Alessio Miranda

Curriculum Vitae

Personal

Name: Alessio Massimiliano Miranda
Sex: Male
Born: April 6, 1980 in Milan, Italy

Languages: English (fluent), German (good), French (very good), Greek (very good), Spanish (good), Dutch (good), Hebrew (basic) and Italian (mother tongue)

Address

Work
IMEC (
IMECBE-STS-SCD-WSA

Education

2009 **PhD in Physics**
Department of Physics
Politecnico di Milano
Subject of Thesis: *Single-channel nanoelectronic and nanofuidic devices in two-dimensional SiGe heterostructures*

2004 **Master Degree in Electrical Engineering Politecnico di Milano**
Subjcct (major): Physics
Subject (minor): Electronics
Subject of Thesis: *Dependence of Brillouin cross-section in anisotropic multilayers on acoustic and optical polarizations*
Final Grade: 85/100

Employment

2005-2007 **Research assistant** (with scholarship from Cariplo foundation)
L-NESS Centre
Department of Physics
Politecnico di Milano
Italy

2006 – 2009 **PhD student** (with scholarship)
L-NESS Centre
Department of Physics
Politecnico di Milano
Italy

2009 –2011 **Postdoctoral Research Associate**
CEMES-CNRS and LAAS-CNRS
Toulouse
France

2011-2012 **Postdoctoral Research Associate**
Weizmann Institute of Science
Rehovot
Israel

2013-2014 **Postdoctoral Research Associate**
Tyndall National Institute
Cork
Ireland

2014-2016 **Postdoctoral Research Associate**
Universität Duisburg-Essen
Duisburg
Germany

2016-2018 **Postdoctoral Research Associate**
EPFL
Lausanne
Switzerland

2018-15/07/2020 **Postdoctoral Research Associate**
IMEC
Leuven
Belgium

Research topics

PhD at L-Ness:

- ***Electronic transport in high-mobility SiGe heterostructures*** (nano- and microfabrication and cryo-measurement of the devices, data analysis, computational modelling).
- ***Nanofluidic devices in two-dimensional semiconductor heterostructures*** (nano- and microfabrication of the devices).
- ***Patterned metallic nanostructures as templates for polymer deposition and optics*** (nanofabrication).

PostDoc at CEMES-CNRS and LAAS-CNRS:

- ***Graphene-based nanoelectronic devices*** (conception, nano- and microfabrication, cryo-measurement and data analysis).
- ***Optical visibility of graphene, colorimetric and computational methods for the improvement of the contrast*** (theoretical and computational modelling).

PostDoc at Weizmann Institute of Science:

- ***Developing a polymerised vesicle temperature and stress sensor*** (fabrication of polymerised liposomes, construction of the experimental set up, fabrication of microfluidic channels, microfluidic experiments in elongational flow and data analysis).

PostDoc at Tyndall National Institute:

- ***Characterization of functionalised graphene as transparent electrodes*** (fabrication of G-FET, structural and electrical characterization of graphene before and after functionalization, data analysis).
- *Effects of **rapid thermal annealing on the electrical properties** of graphene as a base substrate for functionalization (fabrication, electrical measurements, data analysis).*

PostDoc at Universität Duisburg-Essen:

- ***Characterization of MXene devices*** (fabrication of MX-FET, structural characterization, and electrical measurements at cry and room temperature, data analysis).
- Optimization of an ***electron-beam induced cutting strategy*** graphene (fabrication, electrical measurements, data analysis).
- Detailed ***real time in-situ characterization*** of current annealing in various environments.
- ***Nanodevices*** made by electron-beam induced cutting (fabrication, structural and electrical characterization, data analysis).

