

## Tito Busani's Curriculum Vitae

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### EDUCATION

- 2006**            **P.h.D.**    Physics – Physics and Nanotechnology (Universite' J. Fourier, Grenoble-France – CNRS Center for national)  
(Personal felicitation of the members of the jury - Distinction)
- 2002**            **BS+MS**    Nuclear Engineering-Politecnico di Milano (90/100)

**PhD thesis title:** *Growth and characterization of high-k materials for advanced gate applications: the role of the material structure on the electrical properties.*

### PROFESSIONAL EXPERIENCE

**August 2019- Assistant professor at Electrical and Computer Engineering at the University of New Mexico**

- Integration of Si and III-N for qubits fabrication
- Functional STM and AFM probes: NSOM and in-situ oxidation of single MOS (sub-1nm)
- Etching of ferroelectric and piezoelectric materials and their integration on Si, graphene and III-N platforms
- Tunable band gaps in nano-scale phononic crystals fabricated in suspended lithium niobate membranes
- DC to Ku-Band signal processor in a single chip using LN integrated with GaN and AlN onto suspended Si substrates
- Quantum sensing magnetometry capability through nanofabrication of atomic force microscopy tips

**2015-2019 Associate Research Professor and NanoFab manager at University of New Mexico-Center for High Technology Materials**

- III-N NWs devices used in tip metrology and nano lithography combined with confocal microscopy Raman spectroscopy.
- III-N device design and fabrication for high throughput fabrication of qubits and quantum structures.
- Electronic properties of 1D nano structured materials such as Si nano wires (NWs), ZnO NWs and GaN NWs.
- Design and 3D Integration of transparent rf Antennas with solar cells
- Integration of Thermoelectric with photovoltaics for large spectrum harvesters

**Jan 2013- Assistant Research Professor at University of New Mexico**

- Nanostructured materials for energy harvesting: Piezo harvesting advanced solar materials

- Atomic Force Microscopy: Single Nano wire tip metrology and integrated laser cantilever fabrication
- Nanostructured material applied to the anode and cathode of Li based batteries to improve the capacitance and energy storage
- Self assembled conjugated polymers and 1D nano structured materials integrated into a single very wide spectrum solar harvesting device

**Nov 2009-2012 Junior Research professor at FCT-UNL CENIMAT**

- Nano fabrication of single Nano Wires, TCO. (i.e. dual gate FET, single wire sensors): nano lithography and selective etching
- Design and fabricated GaAs AFM optical probes and High aspect ratio probes using both FIB and lithography.
- Leading AFM, FIB/SEM/EDS/EBSD/nano manipulator scientific group
- Clean room safety responsibility
- Design first principle of Porphyrin photoconductivity solar cells devices with cellulose and polymer fibers.
- AFM and SEM/FIB studies of polychromatic surfaces: enzyme selective cleaning: Dual frequency analysis and elastic moduli using AM and FM AFM
- Organized and managed research activities for graduate students
- Established collaborations with Brescia gas sensors research center and rose funding to produce novel integrated single wire transistors.

**Jan 2009-2012 ADJ. Research Assistant Professor at University of New Mexico**

- P3HT-PCBM defects studies in solar cell and CMOS (5-20 micron channel): degradation and the electrical stress analysis
- Designed process methodology to enhanced mobility in organic transistors using SANDIA metallic nano-sphere of gold and platinum.
- **AFM controlled nano printing** of Ag/TiO<sub>2</sub> structures: first principle of memory array for dog tags.
- Demonstrated FTIR evidence of surface roughness using the absorbance LO peaks

**Jan 2007-Nov 2009**

**Post Doctoral Fellowship**, Energetic Materials Research Technology Center, Socorro

- Fabrication and characterization of Ti based alloys and related oxides
- Define reliability procedures using NBTI technique and radiation effects on HfO gate oxide transistors for the Air Force space program
- Processed PECVD TiO<sub>2</sub> and SiO<sub>2</sub>-TiO<sub>2</sub> for memory switching: material and devices studies.
- Improved lifetime of 150 nm SiN<sub>3</sub> gate transistors using deuterium and Hydrogen controlled diffusion.

**Jan 2003 – Nov 2007**

**Research Scientist/PhD Student**, Center for High Technology Materials (CHTM), Albuquerque Characterized,.

- Intensive work in Clean room class 100 and 1000: grew and deposited new high-k materials using different techniques such as: ECR plasma reactor, CVD and PECVD reactors, sputtering RF, thermal furnaces and electron beam evaporation
- Defined Semi-Empirical law for RE and high k oxides as possible SiO<sub>2</sub> replacements candidates
- Studied TiO<sub>2</sub> and SiO<sub>2</sub>-TiO<sub>2</sub>, Al<sub>2</sub>O<sub>3</sub> and rare earth ternary oxide (La<sub>2</sub>O<sub>3</sub>, LaAlO<sub>3</sub>, Gd<sub>2</sub>O<sub>3</sub>, Pr<sub>2</sub>O<sub>3</sub>) gate dielectrics for use in Si technology (poly-crystalline and amorphous)
- Modified Plasma reactor to deposit Fabricated MOSFETs and characterized
- Demonstrated the Lii theory to the direct oxidation of plasma deposited ternary alloys.
- Design in situ thickness control of sacrificial layers of Si while oxidizing the sub layer of Ti using spectroscopic ellipsometry

**2003-2006** Student- CNRS France

**2000-2002** **Mask engineer**, STMicroelectronics, France

- Analyzed and resolved metrology challenges in new masks
- Specified supplier requirements for advanced masks and mask-making processes.

