the physics of this system.

2.a – Alternative oxide interfaces exhibiting a 2D electron gas

In the course of my activity I proposed and realised in my PLD system and with my coworkers several novel variants of the original $\text{LaAlO}_3/\text{SrTiO}_3$ interface, as $\text{LaGaO}_3/\text{SrTiO}_3$, $\text{NdGaO}_3/\text{SrTiO}_3$, $\text{LaAlO}_3/\text{BaTiO}_3/\text{SrTiO}_3$ (yet unpublished) and $\text{LaAlO}_3/\text{EuTiO}_3/\text{SrTiO}_3$ (research on this interface is currently led by a colleague, Marco Salluzzo, the samples being realized in my PLD system). The most relevant papers, with reference to the publication list, are Refs 67, 68, 75, 82, 86, 87, 92, 94, 109.

Ref. 67 is a pretty influential paper (also cited on the Wikipedia page dedicated to the Lanthanum aluminate-strontium titanate interface) for which I was leading/corresponding author. Ref. 94 was published on Nature Materials: the currently running Quantero program called “Quantox” is largely based on exploiting the system proposed and studied in this work.

2b – Fundamental studies on oxide interfaces based on Electron Microscopy, EELS, X-ray Spectroscopies and linear or nonlinear optical microscopies.

My relevant papers in this field, with reference to the publication list, are Refs 59, 70, 76, 79, 85, 86, 87, 88, 89, 90, 91, 94, 98, 103, 105, 110, 113, 115, 117. The most influential ones are 59 (also this paper is cited on the Wikipedia page dedicated to the Lanthanum aluminate-strontium titanate interface), 76 (Publ. on Nat. Materials), 94 (publ. on Adv. Materials), 103 (Published on Nat. Comm).

2.c - Fabrication and characterization of $\text{LaAlO}_3/\text{SrTiO}_3$ -based devices in combination with other materials, as manganites and graphene

My most relevant papers in this field, with reference to the publication list, are Refs 97, 100, 106 and 108.

2.d – Fabrication and characterization of (super)conducting LAO/STO Heteromembranes

The only currently published paper on the field is Ref 116 (Advanced Functional Materials), together with the filed CNR patent N° 10202000020317. This work is collecting a major interest from several collaborating groups, and a number papers based on our heteromembranes are currently in preparation

3 - Interplay between magnetic and structural properties of manganite-based films and multilayers. Fabrication of spintronic device prototypes.

My papers in this field, with reference to the publication list, are Refs 43, 44, 45, 46, 47, 48, 50, 65, 66, 69, 80, 88, 100, 103, 106

4 – Characterization of TiO₂ anatase epitaxial films

My papers in this field, with reference to the publication list, are Refs 73, 74, 81, and 104

5 - “Real time” or “in-situ” characterizations performed within the “Modular Facility for Oxide Deposition and Analysis” (MODA).

These papers are largely based on all-in-situ sample growth and characterization in the MODA laboratory

5.a - Papers based on real-time laser plume emission spectroscopy during PLD growth.

These papers are based on a) time-gated fast photography of the plume self-emission, performed resorting to a cooled intensified CCD sensor. b) time-gated fast spectroscopy of the plume self-emission, obtained by dispersing the spectrum (perpendicularly to the plume propagation direction) with the help of a diffraction lattice; c) spectrally-resolved (.e. chemically resolved) plume photography, that allows to collect pictures related to the self-emission of single atomic species in the plume. The main figures leading this research have been Salvatore Amoruso, expert in optical spectroscopy and of laser-matter interaction, and myself as the leader of the PLD group. With reference to the publication list, refs 52,56, 66, 68,75, 77, 96, 102

5b - Papers is based on in-situ, RHEED, LEED, XPS and AFM/STM analysis performed within the MODA system

With reference to the publication list, refs 57, 73, 77

6 - Author under invitation of review papers and editor of special issues on oxide electronics and oxide interfaces.

With reference to the publication list, the papers are refs 83, 101 and 112. Ref. 112, for which I was Editor and leading/corresponding author, Fluctuates in the Web of Science classification between “highly cited paper” (top 1% in the field), and “hot paper” (top 0,1% in the field). It has collected 54 ISI-Web citations in about 15 months from publication

7 – Scientific, fundraising and dissemination activity related to COVID-19 pandemic.