PostDoc at EPFL:

- ***Optimization of the nanofabrication*** *process of templates for the deterministic growth of site controlled quantum dots (fabrication, structural characterization, data analysis).*
- ***Optimization of the nanofabrication process*** of suspended photonic crystals and ***deterministic integration of quantum dots in photonic crystals*** *(fabrication, structural characterization, data analysis).*
- Optical measurements (**μ-photoluminescence**) of isolated quantum dots and of photonic devices with embedded quantum dots for cavity-QED applications (measurements and data analysis).

PostDoc at IMEC:

- ***Design and implementation of phoXonic micro/nanosystems*** (full multiphysics modeling and design, fabrication).

Awards, memberships, further qualifications

2005	Admission to the Italian Order of Engineers
2005-2007	Cariplo foundation research fellowship (project NANOPAT)
2006	Politecnico di Milano PhD fellowship
2008	SEM-picture published on the Raith Calendar for year 2008
2011	Weizmann Institute Dean of faculty fellowship
2014	AMAROUT Marie Curie fellowship (declined)
2014	UCC Laser and Laser Safety Certificate
2015-2020	Member of the German Physical Society (153791)
2017-2020	Member of European Physical Society (IM170299)
2017-2018	Member of APS (61254932)
2017-2018	Member of IEEE (94422430)

Web of Science ResearcherID AAH-4130-2019
ORCID 0000-0003-4794-882X

Experience

Micro- and nanofabrication

- ***Electron beam lithography*** (Raith Elphy Quantum, Raith 150, XENOS, Vistec EBPG5000)
- ***Optical lithography*** (EVG 620, Karl Suss microtech MA6, MA150, MJB-3, and MJB. Design of masks with Autocad, Clewin and Qcad)
- ***FIB*** (Zeiss 1540XB, FEI Helios Nanolab)
- ***EBIE***
- ***Soft lithography*** (with PDMS) microchannel formation.
- electron-beam evaporator (Leybold and Moorfield minilab) and thermal evaporator.
- PECS Gatan
- Plasma Asher (Fischione 1020, March Plasmod and Tepla 300)
- Supercritical dryer (Tousimis Autosamdri 815B, Leica CDP3000)
- Rapid thermal Annealing (Jipelec Jet First)
- Tube furnace (Carbolite)
- Reactive ion etching (Oxford PlasmaLab 80 plus and 100, STS deep RIE Plasma etcher)
- Inductive coupled Plasma (Sentech ICP-RIE SI 500)
- PECVD (Oxford Plasmalab System 100)
- Wet etching and general clean room techniques
- Working with acids including HF and BHF
- Use of a glove-box

Characterization

- ***Scanning electron microscopy*** (Zeiss 1540XB, JEOL JSM-7500F, SEM Jeol JSM-6701F, FEI Inspect F and Philips XL30 with EDX, Zeiss Leo 1550)
- ***Atomic force microscopy*** (Veeco 3100, 3000, Multimode Picoforce, Innova, and Asylum Research MDP-3D Oregon)
- ***Confocal and interferometric microscopy (Optical Microscope Sensofar S-Neox)***
- ***Phase contrast and fluorescent microscopy*** (Olympus IX70)
- Standard optical microscopy
- Profilometers (eg Dektak XT)
- Ellipsometers (Horiba Jobin Yvon, Sopra GES 5E))
- Advanced use of microscope cameras and image processing

Electrical measurements

- ***Cryogenic techniques*** (closed cycle liquid helium-4 cryostat down to $T = 1.4$ K and up to $B = 9$ T Oxford cryogenics, Cryogenic limited, measures in He-tanks and cold finger cryostat down to 40K)
- ***Probe stations***
- ***LCR meters***
- **Various measuring techniques**: Van-der Pauw, 4 probe measurements, multiple gate measurements, evolution of current in time, effect of magnetic fields.
- ***Remote controlling of multiple devices*** *and automatic preliminary elaboration of the data signals* ***with Labview***
- Ball and wire bonding

Optical measurements

- **μ-photoluminescence spectroscopy of quantum dots** (isolated or embedded in PhCs) **and photonic devices** at various temperatures
- **Time resolved μ-photoluminescence.**
- ***Raman spectroscopy*** (Renishaw)
- UV/VIS spectrometer (Lambda 950)

