

## PERSONAL INFORMATION

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## EDUCATION

1992      PhD in Physics  
            Physics Department, Università degli Studi di Milano, Italy  
1988      Master in Physics (with honours)  
            Physics Department, Università degli Studi di Milano, Italy

## CURRENT POSITION

2019 -      Professor in Condensed Matter Physics (Full)  
            Department of Materials Science, Università degli Studi di Milano Bicocca, Italy

## PREVIOUS POSITIONS

2004 – 2019      Professor in Condensed Matter Physics (Associate)  
                        Department of Materials Science, Università degli Studi di Milano Bicocca, Italy  
1996 – 2004      Senior Researcher  
                        Department of Materials Science, Università degli Studi di Milano Bicocca, Italy  
1995              Postdoc fellowship in Materials Science, Material Science Institute, CSIC Madrid, Spain  
1993-1995      Postdoc, University of Milano, Italy  
1992              Postdoc, Inter-University Research Consortium of Milan, Italy

## FELLOWSHIPS AND AWARDS

2000 – 2001      Center of Excellence Fellow, National Research Institute of Metal (now National Institute for Materials Science), Tsukuba, Japan  
1990 – 1991      Fellowship, Metal Physics Institute, University of Goettingen, Germany

## INSTITUTIONAL RESPONSIBILITIES

2018-              **Co-Director**, Joint Laboratory **QuCAT** (Quantum Nanostructure Photo-Catalysis), Università di Milano Bicocca and South China Normal University (Guangzhou, China)  
2020-              **Director**, Inter-University Laboratory **L-NESS** (Epitaxial nanostructures on Silicon and Spintronics), Università di Milano Bicocca and Politecnico di Milano, Italy  
2018-              **Project PI** of the Materials Science Department Project “Dipartimenti di Eccellenza 2017” of the MIUR (Ministry of Education, University and Research)  
2015–              Member of the Committee of the PhD school in Science and Nanotechnology of Materials, Università degli Studi di Milano Bicocca  
2000 – 2015      Member of the Committee of the PhD school in Nanostructures and Nanotechnologies, Università degli Studi di Milano Bicocca  
2014 – 2018      Member of the University Committee for International Cooperation, Università degli Studi di Milano Bicocca, Italy

**RESUME**

My main research activity focuses on the field of III-V semiconductor heterostructures and nanostructures for optoelectronic applications covering various aspects related to the growth, the optical characterization and the modeling. In particular semiconductor quantum nanostructure growth fundamental studies and device applications.

This activity relies on my previous experience on both experimental and theoretical research starting from the graduation and continuing during my years as Assistant Professor at the Milano-Bicocca University. My theoretical activity started with the ab-initio modeling of defects in semiconductors (with Prof. Teichler at Goettingen Univ.) and continued studying carbon-based networks with complex topology in the group of Prof. Benedek, also in collaboration with the FKF Max Plank Institute. Experimentally my attention was devoted to the study of the emission properties of semiconductor quantum nanostructures in collaboration with Nottingham University (Prof. Eaves) and NIMS-Japan (Prof. Koguchi)

In 2008, after 15-year experience in the modelling, using both ab-initio and semiempirical simulation methods, and optical characterization of the electronic properties of semiconductors, I founded a new laboratory, within the InterUniversity (Milano-Bicocca University and Politecnico di Milano) laboratory L-NESS (I'm now Vice-Director of L-NESS), for the development of innovative growth strategies for the fabrication, by Molecular Beam Epitaxy, of nanostructured III-V materials based on kinetically controlled growth processes. The approach I have adopted for the research planning is to combine, directly in the material and growth process design phase, a deep understanding of semiconductor basic growth methods, nanostructure electronic states knowledge and device design. This permit to make use of extremely innovative growth processes, to achieve basic understanding of the physical phenomena in the growth and in the structure, while directly targeting device applications. In this respect my multidisciplinary experience plays a fundamental role, allowing for an in-depth understanding of all the steps involved in the device design, from growth, to device engineering. My main achievement is the development of an innovative growth procedure, invented by NIMS labs in Japan, for quantum nanostructure formation, the Droplet Epitaxy. This growth method permits the self-assembly of nanoisland of the desired shape on virtually any substrate, included silicon.

