CURRICULUM VITAE

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Dr. Giuseppe D'Arrigo's research activity concerns the science and technology of materials for microelectronics. His scientific production consists of about 100 publications between JCR journals and peer-reviewed papers published on international conference proceedings, 10 US patents and 2 EU patnets, 1 book chapter, and several invited papers. A common feature of his scientific works is to move forward the level of understanding of the properties of materials by combining a specific fabrication of nano-structures, both electronically active and passive, with very high spatial resolution investigation techniques even at the atomic level. . The activity carried out finalizes the research results, where possible, towards possible concrete technological applications, through collaborations with industries in the sector related to microelectronics as demonstrated by the countless contracts stipulated over the years with MICRON (American Industry leader in the sector of Memories), assuming the role of Project Manager for CNR-IMM fro about 6 Year:

- **Year 2017 Contract CNR-IMM e MICRON TECHNOLOGY, INC BOISE Prot. CNR-IMM: 0006367 del 11/12/2017**
- **Year 2016 Contract CNR-IMM e MICRON TECHNOLOGY, INC BOISE Prot. CNR-IMM: 0002405 del 05/05/2016**
- **Year 2015 Contract CNR-IMM e MICRON TECHNOLOGY, INC BOISE Prot. CNR-IMM: 0000343 del 20/12/2015**
- **Year 2013 Contract CNR-IMM e MICRON SEMICONDUCTOR, ITALIA Prot. CNR-IMM: 0003181 del 17/04/2013**

In this activity, his contribution in the field of the manufacture of ultra-scaled Chalcogenide Memory devices is obtained thanks to the Electronic Beam Lithography system of which he is appointed the responsible (prot CNR.: 0001980 of 23/12 / 2008). Since the beginning of its activity it has implemented, within the IMM Catania Lab. structure, a new Micro and Nano-fabrication laboratory combining unconventional two-dimensional and three-dimensional structuring techniques with Electronic Lithography as attested by the countless publications and patents relating to the structuring of Phase Transition Materials of both Silicon Carbide and Silicon. The lithography system is characterized by a Schottky Field Emission Gun source, which is used for the manufacture of ultra-scaled structures. The methodologies developed in the laboratory allow

to create structures with minimum dimensions below 20 nm as demonstrated by several publications relating to localized implantation methodologies with Nano-Masks with minimum dimensions below 20 nm for the study of the transition of phase of chalcogenide materials and for the study of ultra-scaled doped areas in Silicon. The laboratory dedicated to nano-fabrication today includes two Electron Beam Lithography Systems, extending the versatility of the laboratory itself, making it possible to integrate nanoscale devices even on 8-inch slices.

The Nanofabbrication lab. actually include the following instrumentations:

- **E-Line Electronic Beam Lithography Apparatus (Raith GmbH) (Prot .: 0001980 of 23/12/2008).**
- **Electronic Beam Lithography Apparatus Raith 150 (Raith GmbH) (Prot .: 0003342 of 11/06/2019).**
- **Elettrorava Thermal Evaporator consisting of a column for the deposition of Organic Led and one for the deposition of Metal. (Prot.:0001061 of 02/27/2017).**
- **Sputter Elettrorava for metal and dielectric deposition. (Prot.:0003340 of 11/06/2019).**
- **Nanoindenter system (Anton Parr) for the characterization of advanced materials from the tribological point of view (Young's modulus, Hardness and Adhesion) (Prot.:0004999 of 04/09/2015).**
- **Micro-processing wet bench for KOH or TMAH hot processing (Prot .: 000026/2003).**
- **Probe station Cascade for the devices characterization having. The electronic equipment include several electronic instrumentation SMU, Pulser and Oscilloscope for the complete devices electrical characterization.**

Thanks to the activity carried out within the chalcogenide community, it has made possible the organization in 2018 of the **International Conference E / PCOS2018 (European Phase-Change and Ovonic Symposium) http://epcos2018.imm.cnr.it/** being a member of the Conference Program Committee for several years now. Thanks to the experience developed in the industrial field, he currently carries out his coordination activity, **WP3 Leader**, within **the European Project H2020 BeforeHand No 824957 (http://www.beforehand.eu/about-us.html /)** for the manufacturing of chalcogenide memory cells through the use of advanced materials.

In addition, the activities carried out in the laboratory have contributed, within the national and international panorama, to the study of Silicon Carbide (SiC) in its various polytypes and in particular to the study of stresses in 3C Carbide epitaxially grown on Silicon. In particular, attention was paid not only to the crystallographic characteristics of the 3C carbide, carried out not only through very high spatial resolution systems with transmission electron microscopy techniques but also through the fabrication of micro and nano vibrating beams with which they were investigated. the mechanical characteristics of SiC 3C and correlated with the internal defects of the material. As part of the activity related to Silicon Carbide, new epitaxial growth methodology of 3C Carbide on silicon have been implemented, improving the coupling with the Silicon germ substrate through the realization of a surface patterning of the Silicon which has been translated into a patent CNR (US Patent 8,890,103) and a second patent with ST-Microlectronics for the decoupling of the silicon substrate after the growth of the Silicon Carbide Application Patent in collaboration with ST-Microelectronics ST New Provisional Patent Application ST Ref

.: 16-CTCO- 0228US01 (Seed IP Ref .: 810063.599P1). Currently, the structural, physical and tribological characterization of materials has been further strengthened with the acquisition of a Nanoindentation and Nanoscratch system for the analysis of the mechanical characteristics and adhesion of films of various kinds: Metallizations on Oxides or on semiconductors. The tribological characterization activity was particularly welcomed by the industrial partner ST-Microelectronics with whom new collaborations were put to good use, in particular three new activities were included in the collaboration agreement CNR-IMM Catania and ST-Microelectronics both of Catania and Agrate. The activity is aimed at the study of front-end materials and processes in Silicon and Silicon Carbide technologies at very high levels of integration not only from the point of view of advanced development of the front metal or dielectric device, but also to study of the coupling of the device itself inside the package and in combination with the frame. Finally, in the field of Post-Silicon Nano-Electronics we cite his most recent activities on the understanding of crystallization and amorphization mechanisms in chalcogenide materials (Ge2Sb2Te5 or GeTe) used for the realization of ultra-scaled non-volatile memories, on the development of mask-less ion nano-implantation processes for localized doping in silicon on insulator and on the study of SiC, a wide band-gap semiconductor, recently used for the control electronics and management of high energy efficiency electric power as demonstrated by participation in various projects in the Italian and European context. The research and work activity carried out has also made it possible to train countless students about 19 during both the internship period for the achievement of the Master's thesis and during the university tutoring of three-year and PhD theses. He is the owner of a teaching course " Nanofabrication, a jump into Nano-word" at the Faculty of Mechanical and Industrial Engineering of the University of Catania. He has also conducted coordination activities for many research grants and for Co.Co.Co.

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Dr Giuseppe D'Arrigo