Microfluidic experiments

- Able to set up and run ***microfluidic experiments in microchannels***

Sample preparation

- ***Graphene scotch tape*** fabrication and identification
- Liposomes electroformation
- Various dispersion methods (eg dropcasting, spin-coating, Schlenk tube)

Workshop and hand activities

- Lathe, drill, saw, folder etc…
- Mechanical drawing (Gcad and Autocad)
- Able to build small experimental setups

The experience on all cited machines was acquired in the L-NESS, CEMES-CNRS, LAAS-CNRS, WIS, Tyndall National Institute, Universität Duisburg-Essen, EPFL and IMEC labs where I had access to them as an independent hands-on user.

Computer skills

- Operating systems: ***Windows*** and DOS, ***LINUX, Ubuntu***, ***Macintosh***
- Programming languages: ***Matlab, Mathematica, Python,*** *Excel-VBA, C/C++*
- Simulators: *PSpice,* ***Comsol****, LTspice, QUCS*
- ***Multiphysics modelling*** (with Comsol)
- Computational ***simulations of electrical transport*** in nanodevices (with Matlab)
- ***Image processing*** (with Matlab)
- Remote control of instrumentation: ***Labview***, Arduino
- Applications: ***Office***, ***Libre Office, Origin (with labtalk)***
- Markup languages: ***LaTeX (with TikZ and GeoGebra), HTML*** *(with basics of Javascript)*
- Graphical software: ***Autocad, Photoshop***, Adobe Illustrator, ImageJ, Qcad, Clewin, **KLayout**

Theoretical specializations

- Surface and bulk acoustic wave physics
- Physics of micro- and nanoelectronic devices with notions of mesoscopic physics
- 2-dimensional systems (in particular HEMT, graphene, MXene)
- Physics of photonic, phononic, and phoxonic crystals
- Photonics and notions quantum optics
- Image processing and colorimetry
- Micro- and nanofluidics

Teaching activity and writing skills

- 144 hours of teaching (in German) through 18 Praktika (practical lab courses and examination followed by the revision of a 20-30 page long report), Praktikum 4.1 Ionenleitung and Praktikum 4.2 Halbleiter-Dioden und -Solarzellen, sup. Prof. A. Lorke and U. Wiedwald
- 26 hours of class tutoring (in French), course PHYS-101, sup. Dr. S. Brechet
- 22 hours of class tutoring (in French), course UNIL-112, sup. Dr. J-M. Fürbringer

The teaching activity included preparation of exercises; preparation, correction and grading of written exams; conduction and grading of oral exams.

- Supervision of interns and master students:
- Thomas Sannicolo and Robert Daly, "Optimization of Graphene Synthesis by Mechanical Exfoliation" June – September 2013
- Adam Cellon "Production, identification and characterization of monolayer mechanically exfoliated graphene flakes" (June- August 2015)

- Bernard Einstoss Pato and Claudia Castillo Moreno, "Advanced design of PhoXonic devices" (February – May 2019)
- Ahmed Sobhi Saleh and Ruben Helsen "Frequency dependent properties in PhoXonic devices" (February 2020 – May 2020)
- Partially Andre' Ditthard, "Optimization of EBIE nanopatterning of suspended graphene devices" (2015)
- Partially Maja Zunic, "Development of a micro-opto-mechanical ultrasound sensor for a photoacoustic imaging setup" (2018-2019)

- Writing scientific research papers (on letter journals)
- Writing clear internal manuals and procedures for scientific instrumentation and methods
- Able to conduct comprehensive and focused bibliographic research on specific subjects

Continuous scientific education

- Coursera diplomas: "The Data Scientist's Toolbox" (2015), "Programming for Everybody (Python)" (2015), "Image and video processing: From Mars to Hollywood with a stop at the hospital" (2015).
- Regularly attending seminars offered in the current workplaces and free webinars online.
- Intrinsic attitude to expand my knowledge towards new fields of science.