**1999-2000** **Research Engineer**, IMEC (Belgium)

- Optimized plasma and wet surface cleaning processes for Ge wafers (clean room class 100) epy-grown.
- Collaborated with U. Milan

**1998-1999** **Research Engineer**, France Telecom/CNET/DTM/TFM, Grenoble, France

- Processed Ge, Si and SiGe alloys and relative oxides, for gate transistors in C-MOS technology
- Point defects analysis using thermo stimulated luminescence and current

**1997-1998** **Student Internship**, University of Milan, Italy

- Characterized Ta<sub>2</sub>O<sub>5</sub> and SiO<sub>2</sub> point and ion implantation defects

## RESEARCH INTERESTS

1. Nanomaterial (1D and 2D) growth, synthesis and etching mechanisms
2. Wide bandgap semiconductors
3. Quantum materials and quantum devices

4. Nanofabrication: Scanning Probe Microscopy (SPM), Atomic Force Microscopy (AFM), SPM Local Oxidation Nanolithography, SPM Scratching Nanolithography, Electron-Beam Lithography, Thermal Probe lithography and Near Field Lithography
5. Device applications: Energy harvester such as Photovoltaic, piezo systems and thermoelectric
6. Near Field Spectroscopy
7. Si Photonics
8. Dependence of mechanical electrical and optical properties of nano materials
9. Complex oxides
10. Nano lasers

## CONFERENCE ORGANIZER

- SPIE 2021**    **Advance Litho conference**, conference organizer for the tip base lithography and metrology section
- SPIE 2020**    **Advance Litho conference**, conference organizer for the tip base lithography and metrology section (online only)
- New Mexico Energy 2019** Chair and Co-Organizer of the New Mexico Energy: “Powering the State’s Economy” Sept 2019 Albuquerque, NM
- MRS 2017**    **Chair organizer** of the MRS symposium EN16 ‘Combining Materials, Technologies and Societal Awareness to Harvest Natural and Human-Made Energy Sources’

## CONFERENCE PLENARY SPEAKER

- 2020**            ENEL ENERGY conference (Rome 2020) (~5000 people conference attendance)

## INVITED TALKS

- 2022**            **SPIE Advance Litho** invited talk ‘‘ Silicon and Gallium Nitride Whisker Active Probes for Field-Emission Scanning Probe Lithography’’
- 2019**            **Tufts University** invited at ECE colloquium series: ‘‘STM, AFM and NSOM and their applications in nano lithography spectroscopy and’’
- 2018**            **Invited speaker** at the SPIE (San Diego): III-N nanowire atomic force cantilevers for ultra-vertical-wall scanning-probe, scanning-tunneling, and near-field microscopy
- 2018**            **Invited speaker** at Rainforest event organized by STC at UNM
- 2018**            **Invited speaker** at Molecular Foundry at Berkeley Lab
- 2016**            **Speaker** OSE seminar at UNM
- 2016**            **Invited Speaker** at the “energy Materials Conference”, Osaka, Japan

**2012**            **Invited Chair** at ‘‘Nano science and Technologies’’ conference in Qingdao (China)

## **SYNERGETIC ACTIVITIES**

**2021-**            Organizing Committee member and session chair of the ‘‘2021 Novel Patterning program committee for SPIE Advanced Litho’’

**2020-**            Member of the Vacuum Society Local Chapter (Hosted by Sandia Labs)

**2018**            Sandia and UNM seminar series organizer

**2018-present**   **President and** Trust leader in the ‘‘Advance Energy Manufacturing Cluster’’ in New Mexico

**2013**            Board of the organizing committee of the 2013 RESEARCH conference in Evora (Portugal)

**2006 - present**   Consultant for round table group: patent litigation by semiconductor industries and Round Table Group.

**2002 - 2005**    Member of the ANACI (Italy)

**1992 - 2000**    EMT of the Red Italian Cross: ambulance service

## **SERVICES (current)**

- IT Research Advisory Board at UNM
- Undergraduate committee (ECE/UNM)
- RPC (UNM)
- CHTM safety committee (UNM)
- Local Chapter Vacuum Society
  
- President New Mexico Energy Manufacturing consortium: developpe a network of industry affiliated with energy in order to help to spin off companies based on University and National Labs IP
  
- Board Member of the Mid Rio Grande Advisory Group: an initiative funded by NSF to provide New Mexico State guideline and road map for the clean energy goals for 2030

## **FELLOSHIPS**

**2003-2006**    Kirkland Air Force space laboratories graduate sponsorship

**2003-2004**    Rhone Alpes scholarship exchange student program.

## **EDITORIAL WORK**

**2020- ‘ The Development, Synthesis and Characterization of Nanowires’** Nanomaterials, special issue ‘ Nano structured materials, Wide bandgap semiconductors, nano and quantum lithography, mechanical and optoelectronic characterization, Tip pattern lithography and tip metrology’

## SCHOLARLY PUBLICATIONS IN REFERRED JOURNALS

### Manuscript under review

1. T. Busani et al, “**A review of advances and challenges of III-nitride nanostructures: From synthesis/fabrication methods to applications**”, Advance Materials (2021)
2. T. Busani et al, “**Optimized processing for LiNbO3 based devices**”, Applied Physics Letter (2021)

### *Citations summary*

	All	Since 2016
citations	1204	667
h-index	19	15
i10-index	33	21

### Fall 2019-2021 (Published)

1. Mahmoud Behzadirad, Stephan Meholdt, John N. Randall, Joshua B. Ballard, James Owen, Ashwin K. Rishinaramangalam, Alexander Reum, Teodor Gotszalk, Daniel F. Feezell, Ivo W. Rangelow, and Tito Busani, ‘ **Advanced Scanning Probe Nanolithography Using GaN Nanowires**’ Nano Letters 2021 21 (13), 5493-5499 DOI: 10.1021/acs.nanolett.1c00127 (2021)
2. Rahul Jaiswal, Manel Martínez-Ramón, Tito Busani, ‘ **Probabilistic analysis of solar cell optical performance using Gaussian processes**’, arXiv:2107.07342 (accepted for publication in IEEE Photovoltaics journal (November 2021))