Also thanks my discoveries and my efforts to constitute and coordinate a scientific community focused on its development, the Droplet Epitaxy gained a relevant status among nanostructure growth processes and it is now one of the best way to obtain single photon sources for quantum photonic applications. Several projects proposed, both on-going and completed (see list), are based on this innovative growth method. In particular 4PHOTON, an MSCA-ITN network, approaches the development of fundamental strategies for the implementation of innovative quantum technologies starting from Droplet Epitaxy nanostructures. More recently, I implemented kinetic controlled growth methods for the fabrication of vertical heterostructures for the integration of high quality III-V materials on Si. This is a strongly innovative approach, that permits the design of completely different device design. Two projects based on this approach are on-going, one of them an H2020-FET (microSPIRE).

My approach, combining fundamental studies with a clear application target, gained a major recognition by the community, with many invited talks in the major conference of the area (19 from 2009) and the involvement program and steering committee of the major conferences (including the International Conference of Molecular Beam Epitaxy) and the direct organization of two of them. In recognition of the relevance of my work at the international level, a joint laboratory (QuCAT), between the my laboratory at L-NESS/Milano-Bicocca University and the South China Normal University of Guangzhou, for the development quantum nanostructured InGaN materials for photocatalysis has been recently established (July 2018).

## SUPERVISION OF GRADUATE STUDENTS AND POSTDOCTORAL FELLOWS

2006 – 2018 5 PostDocs/ 8 PhDs/ 20 Master Students

## ORGANISATION OF INTERNATIONAL CONFERENCES

- 2018 Chair of the Symposium “Epitaxial Crystal Growth at the Nanoscale” of the 3<sup>rd</sup> AIC-SILS Conference, Rome, Italy
- 2017 Chair of Organizing Committee, Semiconnano Conference 2017, Italy
- 2015 Chair of Organizing Committee, European Molecular Beam Epitaxy Conference, Canazei, Italy
- 2016- Program Committee International Molecular Beam Epitaxy Conference (Montpellier (F) 2016, Shanghai (China) 2018)
- 2013- Program Committee, European Molecular Beam Epitaxy conference (XVIII - Canazei (IT) 2015, XIX – St. Petersburg (RU) 2017, XX – Lenggries (D) 2019)
- 2011- Program Committee, Semiconnano Conference (Traunkirchen (Austria) 2011, Lake Arrowhead (USA) 2013, Hsinchu (Taiwan) 2015, Como (Italy) 2017, Kobe (Japan) 2019)
- 2010- Program Committee, Epitaxial Semiconductors on Patterned Substrates and Novel Index Surfaces Conference (VIII- Como (Italy) 2010, IX-Eindhoven (Netherlands) 2012, X-Traunkirchen (Austria) 2014))

## REVIEWING ACTIVITIES

- 2018- International Advisory Committee, International Conference on Molecular Beam Epitaxy
- 2018 Steering Committee of the e-MRS Symp. On “Epitaxial integration of dissimilar materials: challenges and fundamentals”
- 2014 Scientific Advisory Board, International Conference on Crystal Growth and Epitaxy (ICCGE-17), Poland
- 2014– Scientific Advisory Board, Inter-University Laboratory L-NESS, Università di Milano Bicocca and Politecnico di Milano, Italy
- 2017 Reviewer, ANR-DFG projects evaluator
- 1996- Reviewer for the major Journals in Solid State Physics: Phys. Rev. series (Lett, B, Materials, Applied); Applied Physics Letters; Advanced Materials, etc.

## MEMBERSHIPS OF SCIENTIFIC SOCIETIES

- 2015- Member, Associazione Italiana di cristallografia (AIC), Italy

## PATENT APPLICATIONS

- PCT n. PCT/EP2017/056029 - 14.03.2017 "Method for the fabrication of indium-gallium nitride electrodes for electrochemical devices
- PCT n. PCT/EP2017/068423 - 20.07.2017 "Photoelectrochemical water splitting device for solar hydrogen generation and method for fabricating the same"

## PROJECTS

- **Project Coordination** of **3** International Projects (one running) and **4** National Projects
- **Milano-Bicocca Unit Responsible** in **1** International Projects (one running) and **3** National Projects (three running)
- **Project PI** of the Materials Science Department Project within the call “Dipartimenti di Eccellenza 2017” of the MIUR (Ministry of Education, University and Research) Amount: 10,693,820€

### Coordination of International Projects:

- “4PHOTON, Novel Quantum Emitters monolithically grown on Si, Ge and III-V substrates”, **EU-H2020** MSCA-ITN (721394)- (2017-2020) Project total amount 3,960,000 €