Hobbies

- Study of ancient and modern languages
- Sport (swimming, golf and skiing)
- Travelling
- Balkan history, culture, and music
- Translation of songs into other European languages for various websites (eg http://www.stixoi.info/stixoi.php?info=Members&sort=translations more than four hundred songs translated from Greek into Italian or other languages)
- Chess
- Amateur astronomy
- Philosophy, history and art
- Numismatics

List of publications (Journals)
Published papers:

1. A. Delgoffe, A. Miranda, B. Rigal, A. Lyasota, A. Rudra, B. Dwir, and E. Kapon '***Tilted-potential photonic crystal cavities for integrated quantum photonics***' Optics Express. **27: 15**, pp. 21822 (2019). WOS:000476652500143

2. A. Miranda, A. Lorke '***Stability of Suspended Monolayer Graphene Membranes in Alkaline Environment***' *Materials Research Letters.* **6:1**, 49 (2017). WOS:000428141500007

3. A. Miranda, J. Halim, A. Lorke, and M. W. Barsoum '***Rendering Ti3C2Tx (MXene) monolayers visible***', *Materials Research Letters.* **5:5**, 322 (2017). WOS:000405592100005

4. A. Miranda, J. Halim, M. W. Barsoum, and A. Lorke '***Electronic properties of freestanding $Ti_3C_2T_x$ MXene monolayers***', *Appl. Phys. Lett.* **108**, 033102 (2016). WOS:000373055500039

5. V. Kapaklis, S. Grammatikopoulos, R. Sordan, A. Miranda, F. Traversi, H. von Kaenel, D. Trachylis, P. Poulopoulos and C. Politis: '***Nanolithographic templates using diblock copolymer films on chemically heterogeneous substrates***', J. Nanosc. & Nanotech. **10**, 6056 (2010). WOS:000279836400080

6. R. Sordan, A. Miranda, F. Traversi, D. Colombo, D. Chrastina, G. Isella, M. Masserini, L. Miglio, K. Kern, K. Balasubramanian: '***Vertical arrays of nanofluidic channels fabricated without nanolithography***', *Lab on a Chip* **9**, 1556 (2009). WOS:000266269400011

7. R. Sordan, A. Miranda, J. Osmond, D. Colombo, D. Chrastina, G. Isella, and H. von Känel: '***Gate-controlled rectifying barrier in a two-dimensional hole gas***', *Nanotechnology* **19,** 335201 (2008). WOS:000257500800003

8. R. Sordan, A. Miranda, J. Osmond, D. Chrastina, G. Isella, and H. von Känel: '***Logic gates with a single Hall bar heterostructure***', *Appl. Phys. Lett.* **89,** 152122 (2006). WOS:000241247900071

Papers pending to be published (in advanced finalization):

1. A. Miranda, R. Puicervert, A. Quinn, and M. Burke '***Evolution of graphene sheet resistance by rapid thermal annealing in gaseous environments***' (in finalization).

2. A. Miranda, J. Halim, A. Lorke, and M. W. Barsoum '***The Role of Contact Resistance in Ti3C2Tx (MXene) Monolayers Electrical Measurements***' (in finalization).

3. A. Miranda, A. Lorke '***Real-time and in situ monitoring of electron beam irradiation and current annealing on the electrical properties of suspended graphene***'(in finalization).

4. B. Rigal, A. Miranda, B.Dwir, A. Rudra, A. Lyasota and E. Kapon ***'Site-controlled quantum dots integrated with coupled cavity-waveguide systems for efficient single photon extraction and routing'*** (under revision).