3. R. Jaiswal, M. Martinez-Ramon and T. Busani, "**Hierarchical optimization of photovoltaic device performance using machine learning**," 2021 IEEE 48th Photovoltaic Specialists Conference (PVSC), 2021, pp. 2368-2371, doi: 10.1109/PVSC43889.2021.9518981. (2021)
4. Robynne L. Paldi, Arjun Aryal, Mahmoud Behzadirad, Tito Busani, Aleem Siddiqui, and Haiyan Wang, "**Nanocomposite-seeded Single-Domain Growth of Lithium Niobate Thin Films for Photonic Applications**", Optical Society of America, May 2021, ISBN: 978-1-943580-91-0 [https://doi.org/10.1364/CLEO\\_SI.2021.STh4J.3](https://doi.org/10.1364/CLEO_SI.2021.STh4J.3) (2021 conference proceeding)
5. Wostbrock, N.; Busani, T. "**Stress and Refractive Index Control of SiO<sub>2</sub> Thin Films for Suspended Waveguides**". *Nanomaterials* 2020, 10, 2105. <https://doi.org/10.3390/nano10112105> (2020)
6. Mahmoud Behzadirad, Ashwin K. Rishinaramangalam<sup>1</sup>, Daniel Feezell, Tito Busani, Christoph Reuter, Alexander Reum, Mathias Holz, Teodor Gotszalk, Stephan Mechold, Martin Hofmann, Ahmad Ahmad, Tzvetan Ivanov, and Ivo W. Rangelow, "**Field emission scanning probe lithography with GaN nanowires on active cantilevers**", *Journal of Vacuum Science & Technology B* 38, 032806 (2020); <https://doi.org/10.1116/1.5137901> (2020)
7. Mousavi, B. , Busani, T. , Zadeh, M. and Brueck, S. "**Enhancing Mechanical Stability of Nano-Structured Anti-Reflection Coatings**", *Journal of Applied Mathematics and Physics*, 8, 247-258. doi: 10.4236/jamp.2020.82020. (2020)
8. Mousavi, B.K., Mousavu, A.K., Busani, T., Zadeh, M.H. and Brueck, S. (2019), "**Nanostructured Anti-Reflection Coatings for Enhancing Transmission of Light. Journal of Applied Mathematics and Physics**", 7, 3083-3100. (2019)
9. Xuemei Wang, Juan J. Faria-Briceno, Tito Busani, and S. R. J. Brueck, "**Nanoscale details of liquid drops on 1D patterned surfaces revealed by etching**", *Journal of Vacuum Science & Technology B* 37, 051806 (2019); <https://doi.org/10.1116/1.5116703> (2019)

## **2018**

1. Song, Erdong, Andrei Baranovskiy, Enzhi Xu, Tito Busani, Brian Swartzentruber, Shixiong Zhang, Yaron Amouyal, and Julio Martinez. "Manipulating Thermal and Electronic Transports in Thermoelectric Bi<sub>2</sub>Te<sub>3</sub> Nanowires by Porphyrin Adsorption." *J AIP Advances* 8, no. 10 (2018): 105010.
2. Lenk, Claudia, Steve Lenk, Mathias Holz, Elshad Guliyev, Martin Hofmann, Tzvetan Ivanov, Ivo W Rangelow, T. Busani et al. "Experimental Study of Field Emission from Ultrasharp Silicon, Diamond, Gan, and Tungsten Tips in Close Proximity to the Counter Electrode." *JVST B*, 36, no. 6 (2018): 06JL03.
3. Lenk, Claudia, Martin Hofmann, Tzvetan Ivanov, Ahmad Ahmad, Steve Lenk, Ivo W Rangelow, Alexander Reum, T. Busani et al. "Sharp GaN Nanowires Used as Field Emitter on Active Cantilevers for Scanning Probe Lithography." *JVST B*, 36, no. 6 (2018): 06JL04.
4. Kouhpanji, Mohammad Reza Zamani, Mahmoud Behzadirad, Daniel Feezell, and Tito Busani. "Insufficiency of the Young's Modulus for Illustrating the Mechanical Behavior of Gan Nanowires." *Nanotechnology*, 29, no. 20 (2018): 205706.
5. Behzadirad, Mahmoud, Mohsen Nami, Neal Wostbrock, Mohammad Reza Zamani Kouhpanji, Daniel F Feezell, Steven RJ Brueck, and Tito Busani. "Scalable Top-Down Approach Tailored by Interferometric Lithography to Achieve Large-Area Single-Mode Gan Nanowire Laser Arrays on Sapphire Substrate." *J ACS nano*, 12, no. 3 (2018): 2373-80.

## **BEFORE 2018 (SELECTED)**

56. Zamudio, ME, M Behzadirad, C Christodoulou, and T Busani. "Optimization of Azo Films for Integrating Optically Transparent Antennas with Photovoltaics." *Applied Physics Letters*, 110, no. 23 (2017): 234101.
55. Zamani Kouhpanji, Mohammad Reza, Mahmoud Behzadirad, and Tito Busani. "Classical Continuum Theory Limits to Determine the Size-Dependency of Mechanical Properties of Gan Nws." *Journal of Applied Physics* 122, no. 22 (2017): 225113.