- "FEMTOTERA: Plasmon-enhanced Tera-Hertz emission by Femtosecond laser pulses of nanostructured semiconductor/metal surfaces" funded by **EU-FP7** CONCERT-Japan (2014-2016) Project total amount: 200,132 €
- **Japan-Italy Bilateral Project** "DELOS: Droplet Epitaxy Quantum Dots for Next Generation Optoelectronics" funded by the Italian Minister of Foreign Affairs (2008-2009)

**Coordination of National Projects:**

- "HYPERMAT: Development of advanced materials for hyperspectral sensors" funded by Fondazione **CARIPLO** and **Regione Lombardia** (2019-2021) Project total amount 886,000 €
- Research Program of Relevant National Interest (**PRIN-2008**) "GOCCIA: GaAs based Optoelectronic materials for C-MOS Compatible Integrated Applications" funded by Italian Minister of University and Education (2010-2012): Project total amount 151,242 €
- "QUADIS: Quantum Dot Integration on Silicon " funded by Fondazione **CARIPLO** (2007-2009) Project total amount 640,000 €
- "SOQUADRO: Solar cells based on QUAntum nanostructures grown by DROplet epitaxy" funded by Fondazione **CARIPLO** (2011-2014) Project total amount 630,000€
- "COSMOS: Compact Optical System with Monolithically integrated multispectral Sensor" funded by Fondazione **CARIPLO** and **Regione Lombardia** (2013-2016) Project total amount 734,558 €

**Milano-Bicocca Unit PI**

- "MicroSpire: micro-crystals Single Photon InfraREd detectors" H2020-FETOPEN (766955) - (2018-2020) Project total amount 3,106,381€
- "TEINVEIN: TEcnologie INnovative per i VEicoli INtelligenti "Regione Lombardia & UE POR-FESR (2017-2019) Project total amount 8,128,000€
- "COSMITO: COmpressive Sampling Multispectral Imaging camera for remoTe Observation" Regione Lombardia & UE POR-FESR (2016-2018) Project total amount 995,000€
- "Silicio-Rosso: Development of silicon integration technologies of Thermal Infrared detectors" Agenzia Spaziale Italiana (ASI) (2018-2020) Project total amount 150,650€
- "EIDOS: Epitaxial Intersubband Detectors On Silicon" Fondazione CARIPLO (2011-2014) Project total amount: 440,000€

**COLLABORATIONS**

**MAJOR ACADEMIC COLLABORATIONS**

- 1) Prof. Hiroshi Amano, development of InGaN based red LED, Nagoya University (Japan),
- 2) Prof. Richar Noetzel, Co-Director of QuCAT Joint-Lab, development of quantum nanostructured InGaN materials for photocatalysis, South China Normal University, Guangzhou, China
- 3) 4PHOTON MSCA network: Prof. Paul Koenraad, Prof. Michael Flatté (TU Eindhoven), Prof. Sven Hofling (Univ. Wurzburg), Prof. Richard Warburton (Univ. Basel), Prof. Bernhard Urbaszek (CNRS Toulouse), Prof. Wolfgang Hansen and Prof. Christian Heyn (Univ. Hamburg), Prof. Huiyun Liu (UCL), Prof. Alexander Tartakowski (Univ. Sheffield). Development and characterization of droplet epitaxy quantum dots for quantum information applications.
- 4) Prof. Takashi Kita, development of quantum dot infrared photodetectors, Univ. Kobe, Japan
- 5) Dr Masafumi Jo, Development and characterization of Nitride materials for ultraviolet sources, RIKEN (Tokyo-Japan)
- 6) Dr Lutz Geelhaar, Development of Molecular Beam Epitaxy processes, Paul Drude Institut (Berlin)
- 7) Microspire FET Collaboration: Prof. Giovanni Isella (Politecnico di Milano), Prof. Douglas Paul (Univ. Glasgow), Prof. Kerstin Voltz (Univ. Marburg), Prof. Axel Voight (TU Dresden). Development of three-dimensional epitaxial growth on patterned Si substrates for optoelectronics applications.

