

Personal information

Marta Antonella Agati



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Born on

Nationality



Main objective: Understanding the physics of matter starting from nanoscale phenomena via Transmission Electron Microscopy (TEM).

Research Projects

- [01/02/2021-until now](#)

Transmission Electron Microscopy of semiconductor materials and devices

Imec – Leuven (Belgium)

Scientific responsible: Eva Grieten

I am part of the Materials and Component Analysis (MCA) group, within the team in charge of structural analyses, which proactively supports Imec's ongoing R&D. Here, I have the opportunity to study thin films and devices developed at Imec, which aims to push IC technology towards the 2nm-node and beyond. To do this, I apply Transmission Electron Microscopy related techniques, while I am also in charge of the sample preparation via Focused Ion Beam (FIB) as well as data analysis and reporting. In addition, I am involved in **research projects** on Indium-Gallium-Zinc-Oxide (IGZO) devices. In this framework, together with FIB and AFM experts, I carried on a new method of FIB sample preparation, which allows performing TEM characterization and AFM measurements in a unique metrology flow. In this step of the project, I could establish new collaborations within Imec and contributed to the experimental work performed by a young master student working at Imec. To understand the behaviour of IGZO transistors before and after cycling, I am probing the Oxygen peak changes in the IGZO via EELNES (Electron Energy Loss Near Edge Spectroscopy). I am also supporting my team in the understanding and application of **Precession Electron Diffraction** as a tool to identify the crystalline phases of Hf-Zr-O and IGZO thin films.

- [28/01/2020-27/01/2021](#)

3C-SiC Hetero-epitaxially grown on silicon compliant substrates and new 3C-SiC substrates for sustainable wide-band-gap power devices (CHALLENGE)

Institute for Microelectronics and Microsystems-Italian National Research Council (IMM-CNR) - Catania, Italy

Scientific responsible: Dr. S. Boninelli (IMM-CNR)

CHALLENGE was a research and innovation action funded by the European Union's Horizon 2020 research and innovation programme. Its main objective aimed at developing cubic Silicon Carbide (3C-SiC) films, with perspectives in power-electronics applications. In this framework, I was mainly involved in the study of 3C-SiC grown on Silicon micropillars. My role was focused on the structural characterization of the crystallographic defects present in the 3C-SiC films up to atomic resolution, via **TEM-based techniques**. This project included also **industrial partners**, such as **NOVASiC SA**

(FRA), LPE SPA (ITA) and ST-Microelectronics (ITA). During this time, I was also charged to train an early-stage post-doc to the use of the TEM facilities available at IMM-CNR.

- [05/07/2019-
27/01/2021](#)

Characterization of Cu and Sn-Zn based nanoparticles synthesized by electrical discharges (ESTEEM3 Project)

Institute for Microelectronics and Microsystems-Italian National Research Council (IMM-CNR) - Catania, Italy

Scientific responsables: Dr. S. Boninelli (IMM-CNR) and Prof. A. Hamdan (UQÀM)

This project received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 823717 – ESTEEM3. The project's goal was based on the controlled synthesis of nanomaterials via electrical discharges in liquid media. My role in this project concerned both the study of the structural/compositional properties of the nanoparticles and the understanding of their growth mechanism, as a preliminary step to control the synthesis process. To this aim I employed both spectroscopic and structural **TEM-based techniques**.

- [28/01/2019-
27/01/2020](#)

WInSiC4AP (Wide band gap Innovative Silicon Carbide for Advanced Power) - H2020-ECSEL-2016-1-RIA

Institute for Microelectronics and Microsystems-Italian National Research Council (IMM-CNR) - Catania, Italy

Scientific responsible: Dr. S. Boninelli (IMM-CNR)

WInSiC4AP was an European project, funded in the framework of the EU call H2020-ECSEL-2016-1-RIA. Its main objective aimed at developing reliable technological components based on Hexagonal Silicon Carbide (4H-SiC) for automotive, avionics, railway and defense. My role was focused on the study of the crystallographic defects in 4H-SiC films, previously subjected to phosphorous ion-implantation and thermal/laser annealing, via **TEM**. This project was developed in close collaboration with **ST-Microelectronics as industrial partner**.