54. Mesibov, Melinda, Nick Flor, Ceagan Lino, Rodrigo Arias, Megan Hayden, Tim Van Osdell, Ryan Sishc, et al. "Energy Robots." *Virtual Energy World*, (2017).
53. Mesibov, Melinda, Nick Flor, Ceagan Lino, Rodrigo Arias, Megan Hayden, Tim Van Osdell, Ryan Sishc, et al. "Energy Surge System Quiz." (2017).
52. Zhu, Ruichao, Steven RJ Brueck, Noel Dawson, Tito Busani, Praveen Joseph, Shrawan Singhal, SV Sreenivasan. "Scatterometry for Nanoimprint Lithography." *JVST B*, 34, no. 6 (2016).
51. Behzadirad, Mahmoud, Olga Lavrova, and Tito Busani. "Demonstration of 99% Capacity Retention in Li/S Batteries with a Porous Hollow Carbon Cap Nanofiber–Graphene Structure through a Semi-Empirical Capacity Fading Model." *J Journal of Materials Chemistry A*, 4, no. 20 (2016): 7830-40.
50. Behzadirad, M, O Lavrova, and T Busani. "Theoretical Modeling of Internal Ionic Resistance Due to Sei Layer Formation in Li/S Batteries." *MRS Online Proceedings Library 1774* (2015): 63-68.
49. Sandu Irina, Elsa MURTA, Fátima EUSEBIO, Rita VEIGA, Lia JORGE, Vânia Solange MuraglhA, Manuel Francisco Costa Pereira, et al. "Creating the Illusion: The Marble and Stone-Like Decoration of the Main Altarpiece of St. Francis Church, in Viseu." 6 (2015).
48. Anca Sandu, Irina Crina, Elsa Murta, Fatima Eusebio, Rita Veiga, Lia Jorge, Vania Solange Muralha, Manuel Francisco Costa Pereira, Tito Busani et al. "Creating the Illusion: The Marble and Stone-Like Decoration of the Main Altarpiece of St. Francis Church, in Viseu." 6 (2015): 473-86.
47. Rahimi, Nassim, Andrew A Aragon, Darryl M Shima, Christopher Hains, Tito Busani, Olga Lavrova, Ganesh Balakrishnan, et al. "Characterization of Surface Defects on Be-Implanted GaSb." *JVST B*, 32, no. 4 (2014): 04E109.
46. Kardarian Kasra, Tito Busani, Inês Osório, Helena Domingos, Rui Igreja, Ricardo Franco, João Cortez. "Sintering of Nanoscale Silver Coated Textiles, a New Approach to Attain Conductive Fabrics for Electromagnetic Shielding." *Materials Chemistry and Physics* 147, no. 3 (2014): 815-22.
45. Hrdlickova Kuckova, Stepanka, Michaela Crhova Krizkova, Catarina Luísa Cortes Pereira, Radovan Hynek, Olga Lavrova, Tito Busani, Luis Cobra Branco, Irina Crina Anca Sandu, and technique. ", J.

Microscopy research, Assessment of Green Cleaning Effectiveness on Polychrome Surfaces by Maldi-Tof Mass Spectrometry and Microscopic Imaging." 77, no. 8 (2014): 574-85.

44. Dencheva Nadya, Hugo Gaspar, Sergej Filonovich, Olga Lavrova, Tito Busani, Gabriel Bernardo, and Zlatan Denchev. "Fullerene-Modified Polyamide 6 by in Situ Anionic Polymerization in the Presence of Pcbm." J Journal of materials science, 49, no. 14 (2014): 4751-64.

43. Bernacka-Wojcik, Iwona, Susana Ribeiro, Pawel Jerzy Wojcik, Pedro Urbano Alves, Tito Busani, Elvira Fortunato, Pedro Viana Baptista, et al. "Experimental Optimization of a Passive Planar Rhombic Micromixer with Obstacles for Effective Mixing in a Short Channel Length." RSC Advances, 4, no. 99 (2014): 56013-25.

42. Santos, R, J Loureiro, A Nogueira, E Elangovan, JV Pinto, JP Veiga, T Busani, et al. "Thermoelectric Properties of V2o5 Thin Films Deposited by Thermal Evaporation." Applied Surface Science, 282 (2013): 590-94.

41. Sandu, Irina Crina Anca, Elsa Murta, Rita Veiga, Vânia Solange F Muralha, Manuel Pereira, Stepanka Kuckova, Tito Busani, J Microscopy Research Busani, and Technique. "An Innovative, Interdisciplinary, and Multi-Technique Study of Gilding and Painting Techniques in the Decoration of the Main Altarpiece of Miranda Do Douro Cathedral (Xvii-Xviiiith Centuries, Portugal)." 76, no. 7 (2013): 733-43.

40. Rodrigues, FD, Mara Cunha, L Hilliou, L Rino, MR Correia, T Busani, Gabriel Bernardo, et al. "Impact of Composition and Morphology on the Optical Properties of Si-Nc/P3ht Thin Films Processed from Solution." 113, no. 2 (2013): 439-46.

39. Pereira Catarina, Isabel Ferreira, LC Branco, ICA Sandu, and Tito Busani. "Atomic Force Microscopy as a Valuable Tool in an Innovative Multi-Scale and Multi-Technique Non-Invasive Approach to Surface Cleaning Monitoring." J Procedia Chemistry, 8 (2013): 258-68.

38. Pereira, Catarina, Tito Busani, Luis C Branco, Ineke Joosten, Irina Crina Anca %J Microscopy Sandu. "Nondestructive Characterization and Enzyme Cleaning of Painted Surfaces: Assessment from the Macro to Nano Level." Microanalysis 19, no. 6 (2013): 1632-44.