Following the start of the coronavirus outbreak in Italy, I started an intense activity including addressing specific epidemiological aspects, as summarised below

a) Writing of scientific papers that are currently either published as preprints or in preparation (preprints reported below):

Comparative analysis of the diffusion of Covid-19 infection in different countries, F. Miletto Granozio, <https://arxiv.org/abs/2003.08661> [physics.soc-ph]

On the problem of comparing Covid-19 fatality rates, F. Miletto Granozio, <https://arxiv.org/abs/2004.03377> [q-bio.PE]

b) Writing of papers for a wider audience, that were published on the online Journal **Scienzainrete** <https://www.scienzainrete.it/autori/miletto-granozio/2340>

<https://www.scienzainrete.it/articolo/cruscotto-del-cnr-capire-landamento-dellepidemia-nel-mondo/mario-barra-emiliano-di-gennaro> (over 35.000 reads)

<https://www.scienzainrete.it/articolo/levoluzione-dellepidemia-europa-al-17-marzo/fabio-miletto-granozio/2020-03-18>

<https://www.scienzainrete.it/articolo/levoluzione-dellepidemia-europa/fabio-miletto-granozio/2020-03-13>

c) Set-up of the website of the CNR-SPIN Institute dedicated to COVID-19: <https://covid19.spin.cnr.it/>

d) Filing of some funding applications, currently in preparation

CHRONOLOGICAL PUBLICATION LIST: PAPERS ON ISI-WOS PEER-REVIEWED JOURNALS

- 117 Transition from a Uni- to a Bimodal Electron Liquid in LaAlO₃/SrTiO₃ upon cooling, M. Zwiebler, E. Di Gennaro, J. E. Hamann-Borrero, T. Ritschel, J. Green, G. A. Sawatzky, E. Schierle, E. Weschke, A. Leo, F. Miletto Granozio, and J. Geck, **Scientific Report 2020**, in press (proofs received)
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- 115 Transient quantum isolation and critical behavior in the magnetization dynamics of half-metallic manganites, T. Pincelli, R. Cucini, A. Verna, F. Borgatti, M. Oura, K. Tamasaku, H. Osawa, T.-L. Lee, C. Schlueter, S. Günther, C. H. Back, M. Dell'Angela, R. Ciprian, P. Orgiani, A. Petrov, F. Sirotti, V. A. Dediu, I. Bergenti, P. Graziosi, F. Miletto Granozio, Y. Tanaka, M. Taguchi, H. Daimon, J. Fujii, G. Rossi, and G. Panaccione **Phys. Rev. B 100**, 045118 (2019)
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- 112 Towards oxide electronics: A Roadmap, M. Coll, J. Fontcuberta, M. Althammer, M. Bibes, Boschker, A. Calleja, G. Cheng, M. Cuoco, R. Dittmann, B. Dkhil, I. El Baggari, M. Fanciulli, I. Fina, E. Fortunato, C. Frontera, S. Fujita, V. Garcia, S.T.B. Goennenwein, C.-G. Granqvist, J. Grollier, R. Gross, A. Hagfeldt, G. Herranz, K. Hono, E. Houwman, M. Huijben, A. Kalaboukhov, D.J. Keeble, G. Koster, L.F. Kourkoutis, J. Levy, M. Lira-Cantu, J.L. Macmanus-Driscoll, Jochen Mannhart, R. Martins, S. Menzel, T. Mikolajick, M. Napari, M.D. Nguyen, G. Niklasson, C. Paillard, S. Panigrahi, G. Rijnders, F. Sanchez, P. Sanchis, S. Sanna, D.G. Schlom, U. Schroede, K.M. Shen, A. Siemon, M. Spreitzer, H. Sukegawa, R. Tamayo, J. van den Brink, N. Pryds, F. Miletto Granozio*, **Appl. Surf. Science 482**, 1 (2019).
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- 108 Probing charge transfer during metal-insulator transitions in graphene-LaAlO₃/SrTiO₃ systems, J. Aliaj, A. Sambri, V. Miseikis, D. Stornaiuolo, E. di Gennaro, C. Coletti, V. Pellegrini, F. Miletto Granozio, and S. Roddaro, **APL Materials 6**, 066103 (2018)
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- 90 Photoresponse dynamics in amorphous- $\text{LaAlO}_3/\text{SrTiO}_3$ interfaces, Emiliano Di Gennaro, Ubaldo Coscia, Giuseppina Ambrosone, Amit Khare, Fabio Miletto Granozio & Umberto Scotti di Uccio, **Scientific Reports** **5**, 8393 (2015)
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