5. At the moment I am in the process of writing a paper about the first results of my research at IMEC.

Conference proceedings

1. H. von Känel, M. Bollani, M. Bonfanti, D. Chrastina, D. Colombo, A. Dommann, M. Guzzi, G. Isella, A. Miranda, E. Müller, A. Neels, J. Osmond, B. Rössner, R. Sordan and F. Traversi: '***Epitaxial Si-Ge heterostructures and nanostructures for optical and electrical applications***', *Proc. of the 2nd Conference on Nanostructures (NS2008)*, Kish Island, Iran (2008). Proceeding

2. A. Delgoffe, A. Miranda, B. Rigal, A. Lyasota, A. Rudra, B. Dwir and E. Kapon: ***Tilted-potential Photonic Crystal Cavities for Integrated Quantum Photonics*** Proceedings of the 20th European Conference on Integrated Optics (ECIO), Valencia, Spain (2018). proceeding

3. A. Delgoffe, A. Miranda, A. Lyasota, A. Rudra, B. Dwir, Y. Yu and E. Kapon: ***Integrated Quantum Photonics using Site-Controlled Quantum Dots and Tailored-Potential Photonic Crystals***, Conference on Lasers and Electro-Optics, OSA Technical Digest (Optical Society of America, 2019), conference paper FTh3D.3. WOS:000482226301126

4. A. Delgoffe, F. Gremion, A. Miranda, B. Rigal, A. Lyasota, A. Rudra, B. Dwir, Y. Yu and E. Kapon ***Tailoring of Photonic Confinement in Photonic Crystal Cavities for Integrated Quantum Nanophotonics***, Nanometa 2019, proceeding and talk

Abstracted talks and posters

1. A. Miranda: '***Logic gates with a single Hall bar heterostructure***', 2nd Italian RAITH user meeting in electron beam lithography, Lecce, Italy (2007). Invited speaker talk*

2. A. Miranda, R. Sordan, J. Osmond, D. Colombo, D. Chrastina, G. Isella, and H von Känel: '***Gate-controlled rectifying barriers in a two-dimensional hole gas***', *1st Transalp'Nano 2008 Conference*, Lyon, France (2008). Poster*

3. A. Miranda, J. Osmond, D. Colombo, D. Chrastina, G. Isella, H von Känel and R. Sordan '***Nanoelectronic and nanofluidic devices using two-dimensional semiconductor structures***', *INFM School on Physics in Low Dimensions*, Lucca, Italy (2008) Poster+presentation talk*

4. M. Aouassa, I. Berbezier, L. Favre, G. Amiard, R.Ronda, H. Maahref, A. Miranda, P.D. Vedova, F. Traversi, R. Sordan : '***Formation and ordering of Si dots by dewetting***', *6th Workshop on Functional and Nanostructured Materials and 10th Conference on Intermolecularand Magnetic Interactions in Matter* Sulmona-L'Aquila, Italy (2009). Poster

5. A. Miranda, E. Dujardin : '***A new real time method to enhance the visibility of graphene***' GDR09 Meeting Coma-ruga, Spain (2009). Poster*

6. V. Kapaklis, S. Grammatikopoulos, A. Miranda, F. Traversi, R. Sordan, H. von Känel, D. Trachylis, P. Poulopoulos and C. Politis: ***The influence of chemically patterned substrates on the phase separation of diblock copolymer films Phase separated structure*** 2nd International Conference from Nanoparticles and Nanomaterials to Nanodevices and Nanosystems (IC4N), Rhodes, Greece (2009). Poster DOI: 10.13140/RG.2.2.22343.70564

7. D. Lordan, A. Miranda, K. Linehan, E. Noonan, R. Puicervert, M. Russell, A. Pescaglini, M. Manning, M. Burke, A. J. Quinn : ***Molecular functionalization of Exfoliated Graphene and Transferred CVD Graphene*** (2014) MRS Spring Meeting & Exhibit, San Francisco, USA (2014). Talk