37. Parthiban, Shanmugam, Elamurugu Elangovan, Pradipta K Nayak, Alexandra Gonçalves, Daniela Nunes, Luís Pereira, Pedro Barquinha, et al. "Performances of Microcrystalline Zinc Tin Oxide Thin-Film Transistors Processed by Spray Pyrolysis." *Journal of Display Technologies*, 9, no. 10 (2013): 825-31.
36. Nandy, Suman, Gonçalo Gonçalves, Joana Vaz Pinto, Tito Busani, Vitor Figueiredo, Luís Pereira, Rodrigo Ferrão Paiva Martins, and Elvira Fortunato. "Current Transport Mechanism at Metal–Semiconductor Nanoscale Interfaces Based on Ultrahigh Density Arrays of P-Type NiO Nano-Pillars." *Nanoscale* 5, no. 23 (2013): 11699-709.
35. Martin, Kathleen E, Yongming Tian, Tito Busani, Craig J Medforth, Ricardo Franco, Frank van Swol, and John Shelnett. "Charge Effects on the Structure and Composition of Porphyrin Binary Ionic Solids: ZnTPPS/SnTMPPY Nanomaterials." *J Chemistry of Materials*, 25, no. 3 (2013): 441-47.
34. Danciu, Anca-I, Viorica Musat, Tito Busani, Joana V Pinto, Raquel Barros, Ana Maria Rego, Ana Maria Ferraria, et al. "Uniform Arrays of ZnO 1D Nanostructures Grown on Al: ZnO Seeds Layers by Hydrothermal Method." *Journal of nanoscience and nanotechnology*, 13, no. 10 (2013): 6701-10.
33. Branquinho, Rita, Joana V Pinto, Tito Busani, Pedro Barquinha, Luis Pereira, Pedro Viana Baptista, Rodrigo Martins, and Elvira Fortunato. "Plastic Compatible Sputtered Ta<sub>2</sub>O<sub>5</sub> Sensitive Layer for Oxide Semiconductor TFT Sensors." *Journal of Display Technology*, 9, no. 9 (2013): 723-28: 1015.
32. Tian, Yongming, Tito Busani, Gregory H Uyeda, Kathleen E Martin, Frank van Swol, Craig J Medforth, Gabriel A Montaña, and John A Shelnett. "Hierarchical Cooperative Binary Ionic Porphyrin Nanocomposites." *J Chemical Communications*, 48, no. 40 (2012): 4863-65.
31. Tian, Yongming, Christine M Beavers, Tito Busani, Kathleen E Martin, John L Jacobsen, Brandon Q Mercado, Brian S Swartzentruber, et al. "Binary Ionic Porphyrin Nanosheets: Electronic and Light-Harvesting Properties Regulated by Crystal Structure." *Chemical Communications*, 4, no. 5 (2012): 1695-700.
30. Musat, Viorica, Elvira Fortunato, Munitzer Purica, Monica Mazilu, Anna Maria Botelho do Rego, Bogdan Diaconu, Tito Busani. "Multifunctional Zinc Oxide Nanostructures for a New Generation of Devices." *Materials Chemistry and Physics*, 132, no. 2-3 (2012): 339-46.

29. Filonovich, Sergej Alexandrovich, Hugo Águas, Tito Busani, António Vicente, Andreia Araújo, Diana Gaspar, Marcia Vilarigues, et al. "Hydrogen Plasma Treatment of Very Thin P-Type Nanocrystalline Si Films Grown by Rf-Pecvd in the Presence of B (CH<sub>3</sub>)<sub>3</sub>." *Science and technology of advanced materials*, 13, no. 4 (2012): 045004.
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27. Danciu, Anca-Ionela, Viorica Muşat, Tito Busani, Alexandra Gonçalves, Joana V Pinto, Mafalda Costa, Iwona Bernacka-Wojcik, Rodrigo Martines, and Elvira Fortunato. "Selective Growth of 1d Nanostructured Oxide Materials Using Pdms Stamp." (2012).
26. Tian, Yongming, Kathleen E Martin, Julian Y-T Shelnut, Lindsey Evans, Tito Busani, James E Miller, Craig J Medforth, and John A \ Shelnut. "Morphological Families of Self-Assembled Porphyrin Structures and Their Photosensitization of Hydrogen Generation." *Chem Comm*, 47, no. 21 (2011): 6069-71.
25. Sandu, IC A, Tito Busani, Maria Helena de Sá. "The Surface Behavior of Gilding Layer Imitations on Polychrome Artefacts of Cultural Heritage." *Surface and Interface Analysis*, 43, no. 8 (2011): 1171-81.
24. Nayak, Pradipta K, Tito Busani, Elangovan Elamurugu, Pedro Barquinha, Rodrigo Martins, Yongtaek Hong, and Elvira Fortunato. "Zinc Concentration Dependence Study of Solution Processed Amorphous Indium Gallium Zinc Oxide Thin Film Transistors Using High-K Dielectric." *Applied Physics Letter*, 97, no. 18 (2010): 183504.
23. Musat, V, E Fortunato, M Mazilu, T Busani, B Diaconu and M Dobre. "Solution-Based Synthesis of Semiconductive Oxide 1-D Nanostructures." *Journal of optoelectronics and advanced materials* 12, no. 9 (2010): 1909-14.
22. Martin Kathleen E, Zhongchun Wang, Tito Busani, Robert M Garcia, Zhu Chen, Yingbing Jiang, Yujiang Song, et al. "Donor– Acceptor Biomorphs from the Ionic Self-Assembly of Porphyrins." *Journal of the American Chemical Society*, 132, no. 23 (2010): 8194-201.