- [03/01/2017-
31/12/2018](#)

Influence of the Atomic Structure on the COnductivity of materials for Phase Change Memories (ASCO-PCM 2016)

Centre d'Élaboration de Matériaux et d'Études Structurales-Centre National de la Recherche Scientifique (CEMES-CNRS) - Toulouse, France

Scientific responsible: Prof. A. Claverie (CEMES-CNRS)

The main objective of this project concerned the study of Germanium-rich Phase Change Materials (PCMs) for Phase Change Random Access Memories. This project was developed in collaboration with **ST-Microelectronics** (Crolles) and the “**Laboratoire de Physique et Chimie des Nano-objets**” (Toulouse). My role was mainly focused on the study of the amorphous-to-crystal transition of PCMs, in order to unveil the structural and chemical changes occurring during the phase transition via **in-situ** and **ex-situ TEM**, as well as **XRD**. During this time, I was also charged to **train a PhD student and a master student**. I was charged to **communicate** the main advances concerning the structural analyses of PCMs **during the periodic meetings with industrial and academic partners**.

- [03/01/2014-
13/03/2017](#)

Synthesis and characterization of Silicon nanowires grown by plasma torch to fabricate novel nanohybrids for solar cell applications

IMM-CNR (Catania, Italy),

Institut National de la Recherche Scientifique-Centre Énergie Matériaux Télécommunications (INRS-EMT) - Varennes, Canada

University of Rome “Tor Vergata” - Rome, Italy

Scientific responsables: Dr. Simona Boninelli, Prof. M. A. El Khakani (INRS-EMT) and Prof. Paola Castrucci (University of Rome “Tor Vergata”)

This project was developed in the framework of an Italian-Quebec bi-lateral project funded by the Italian Ministry of Foreign Affairs and International Cooperation. The main objective of the project concerned the study of Silicon Nanowires (SiNWs) produced via an Inductively Coupled Plasma process performed at **Tekna factory** (Sherbrooke, Canada). In this context, I conducted my *Double PhD* program, entitled “**Transmission Electron Microscopy studies of the nanostructural characteristics of the Inductively Coupled Plasma synthesized Silicon Nanowires**”. My work unveiled the growth mechanisms of SiNWs in ICP reactors. I helped also to demonstrate that, by intentionally inducing thermal instability mechanisms in ICP-SiNWs, it is possible to produce diverse Si nanostructures' morphologies.

Job Experiences

- [01/02/2021-until now](#) **Researcher**
Imec (Leuven, Belgium)
- [27/01/2019-27/01/2021](#) **Post-doctoral fellow**
IMM-CNR (Catania, Italy)
- [01/05/2017-31/12/2018](#) **Contrat Durée Déterminé (CDD) chercheur**
(equivalent to the **RTDa/RTDb contract** in Italian University, according to D.M. n. 662-September 2016)
CEMES-CNRS (Toulouse, France)
- [03/01/2017-30/04/2017](#) **Ingénieur d'études (Post-graduated researcher)**
CEMES-CNRS (Toulouse, France)

Formation

- December 2017 **PhD in "Sciences de l'énergie et des Matériaux"**
INRS-EMT (Varennnes, Canada)
Supervisor: Prof. My Ali El Khakani (INRS-EMT)
- March 2017 **PhD in Physics (cum laude)**
University of Catania (Italy)
Thesis: Transmission Electron Microscopy studies of the nanostructural characteristics of the Inductively Coupled Plasma synthesized Silicon Nanowires
Supervisors: Dr. Simona Boninelli (IMM-CNR), Prof. Giuseppe Angilella (University of Catania-Phys. Department)
- July 2013 **Master in Physics (110/110 cum laude)**
University of Catania (Italy)
Thesis: Entanglement dynamics of two superconducting qubits subject to random telegraph noise
Supervisor: Prof. E. Paladino (University of Catania-Engin. Department)
- November 2010 **Bachelor in Physics (110/110 cum laude)**
University of Catania (Italy)
Thesis: Synthesis, Characterization and applications of ZnO nanobelts
Supervisors: Prof. F. Priolo (Univ. of Catania-Phys. Department) and Dr. S. Boninelli (IMM-CNR)

May - July 2012

Visiting student

Université de Bordeaux I (France).