8. A. Miranda, J. Sonntag, B. Sommer, D. Braam, G. Prinz, M. Geller, and A. Lorke : ***Suspended graphene nanoribbons fabricated by electron beam-induced nano-etching***, 79th Annual Meeting of the German Physical Society (2015). Poster*

9. J. Halim, E. J. Moon, A. Miranda, P. Eklund, J. Rosen, L. Hultman, S. J. May, A. Lorke, Y. Gogotsi, and M. W. Barsoum : ***Electronic and Optical Properties of Select 2D Thin Films and Single flakes of Transition Metal Carbides*** 2016 MRS Spring Meeting & Exhibit, Phoenix, USA (2016). Talk

10. A. Miranda, J. Halim, M. W. Barsoum, and A. Lorke : ***Electronic properties of freestanding $Ti_3C_2T_x$ MXene monolayers*** 80th Annual Meeting of the German Physical Society, Regensburg, Germany (2016). Talk*

11. A. Miranda, A.Lorke : ***Current annealing recovery from electron beam induced damages in suspended graphene*** Graphene 2016, Genoa, Italy (2016). Poster*

12. B. Dwir, A. Caliman, A. Miranda, B. Rigal, A. Rudra and E. Kapon: ***Advanced optical microscopy of nanophotonic devices*** Sensofar user meeting, Frankfurt, Germany (2017). Talk

13. A. Miranda, A. Delgoffe, B. Rigal, B. Dwir, A. Rudra and E. Kapon : ***Spatially and Spectrally Isolated Narrow-Linewidth InGaAs QDs Grown by MOVPE on Patterned Substrates*** 17th European Workshop on Metal- Organic Vapour Phase Epitaxy (EW-

MOVPE17), Grenoble, France (2017). Poster*

14. B. Dwir, A. Delgoffe, M. Lazarev, A. Lyasota, A. Miranda, B. Rigal. A. Rudra , E. Kapon: ***Advanced Photonic Nanostructures*** EPFL-MicroNanoFabrication Annual Review Meeting 2018, Lausanne Switzerland (2018). Poster

15. A. Miranda, A. Delgoffe, B. Rigal, A. Lyasota, A. Rudra, B. Dwir and E. Kapon: ***Comparing TEIn and TMIn precursors in MOVPE of InGaAs/GaAs site-controlled pyramidal quantum dots*** 19th International Conference on Metalorganic Vapor Phase Epitaxy (ICMOVPE-XIX), Nara, Japan (2018). talk

* Poster or talk presented by me at the corresponding conference.

Attended Conferences and Schools

- 1st Italian RAITH user meeting in electron beam lithography, Naples, Italy (October 2005).
- ESF Exploratory Workshop: Silicon/oxide Hetero-Epitaxy: A new road towards a Si CMOS-compatible resonant tunnel diode technology, Como, Italy (12 - 13 September 2006).
- 13th RAITH nanolithography seminar, Dortmund, Germany (2007).
- 2nd Italian RAITH user meeting in electron beam lithography, Lecce, Italy (20 March 2007).
- INFM School on Physics in Low Dimensions, Lucca, Italy (11-18 October 2008).
- *1st Transalp'Nano 2008 Conference*, Lyon, France (27-29 October 2008).
- GDR09 Meeting Coma-Ruga, Spain (19-23 October 2009).
- Euronanoforum 2013 Dublin, Ireland (18-20 June 2013).
- 7th International School on Organic Photovoltaics Ventotene, Italy (3-7 June 2013).
- Functional metalorganics and hybrids "575, WE-Heraeus Seminar", Bad Honnef, Germany (17-19 November 2014).
- 79th Annual Meeting of the German Physical Society, Berlin, Germany (15 - 20 March 2015).
- 80th Annual Meeting of the German Physical Society, Regensburg, Germany (6 – 11 March 2016).
- Graphene 2016, Genoa, Italy (19-22 April 2016).
- 17th European Workshop on Metal- Organic Vapour Phase Epitaxy (EW-MOVPE17), Grenoble, France (18-21 June 2017).
- Optical Microcavities and Their Applications "653, WE-Heraeus Seminar", Bad Honnef, Germany (6-10 November 2017).