21. Busani Tito and RAB Devine. "Physical and Optical Properties of Room Temperature Microwave Plasma Anodically Grown Ti O<sub>2</sub>." *Journal of Vacuum Science, Surfaces Technology A: Vacuum, and Films* 27, no. 4 (2009): 725-30.
20. Busani Tito and Roderick Devine. "Growth Kinetics and Physical Characterization of Low Temperature Anodic Plasma Assisted Oxide of Titanium." *ECS Transactions*, 19, no. 9 (2009): 27-34.
19. Busani, T, RAB Devine "Nonvolatile Memory and Antifuse Behavior in Pt/a-Ti O<sub>2</sub>/Ag Structures." *Journal of Vacuum Science Technology B* 26, no. 5 (2008): 1817-20.
18. Devine, RA B, Tito Busani, Manuel Quevedo-Lopez, and Husam N Alshareef. "Electrical Bias Stressing and Radiation Induced Charge Trapping in HfO<sub>2</sub>/SiO<sub>2</sub> Dielectric Stacks." *Journal of applied physics* 101, no. 10 (2007): 104101.
17. Busani Tito, RAB Devine, and HL Hughes. "Negative Bias Temperature Instability and Fowler-Nordheim Injection in Silicon Oxynitride Insulators." *Applied physics letters*, 90, no. 16 (2007): 163512.
16. Edwards, AH, T Busani, RAB Devine, and A Pineda. "On the Importance of Atomic Packing in Determining Dielectric Permittivities." In *Defects in High-K Gate Dielectric Stacks*, 457-70: Springer, 2006.
15. Busani, Tito, Patrice Gonon, Fadhel El Kamel, and Fathi Jomni. "Dielectric Properties of Cu/Amorphous Batio<sub>3</sub>/Cu Structures." Paper presented at the Meeting Abstracts, 2006.
14. Busani, Tito, RAB Devine, Xiangkun Yu, Hye-Won "Electrical and Physical Properties of Room Temperature Deposited, Mixed Tio<sub>2</sub>/SiO<sub>2</sub> Oxides." *Journal of Vacuum Science Surfaces Technology A* 24, no. 2 (2006): 369-74.
13. Busani Tito, Roderick Devine, and Patrice Gonon. "Structural Effects in the Dielectric Constant of Rare-Earth Oxides: Nd<sub>2</sub>O<sub>3</sub>." *ECS Transactions* 1, no. 5 (2006): 331-40.
12. Busani Tito. "Elaboration Et Caractérisation De Quelques Diélectriques À Forte Permittivité Avec Application En Microélectronique: Influence De La Structure Du Réseau Sur Les Propriétés Électriques." Université Joseph-Fourier-Grenoble I, 2006.

11. Devine RAB, and Busani Tito. "Molecular Volume Dependence of the Electronic and Ionic Polarizabilities in  $\text{TiO}_2$  and  $\text{SiO}_2$ ." *Applied Physics Letters* 86, no. 6 (2005): 062902.
10. Busani Tito and RAB Devine "Dielectric and Infrared Properties of  $\text{TiO}_2$  Films Containing Anatase and Rutile." *Semiconductor science and technology*, 20, no. 8 (2005): 870.
9. Busani Tito and RAB Devine. "The Importance of Network Structure in High-K Dielectrics:  $\text{LaAlO}_3$ ,  $\text{Pr}_2\text{O}_3$ , and  $\text{Ta}_2\text{O}_5$ ." *Journal of applied physics* 98, no. 4 (2005): 044102.
8. Busani Tito and RAB Devine, "Molecular Volume and Electronic and Vibrational Polarizabilities for Amorphous  $\text{LaAlO}_3$ ." *J. of Applied Physics*, 96, no. 11 (2004): 6642-47.
7. Busani Tito and RAB Devine "Substrate/Oxide Interface Interaction in  $\text{LaAlO}_3/\text{Si}$  Structures." *J MRS Online Proceedings*, 786 (2003).
6. Busani, T, RAB Devine, M Martini, G Spinolo, and A %J *Journal of non-crystalline solids* Vedda. "Electronic Traps in Mixed  $\text{Si}_{1-x}\text{Ge}_x\text{O}_2$  Films." 280, no. 1-3 (2001): 177-82.
5. Busani, T, H Plantier, RAB Devine, C Hernandez and Y. Campidelli. "Si<sub>1-x</sub>Ge<sub>x</sub> Oxidation by Plasma Assisted Processing: Oxide Uniformity and Electrical Properties." *MRS Online Proceedings*, 573 (1999).
4. Busani, T, H Plantier, RAB Devine, C Hernandez, and Y Campidelli. "Growth Kinetics and Physical Characterisation of  $\text{Si}_{1-x}\text{Ge}_x\text{O}_2$  Films Obtained by Plasma Assisted Oxidation." *Journal of non-crystalline solids*, 254, no. 1-3 (1999): 80-88.
3. Busani, T, H Plantier, RAB Devine, C Hernandez, and Y Campidelli. "Growth and Characterization of  $\text{GeO}_2$  Films Obtained by Plasma Anodization of Epitaxial Ge Films." *Journal of applied physics*, 85, no. 8 (1999): 4262-64.
2. Busani, T, P Rathi, TJ Rotter, F Jaeckel, KJ Malloy, Alexander A Ukhanov, E Plis, et al. "Confocal Raman Spectroscopy and Afm for Evaluation of Sidewalls in Type II Superlattices."

1. Busani Tito, H Plantier, RAB Devine, C Hernandez and Y Campidelli, "Sil1ge1 Oxidation by Plasma Assisted Processing: Oxide." MRS proceedin, 573, (2011).