Project: teraHertz Spectroscopy applied to the study of Cultural Heritage

Supervisor: Prof. E. Abraham (Laboratoire Ondes et Matière d'Aquitaine, Université de Bordeaux I-CNRS).

Supplementary Education

2020, November 9th – 13th

Aldo Armigliato SEM School 2020

Organisers: CNR-IMM (Bologna, Italy), CNR-IOM (Trieste, Italy), Italian Society for Microscopical Sciences

This school was performed online because of the restrictions due to COVID-19

2020, June 30th - July 7th - July 14th

Virtual FIB-SEM User Meeting Italy 2020

Organisers: ZEISS

A cycle of webinars held online because of the restrictions due to covid-19

2019, July 22nd-25th

“Conventional and Counting EELS Spectroscopy School”

CNR-IMM Headquarter, Catania (Italy)

Organisers: G. Nicotra (CNR-IMM) and Q. Ramasse (SuperSTEM Laboratory, Daresbury)

2017, May 22nd – June 2nd

“QEM 2017” -School on Quantitative Electron Microscopy

Balaruc-les-Bains (France)

Organisers: CEMES (Toulouse), LPS (Paris), UMET (Lille), CP2M (Marseille), Néel (Grenoble), SSR (Grenoble).

2014, July 12th-18th

International School “Materials for Renewable Energies”

Ettore Majorana Foundation and Centre for Scientific Culture, Erice, TP (Italy)

Organisers: Materials Research Society, European Materials Research Society.

2014, May 26th-29th

“First Italian School on Electron Energy Loss Spectroscopy and Imaging”

CNR-IMM Headquarter, Catania (Italy)

Organiser: CNR-IMM

2011, August 14th-26th

“Summer School on Nanomaterials”

Debye Institute for Nanomaterials Science, Utrecht (the Netherlands)

Organiser: Utrecht University.

Divulgate Activities

2020, December 3rd

Sharper Project 2020 edition

Organiser: University of Catania

2019, September 27th

European Researchers' Night, in the framework of Sharper Project 2019 edition

Organiser: University of Catania

2019, May 14th

“Science, Technology, Engineering, Mathematics (STEM) for women”

Organiser: Dr. Rosaria Puglisi (CNR-IMM)

2018, September 28th

European Researchers' Night in the framework of Sharper Project 2018 edition

Catania- 2018, 28th September

Organiser: University of Catania

Teaching Experiences

January - April 2012

Master students supervisor during laboratory activities

University of Catania (Italy)

June-August 2011

Bachelor student supervisor
University of Catania (Italy)

Skills

General skills

Project managing, first aid.

Technical skills

Bright field and dark field TEM imaging, electron diffraction, High Resolution TEM, Scanning TEM-energy dispersive X-Ray spectroscopy and (quantitative) mapping, in-situ TEM annealing, Electron Energy Loss Spectroscopy, Energy Filtered TEM, Scanning TEM-tomography, Precession Electron Diffraction, High Angle Annular Dark Field Scanning TEM atomic resolution imaging

CEOS (probe and image) corrector alignment

Mechanical polishing, Precision Ion Polishing System, sample preparation via Focused Ion Beam (FIB) for TEM sample preparation.

Scanning Electron Microscopy.

X-ray Diffractometry.

Horizontal furnace.

Microscopes: Philips CM20-FEG TEM, JEOL 2010, JEOL 2010f, FEI TECNAIF20, JEOL ARM 200F, FEI Titan³ 60-300, Talos F200X STEM.

FIB: H450, H460, H500, G5.

Personal skills

Highly motivated, independent, learning lover, creative and determined, good attitude for interpersonal relationships.

Informatic skills

Microsoft Office Package

Data Analysis: Digital Micrograph, Carine31, Esprit 1.9, Origin, Image J, Virtual Dub, Adobe Première Pro, Adobe Première Elements, Gimp.