**NON-ACADEMIC COLLABORATIONS**

- 1) 4PHOTON MSCA network: Toshiba Europe (UK), SingleQuantum (NL), Attocube (D), development of single photon emitters for quantum information applications

- 2) OHB Italia (I), development of multiband photodetectors for space applications
- 3) Imasenic (E), development of multiband photodetectors integrated on silicon ROIC
- 4) Fondazione Bruno Kessler (I), integration of IR photodetectors on silicon
- 5) Micro Photon Devices (I), IR photodetector development

**DISSEMINATION:**

**Publications**

Overall: 230

Scopus: h-index: 33 – total citations 4300

### Invited presentations to international conferences

25 Invited presentations in major international conferences (**21** in the last 10 years)

#### 5 Selected Invited Talks (last 10 Years):

- 2019** Keynote Talk, Semiconnano 2019, Kobe (Japan), *Droplet Epitaxy of Semiconductor Nanostructures for Quantum Photonics*,
- 2018** International Conference on Molecular Beam Epitaxy (ICMBE20), Shanghai (PRC), *High Temperature Droplet Epitaxy Technique for Future Quantum Networks*
- 2016** International Conference on Crystal Growth and Epitaxy (ICCGE 18), Nagoya (JP), *Droplet epitaxy of complex III-V nanostructures*
- 2013** Gordon Research Conf. Thin Film & Crystal Growth Mechanisms, Biddeford (USA), *Droplet Epitaxy fabrication of semiconductor nanostructures: from dots to wires*
- 2011** 16th European Molecular Beam Epitaxy Workshop, Alp d'Huez (F), *GaAs based nanostructures grown by droplet epitaxy*

#### Additional Invited Talks

- 2019** 2nd 4PHOTON winter school, Wuerzburg (D), Quantum Dots: from growth to fundamental properties
- 2018** Engineering of Quantum Emitter Properties VI, Roma (I), High Temperature Droplet Epitaxy Technique for Quantum Photon Source
- 2016** Engineering of Quantum Emitter Properties V, Cork (Ireland), Droplet epitaxy of III-V nanostructures
- 2015** Progress in photonics, Firenze (I), GaAs nanostructures on Si
- 2015** Semiconnano 2015, (TW), Droplet Epitaxy Assisted Nanowire Fabrication
- 2014** HEMP High-efficiency materials for photovoltaics Workshop, London (UK), Quantum Dot Solar Cells by Droplet Epitaxy
- 2013** ICSO 2013 – International Conference on Spin-Optronics, Toulouse (F), Single photon emitter monolithically integrated on Silicon by Droplet Epitaxy
- 2013** Novel Gain Materials and Devices Based on III-V-N/Bi Compounds, Istanbul (TK), 3D heteroepitaxy of Ge and GaAs on patterned Si substrates: a new monolithic integration strategy
- 2013** Energy, Materials and Nanotechnology (EMN) Open Access Week Meeting, Chengdu (PRC), Growth Dynamics of Droplet Epitaxy Dots
- 2012** 9th International Workshop on Epitaxial Semiconductors on Patterned Substrates and Novel Index Surfaces, Eindhoven (NL), Droplet Epitaxy Quantum Nanostructures and Devices
- 2012** Workshop on Site Controlled Epitaxy, Heraklion (GR), Fabrication of Quantum Nanostructures by Droplet Epitaxy
- 2012** SPIE Photonics West: Quantum Dots and Nanostructures: Synthesis, Characterization, and Modeling IX, S. Francisco (USA), *Semiconductor Quantum Nanostructures by Droplet Epitaxy*
- 2011** SemiconNano 2011, Traunkirchen (A), Nanostructure shape control by pulsed droplet epitaxy
- 2011** Collaborative Conference on 3D & Materials Research, 2011 Jeju (Korea), Quantum Nanostructures Fabrication by Pulsed Droplet Epitaxy
- 2010** Villa Conference on Interaction among nanostructures- VCIAN, Santorini (GR), Low Thermal Budget III-V Nanostructures on Silicon by Droplet Epitaxy
- 2009** SemiconNano 2009, Annan (JP), Fabrication and Optical Properties of Quantum Semiconductor Nanostructures by Droplet Epitaxy
- 2001** 6th International Symposium on Advanced Physical Fields (APF-6), Tsukuba (JP), Characterization and Modeling of Droplet Epitaxy Semiconductor Quantum Dots
- 1999** Nanomeeting '99, Minsk (BE), Self-assembly of InAs/GaAs quantum dots: substrate orientation effects
- 1998** Novel Index Surfaces '98, Madrid (E), Optical and morphological properties of InGaAs/GaAs quantum dots grown on novel index surfaces
- 1994** LASERION, Tegernsee (D), Fragmentation of C60