### **Selected Proceeding and conference presentations**

20. Busani Tito, Steven RJ Brueck, and Daniel F Feezell. "III-N Nanowire Atomic Force Cantilevers for Ultra-Vertical-Wall Scanning-Probe, Scanning-Tunneling, and near-Field Microscopy (Conference Presentation)." Paper presented at the Nanophotonic Materials XV, 2018.

19. Busani, Tito, Olga Lavrova, Julio Martinez, John Shelnut, and Shixiong Zhang. "Ultra Wide Spectrum Photovoltaic-Thermoelectric Solar Cell." Google Patents, 2017.  
Behzadirad Mahmoud, Mohsen Nami, Ashwin K Rishinaramagalam, Daniel F Feezell, and Tito %J Nanotechnology, "Gan Nanowire Tips for Nanoscale Atomic Force Microscopy." 28, no. 20 (2017): 20LT01.

18. Behzadirad, Mahmoud, Noel Dawson, Mohsen Nami, Ashwin K Rishinaramangalam, Daniel F Feezell, and Tito L Busani. "Gan Nanowire Tip for High Aspect Ratio Nano-Scale Afm Metrology (Conference Presentation)." Paper presented at the Nanoengineering: Fabrication, Properties, Optics, and Devices XIII, 2016.

17. Zamudio ME, T Busani, Y Tawk, J Costantine, and C Christodoulou. "Design of Azo Film for Optically Transparent Antennas." Paper presented at the Antennas and Propagation (APSURSI), 2016 IEEE International Symposium on, 2016.

16. Rotter, TJ, T Busani, P Rathi, F Jaeckel, PA Reyes, KJ Malloy, AA Ukhanov, et al. "Confocal Raman Spectroscopy and Afm for Evaluation of Sidewalls in Type Ii Superlattice Fpas." Paper presented at the Infrared Technology and Applications XLI, 2015.

15. Rahimi, N, DJ Herrera, A Aragon, DM Shima, OS Romero, TJ Rotter, T Busani, et al. "Gasb Thermophotovoltaics: Current Challenges and Solutions." Paper presented at the Physics, Simulation, and Photonic Engineering of Photovoltaic Devices IV, 2015.

14. Busani Tito L, Olga Lavrova, Matthew Erdman, Julio Martinez, and Noel M Dawson. "Monolithically Self-Assembled Organic Active Materials Integrated with Thermoelectric for Large Spectrum Solar

Harvesting System (Presentation Recording)." Paper presented at the Next Generation Technologies for Solar Energy Conversion VI, 2015.

13. Swartzentruber, Brian S, Hope Quintana, Erdong Song, Matt Erdman, Kathleen Martin, Tito Busani, John Shelnett, George T Wang, and Julio Martinez. "Thermoelectric Transport in Novel Quantum Confined and Organic-Inorganic (Hybrid) Nanostructured Materials." Sandia National Lab.(SNL-NM), Albuquerque, NM (United States), 2014.

12. Swartzentruber, Brian S, John Nogan, Kathleen Martin, Matt Erdman, Hope Quintana, John Allen Shelnett, Julio Alberto Martinez, et al. "Bio-Hybrid Integrated System for Wide-Spectrum Solar Energy Harvesting." Sandia National Lab.(SNL-NM), Albuquerque, NM (United States), 2014.

11. Rahimi, N, M Behzadirad, Emma J Renteria, DM Shima, Ayse J Muniz, T Busani, Olga Lavrova, G Balakrishnan, and LF Lester. "Beryllium Implant Activation and Damage Recovery Study in N-Type Gasb." Paper presented at the Physics, Simulation, and Photonic Engineering of Photovoltaic Devices III, 2014.

10. Martin, Kathleen, Matthew Erdman, Hope Quintana, John Shelnett, John Nogan, B Swartzentruber, Julio Martinez, Olga Lavrova, and Tito Busani. "Bio-Hybrid Integrated System for Wide-Spectrum Solar Energy Harvesting." Paper presented at the Organic Photonic Materials and Devices XVI, 2014.

9. Erdman, Matt, Kathleen Martin, Hope Quintana, John Shelnett, Julio Martinez, Olga Lavrova, and Tito Busani. "New Generation of Biomorph Integrated with Tco and Thermoelectric to Enhance Efficiency in Wide Solar Spectrum Solar Cell." Paper presented at the Photovoltaic Specialist Conference (PVSC), 2014 IEEE 40th, 2014.

8. Martin Kathleen, Yongming Tian, Tito Busani, Gregory H Uyeda, Craig J Medforth, Gabriel A Montano, and John A Shelnett. "Hierarchical Cooperative Binary Ionic Porphyrin Nanocomposites." Sandia National Lab.(SNL-NM), Albuquerque, NM (United States), 2012.

7. Bernardo, Gabriel, L Hilliou, JC Viana, T Busani, Meisha Shofner, and David G Bucknall. "Pressure Induced Mixing and Crystallization Effects in Materials for Polymer Photovoltaic Cells." Paper presented at the Proceedings of the IV Annual Meeting of the I3N Associate Laboratory, 2012.