Languages: Mathematica, C.

Languages

Italian (madrelingua)

English B2 (First Certificate in English, December 2013).

French B2 (Certificat de niveau B1, June 2012; Cours de français langue étrangère B1+/B2 chez l'Alliance Française de Toulouse: 48 hours, April-June 2017 and April-June 2018).

Further Experiences

2018, May 16th-18th

“Du projet professionnel au recruitment: comment réussir?”
Délégation Midi-Pyrénées, Toulouse (France)

2014 March-May

Start-up Academy
University of Catania (Italy)

2014, 20th February

Assertive communication day
University of Catania (Italy)

Publications

- S. Boninelli, **M. Agati**, G. Amiard, V. Paillard, P. Castrucci, R. Dolbec, M. A. El Khakani, *Structural investigations of Inductively Coupled Plasma ultra-thin silicon nanowires*, Nanotechnology Materials and Devices Conference (NMDC), IEEE 2016.
- **M. Agati**, G. Amiard, V. Le Borgne, P. Castrucci, R. Dolbec, M. De Crescenzi, M. A. El Khakani and S. Boninelli, *Growth Mechanisms of Inductively-Coupled Plasma Torch Synthesized Silicon Nanowires and their associated photoluminescence properties*, Sci. Rep. 6, 2016.

Citations (04/03/2023-source Scholar): 12

- **M. Agati**, G. Amiard, V. Le Borgne, P. Castrucci, R. Dolbec, M. De Crescenzi, M. A. El Khakani and S. Boninelli, *Self-assembly of silicon nanowires studied by advanced transmission electron microscopy*, Beilstein J. Nanotechnol. 8, **2017**.

Citations (04/03/2023-source Scholar): 4

- V. Le Borgne, **M. Agati**, S. Boninelli, P. Castrucci, M. De Crescenzi, R. Dolbec, M. A. El Khakani, *Structural and photoluminescence properties of silicon nanowires extracted by means of a centrifugation process from plasma torch synthesized silicon nanopowder*, Nanotechnology 28, **2017**.

Citations (04/03/2023-source Scholar): 7

- **M. Agati**, F. Renaud, D. Benoit, A. Claverie, *In-situ Transmission Electron Microscopy studies of the crystallization of Ge-rich GeSbTe Materials*, MRS Comm. 8, **2018**.

Citations (04/03/2023-source Scholar): 23

- **M. Agati***, S. Boninelli, P. Castrucci, G. Amiard, R. Pandiyan, G. Kolhatkar, R. Dolbec, A. Ruediger, M. A. El Khakani*, *Formation of silicon nanocrystal chains induced via Rayleigh instability in ultra-thin Si/SiO₂ core/shell nanowires synthesized by an inductively-coupled plasma torch process*, J. Phys. Mater. 2, **2019**.

Citations (04/03/2023-source Scholar): 6

- **M. Agati***, P. Castrucci, R. Dolbec, M. A. El Khakani and S. Boninelli, *Formation of Hybrid Silicon Nanostructures via Capillary Instability Triggered in Inductively-Coupled Plasma Torch Synthesized Ultrathin Silicon Nanowires*, Phys Status Solidi B 256, **2019**.

Selected for the back-cover of the Journal

Citations (04/03/2023-source Scholar): 2

- **M. Agati**, M. Vallet, S. Joulié, D. Benoit, A. Claverie, *Chemical phase segregation during the crystallization of Ge-rich GeSbTe alloys*, J. Mater. Chem. C 7, **2019**.

Citations (04/03/2023-source Scholar): 41

- C. Calabretta, **M. Agati**, M. Zimbone, S. Boninelli, A. Castiello, A. Pecora, G. Fortunato, L. Calcagno, L. Torrisi, F. La Via, *Laser Annealing of P and Al implanted 4H-SiC 2 epitaxial layers*, Materials 12, **2019**.