Language certificates and experience

English: fluent (European level Post C2)

2000 – 2005	**British Council, Milan, Italy** Courses of Translation 3 (European level post C2) English through literature (European level C2) Advanced Post proficiency conversation (European level post C2)
2002	**University of Cambridge, UK** Certificate of Proficiency in English Translation Paper Mark B (European level C2)
2000	**University of Cambridge, UK** Certificate of Proficiency in English General English Mark C (European level C2) Also have diplomas CAE, FCE and PET.
2005-present	Daily and extensive use of English in common day and work environment

French: very good (European level C1)

2009-2011, 2016-2018	Daily usage of French in common day and work environment, able to tutor student classes in French.

German: **good** (European level C1)

1999 – 2008	**Goethe-Institut Milan, Italy** German courses up to level 7.2 (European level C2)
2006	**Goethe-Institut Milan, Italy** Zentrale Mittelstufe Prüfung (European level C1) Mark befriedigend (fairly good) Also have ZDaF
2014-2016	Daily usage of German in common day and work environment, able to tutor student classes in German

Modern Greek: very good (European level C1)

2005 – 2008	**Hellenic Cultural Center, Milan, Italy** Greek courses at advanced level
2008	**University Aristotle of Thessaloniki, Greece** Veveosi ellinomathias level D (European level C2) Mark kalòs (good) Also have level A, B and C diplomas

Spanish: good (European level B1)

2010	**Instituto Cervantes de Tolosa** Diploma de español como lengua extranjera, Nivel Inicial

Dutch: **good** (European level B1)

2019– 2020	**Instituut voor levende talen, Leuven, Belgium** Dutch courses up to level 3 (ongoing, European level B1) Diploma of Dutch (levels 1 and 2)
2018 – 2020	Daily usage of Dutch in common day environment

Modern Hebrew: basic (European level A1)

2011-2012	one year of intensive study

Summary of main research accomplishments

During my ***Diploma thesis,***
I developed a theoretical and computational method to calculate the dependence of the Brillouin cross-section in anisotropic multilayers on acoustic and optical polarizations.

During my ***PhD at L-NESS,***
I fabricated, measured and simulated nanodevices based on Si/Ge high speed heterostructures. Starting from pregrown heterostructures, I made several optical lithography, EBL and etching steps in order to fabricate the nanodevices, which I then measured in a He4 cryostat (down to 1.6K). Among the working devices I made:
single device logic gates: this device exploits a single quantum point contact in order to make multiple logic gates. This is a significant advantage with respect to existent digital technologies, which require several transistors for a single logic gate.
gate controlled rectifiers: the rectification was achieved by an asymmetric 2DHG carrier depletion induced by a particular top gate, working variants of the device were also successfully fabricated and measured.
In addition to this, I also developed a method for fabricating *nanofluidic channels*, with a resolution of 1 nanometer, the method exploits the selective etching of Si and Ge; and I supported other groups of research by fabricating nanotemplates for chemical experiments.

During my joint ***Postdoc at CEMES and LAAS CNRS***,
I fabricated and measured *nanodevices on suspended graphene*. Graphene was deposited (scotch tape technique) on a grooved substrate , electrical contacts were made by EBL. The contacted suspended graphene flakes were subsequently cut in various shapes by FIBbing. The fabricated nanodevices, which exploit the ballistic and side gated effect induced by the cutting, were measured in a cold finger cryostat (down to 45K). Similarly I made *devices on supported graphene exploiting* FIB for cutting the structures, and EBL for contacts
I also made a MATLAB simulation program for the real time improvement of the *visibility of graphene*.