Citations (04/03/2023-source Scholar): 10

- **M. Agati***, C. Gay, D. Benoit, A. Claverie, *Effects of surface oxidation on the crystallization characteristics of Ge-rich GeSbTe alloys thin films*, Appl. Surf. Sci. 518, **2020**.

Citations (04/03/2023-source Scholar): 24

- S. Freddi, F. Fabbri, A. Cannizzaro, **M. Agati**, R. Dolbec, G. Drera, S. Pagliara, L. Sangaletti, M. A. El Khakani, S. Boninelli, P. Castrucci, *High-temperature nitrogen annealing induced bonding states and photoluminescence changes in inductively coupled plasma torch synthesized silicon nanostructures*, J. Appl. Phys. 128, **2020**.

Citations (04/03/2023-source Scholar): 2

- C. Calabretta, **M. Agati**, M. Zimbone, S. Boninelli, A. Castiello, A. Pecora, G. Fortunato, L. Calcagno, L. Torrisi, F. La Via, *4H-SiC MOSFET Source and Body Laser Annealing Process*, Mater. Sci. Forum 1004, **2020**.

Citations (04/03/2023-source Scholar): 1

- S. Ponzoni, S. Freddi, **M. Agati**, V. Le Borgne, S. Boninelli, R. Dolbec, M. A. El Khakani, S. Pagliara, P. Castrucci, *Ultrafast Carrier Relaxation Dynamics in Quantum Confined Non-Isotropic Silicon Nanostructures Synthesized by an Inductively Coupled Plasma Process*, Materials 13, **2020**.

- M. A. Luong, **M. Agati**, N. Ratel Ramond, J. Grisolia, Y. Le Friec, D. Benoit, A. Claverie, *On some unique*

specificities of Ge-rich GeSbTe alloys for Nonvolatile Embedded-Memory Applications, Phys. Status Solidi RRL **2020**.

Citations (04/03/2023-source Scholar): 10

- A. Hamdan*, **M. Agati***, S. Boninelli, *Selective Synthesis of 2D Mesoporous CuO Agglomerates by Pulsed Spark Discharge in Water*, Plasma Chem. Plasma Process. **2021**.
Citations (04/03/2023-source Scholar): 8
- **M. Agati***, S. Boninelli, A. Hamdan*, *Atomic Scale Microscopy unveils the Growth Mechanism of 2D-like CuO Nanoparticle Agglomerates produced via Electrical Discharges in Water*, Mater. Chem. Phys. **2021**.
Citations (04/03/2023-source Scholar): 7
- **M. Agati***, S. Boninelli, C. Calabretta, F. Mancarella, M. Mauceri, D. Crippa, M. Albani, R. Bergamaschini, I. Miglio and F. La Via, *Growth of thick [111]-oriented 3C-SiC films on T-shaped Si micropillars*, Materials & Design. **2021**.
Citations (04/03/2023-source Scholar): 4
- C. Calabretta, A. Pecora, **M. Agati**, S. Privitera, A. Muoio, S. Boninelli, F. La Via, *Graphite Assisted P and Al Implanted 4H-SiC Laser Annealing*, Mater. Sci. Forum 1004, **2022**.
Citations (04/03/2023-source Scholar): 1
- **M. Agati**, A. Hamdan, S. Boninelli, *Formation of Sn/Zn alloy or core-shell nanoparticles via pulsed nanosecond discharges in liquid toluene*, Mater. Chem. Phys. **2022**.
- L. Magnarin, **M. Agati**, A. Belmonte, S. Subhechha, N. Rassoul, C. Drijbooms, H. Dekkers, U. Celano, *A Correlative Analysis Flow for Electrical and Structural Characterization of IGZO Transistors*, **2022** IEEE International Symposium on the Physical and Failure Analysis of Integrated Circuits (IPFA).

*Articles for which I was corresponding author

Total citations: 162 (04/03/2023-source Scholar)

H index: 7 (04/03/2023-source Scholar)

Conferences

- **M. Agati**, G. Amiard, V. Le Borgne, P. Castrucci, R. Dolbec, M. A. El Khakani and S. Boninelli, *Advanced TEM investigations on novel core-shell Si/SiO₂ nanocomposites*, E-MRS Spring Meeting (Lille, 2015, May 11th-15th), oral presentation.
- **M. Agati**, G. Amiard, V. Le Borgne, R. Pandiyan, G. Kolhatkar, P. Castrucci, R. Dolbec, M. De Crescenzi, A. Ruediger, M. A. El Khakani and S. Boninelli, *Nanostructure and Optical Properties of Ultra-thin Silicon Nanowires synthesized via Inductively Coupled Plasma*, E-MRS Spring Meeting (Lille, 2016, May 2nd-6th), poster presentation.
- **M. Agati**, G. Amiard, V. Le Borgne, R. Pandiyan, G. Kolhatkar, P. Castrucci, R. Dolbec, M. De Crescenzi, A. Ruediger, S. Boninelli and M. A. El Khakani, *Correlation between structural and optoelectronic properties of Silicon Nanostructures*, E-MRS Spring Meeting (Lille, 2016, May 2nd-6th), oral presentation.
- **M. Agati**, G. Amiard, V. Le Borgne, V. Paillard, P. Castrucci, R. Dolbec, M. De Crescenzi, M. A. El Khakani and S. Boninelli, *Silicon Nanocrystals formation within ultra-thin Silicon Nanowires*, 6th International Conference on NANOstructures and nanomaterials SELF-Assembling (Giardini Naxos, 2016, July 3rd-8th), oral presentation.
- **M. Agati**, G. Amiard, V. Paillard, V. Le Borgne, P. Castrucci, R. Dolbec, M. De Crescenzi, S. Boninelli and M. A.

El Khakani, *Comparative study of nanostructural characteristics and optoelectronic properties of Inductively-coupled-plasma-produced silicon nanowires and pulsed-laser-ablation-synthesized silicon nanocrystals*, 6th International Conference on NANOstructures and nanomaterials Self-Assembling (Giardini Naxos, 2016, July 3rd-8th), poster presentation.

- **M. Agati**, G. Amiard, G. Kolhatkar, R. Pandiyan, P. Castrucci, R. Dolbec, M. De Crescenzi, A. Ruediger, S. Boninelli and M. A. El Khakani, *Advanced TEM-based characterizations and photoluminescence properties of SiNWs synthesized by Inductively Coupled Plasma process*, XIII International Conference on Nanostructured Materials (Québec-city, 2016, August 7th-12th), oral presentation.
- **M. Agati**, F. Renaud, D. Benoit, A. Claverie, *In-situ Transmission Electron Microscopy studies of the structural transition in Ge-enriched Phase Change Materials for future memory devices*, MRS Spring Meeting (Phoenix, 2018, April 2nd-6th), oral presentation.
- **M. Agati**, A. Hamdan, S. Boninelli, *Atomic resolution microscopy reveals the growth mechanism of 2D-CuO agglomerates synthesized via pulsed spark discharges in water*, European Nanoanalysis Symposium – EMRS (2020, October 9th), poster presentation. This conference was held online due to the restrictions imposed by the emergency Covid19.
- **M. Agati**, U. Celano, A. Belmonte, S. Subhechha, N. Rassoul, C. Drijbooms, H. Dekkers, P. Favia, *A correlative method for the characterization of InGaZnO4 Thin Film Transistors*, Partner Tecnical Week (PTW 2022-Fall session, October 24th – 28th), poster presentation.

Referee Service

Journals for which I performed peer review service

- MRS Communications
- Physica Status Solidi B
- WSPC-NANO
- Material Science in Semiconductor Processing
- Acta Materialia
- Applied Nanoscience

Invited talks

- **M. Agati**, *Advanced Transmission Electron Microscopy studies of the crystallization process in Ge-rich Phase Change Materials for future memory devices*, “Electron Microscopy, a bridge between research and industry”-1st joint workshop STMicroelectronics – IMM CNR (Catania, 2018, September 24th).

Awards

- Best poster presentation award at EMRS Spring Meeting 2016 (Lille, 2016, May 2nd-6th), Symposium O

Leuven, 04/04/2023

Marta Antonella Agati