During my ***Postdoc at WIS***,
I focused on microfluidics and soft matter. I developed a *polymerized liposome stress sensor*, in which liposomes change fluorescence intensity upon application of external stimuli (temperature, stress, PH…). In the first part of the project, I optimized the production of liposomes and their fluorescence response (intensity, reproducibility, stability of the liposomes…).
In the second part, I ran microfluidic experiments in which the liposomes were made to flow at different velocities in cross or T-junction microchannels. The elongational flow provided the necessary stress for the change in fluorescence intensity, proving the efficacy of the sensor.

During my ***Postdoc at Tyndall National Institute,***

I supported a chemistry group which aimed at fabricating low-resistance graphene electrodes for solar cells through covalent and non-covalent functionalization. To investigate the change due to the chemical process, I fabricate G-FETs with CVD and exfoliated graphene flakes by aligned optical lithography, (I optimized the process in order to leave as few residuals as possible), I then proceeded to the structural, and electrical characterization of the device (OM, Raman, AFM, SEM, probe station), before and after functionalization. In particular, I developed and optimized a technique to clean graphene from resist and contamination, with rapid thermal annealing in various gas environments, without damaging it, and enhancing its conductivity.

During my ***Postdoc at Universität Duisburg-Essen,***

I improved a *method to cut suspended graphene with an electron beam,* with minimal damage to graphene. This improvement permits the reproducible patterning of suspended graphene with

nanometric precision.
To understand the interaction of the electron beam on graphene, I studied the process of *e-beam irradiation and current annealing in situ*: with our dedicated FIB-SEM system it is possible to electrically connect a bonded sample to external electrical instrumentation. Thus, I was able to perform electrical measurements and apply external potentials during the fabrication process or the irradiation of an electron beam, monitoring the effects in real time.
I then fabricated and measured *nanodevices* based on suspended and supported graphene (eg. nanorectifiers), using this technique.
Finally, I characterized *MXene nanodevices*. MXene is a new 2D material, which is attracting growing attention for a number of applications. A solution containing monolayer MXene flakes, sent by our partners, was dispersed on a substrate and thoroughly electrically characterized. As MXene is very sensitive to air, light, and I had to adopt special precautions and fabrication techniques to minimize damages to the surface.
In addition I made a study on the *visibility of MXene* on various substrates, and illumination conditions, similarly to what was done for other 2-dimensional materials.

During my ***Postdoc at EPFL*****,**

I optimized a procedure for the *fabrication of arrays for deterministic growth of site controlled quantum dots*. These consist of pyramidal grooves in a GaAs substrate where quantum dots are preferentially grown, the size and quality of the quantum dot is directly related to the dimension of the grooved pyramids. The quality of the quantum dots was then assessed through photoluminescence spectroscopy. The accomplished target was to have single quantum dot emission with an average FWHM below 50μeV, and reduce inhomogeneous broadening in the overall emission spectrum. In order to do so, the pyramidal grooves have to be processed in the most accurate way in terms of cleanness and reproducible method in any step of the process. With the same spirit I also *optimized the technology to make photonic crystals* with excellent verticality, circularity of holes and reproducibility of diameters. Also this was achieved, by tailoring every aspect of the fabrication, in particular the dry etching (RIE, ICP).

The optimized fabrication processes were combined to fabricate *nanophotonic devices* in which the quantum dots are deterministically positioned in strategic position inside suspended photonic crystals (for instance inside a cavity) for various applications of cavity-QED (currently under measurement).

During my ***Postdoc at IMEC*****,**

I am working on the ***Design and implementation of phoXonic micro/nanosystems.***

My work consists in the design and full multiphysics modelling, of devices, which are based on the interaction of surface and bulk acoustic wave with optical systems. At the moment the design is completed, and we are in the fabrication stage to which I am also actively collaborating.

Unfortunately, IMEC sets some confidentiality restrictions on the on-going projects and it is forbidden to share detailed information on IMEC-related projects with third parties before patenting or publication, additional details on my work can also be provided by my current supervisor and reference Dr. Xavier Rottenberg.