6. Bernacka-Wojcik, I, AC Vaz, Ivo Martinho, D Barata, P Simões, PJ Wojcik, T Busani, et al. "Development of Microfluidic Devices for Biosensors." I3N Conference (2012): 94-94.
5. Tian, Yongming, Christine Beavers, Tito Busani, Kathleen Martin, Brian S Swartzentruber, Frank B van Swol, Craig J Medforth, and John A Shelnett. "Crystal Structure and Properties of a Cooperative Binary Ionic Solid." Sandia National Lab.(SNL-NM), Albuquerque, NM (United States), 2011.
4. Pereira, Ricardo, J Coutinho, A Carvalho, L Pereira, L Rino, VJB Torres, Luís de Almeida, et al. "Hybridsolar Project: Hybrid Si-Nanoparticle/Polymer Layers for Solar Cell Applications." Paper presented at the III Annual Meeting of the I3N–Institute of Nanostructures, Nanomodelling and Nanofabrication, 2011, 2011.
3. Martins, R, B Brás, I Ferreira, L Pereira, P Barquinha, N Correia, R Costa, et al. "Away from Silicon Era: The Paper Electronics." Paper presented at the Oxide-based Materials and Devices II, 2011. Busani, Tito, Yongming E Tian, Kathleen E Martin, and John A Shelnett. "Structural and Electrical Studies of Novel Photoconductive Self-Assembled Porphyrin Structures." Paper presented at the ACS, 2011.
2. Águas, H, I Bernacka-Wojcik, T Busani, E Fortunato, R Martins, P Lopes, P Simões, M Ferreira, and L Hilliou. "Microplat Project: Development Status." Paper presented at the III Annual Meeting of the I3N–Institute of Nanostructures, Nanomodelling and Nanofabrication, 2011, 2011. Shelnett, John A, Kathleen Martin, Zhongchun Wang, Robert M Garcia, John Jacobsen, Tito Busani, and Craig J Medforth. "Porphyrin Nanostructures and Biomorphs." Paper presented at the ACS, 2009.
1. Busani, Tito, and Roderick Devine. "Growth Kinetics and Physical Characterization of Low Temperature Anodic Plasma Assisted Oxide of Ti." Paper presented at the MRS Meeting, 2009

#### **GRANTS AWARDED (Funded research)**

<b>2021</b>	<b>PI:</b> LANAL donation AFM (~\$190,000)
<b>2021</b>	<b>PI:</b> WeR1_UNM_OVPR (\$2,500)
<b>2021-2022</b>	<b>PI:</b> ENEL group private industry (\$25,000)
<b>2021-2022</b>	<b>PI:</b> Sandia Labs Post Doc (\$80,000/year) pending
<b>2020-21</b>	<b>PI:</b> Sandia Labs Post Doc (\$127,000/year)
<b>2021</b>	<b>PI:</b> Los Alamos Student Summer internship (\$ Student directly paid at LANL)
<b>2021</b>	<b>PI:</b> Sandia Labs Student Summer internship (\$14,000)
<b>2020-2021</b>	<b>PI:</b> UNM ACORN (\$40,000)

**2020** PI: Sandia Labs Student Summer internship (\$14,000)  
**2020-2022** PI: LDRD academic alliance (\$200,000)  
**2019-2022** PI: AFRL Advanced Components for Electronics in Space (\$23,000)  
**2019-2020** PI: NSF INTERN (\$50,000/year)  
**2019-2024** Co-PI: DOD Space Rapid Capabilities Office SpRCO Award No. A20-0073-001.  
(\$ 197,000 PI: Erich Brown and Graig Kief)  
**2015-2021** Co-PI: NSF SEPTET (\$ 150,000/year)  
**2016-2022** Co-PI: ERC NASCENT (\$136,000/year)  
**2016** Co-PI: HBCU-MI (\$ 437.000)  
**2015-2021** Faculty member: ERC QESST  
**2013-2014** Co-PI: Bioinorganic Highly Efficient Flexible Thermoelectric for Producing  
Energetic Fabrics (NASA funding for equipment 5,000 USD).  
**2013-2014** Co-PI: DOD Night Vision Directorate (SBIR-phase I and II)  
**2016-2019** PI: Nanomanipulation of Oxide Nano Wires and 2D structures for sensing  
application (CINT-user proposal)  
**2012-2014** PI: Interdisciplinary and multi scale studies of gilded surfaces of Portuguese  
artifacts (45,000 /year)  
**2011-2012** PI: *Nanotechnology devices processing and characterization to artificial  
photosynthesis of Solar cells (2 years 25,000 €)*  
**2010-2012** Co-PI: *Development of a Microfluid Platforms for DNA amplification and  
detection (2 years FCT-I3N project of 80,000 €)*  
**2010-2014** Collaborator: European ORAMA project for application of NWs in gas sensing  
devices (5 years 500,000 €).  
**2010-2012** Co-PI: *Hybrid Si nanoparticle/Polymer layers for solar cells application  
''HybridSolar'' (2 years FCT-I3N project of 50,000 €)*  
**2009-2012** Collaborator: *Integrated Nanotechnology Approach to Artificial Photosynthesis of  
Solar Fuels (3 years 1 Million USD)*  
**2003-2006** PI: *High k dielectric plasma processing (18 month project 25,000 € - exchange  
student grant)*  
**1998-2000** Collaborator: *AAPPLES (6 years European project of 1 Million €)*

#### GRANTS UNDER CONSIDERATION

**2021-** PI: NRO-DII (\$700,000/1years)  
**2021-** PI: SRC (\$295,000/ 3 years)  
**2021-** PI: Total Fina: (\$200,000/year)  
**2021-** PI: DOE Sandia (\$120,000/year one year)  
**2021-** Co-PI: ARO equipment and instrumentation grant (\$442,000)  
**2021-** Co-PI: DURIP (\$629,000)

#### PATENTS

- 2013** “Micro-Integrated Mosfet-Piezo-Gas sensor using metal oxides nano structures such as ZnO, SnO” No. 2014-069
- 2014** “Ultra Wide Spectrum Organometallic/Inorganic Nanostructured Photovoltaic-Thermoelectric Solar Cell” No. INV-00008
- 2016** “Atomic Force Microscopy Based on Nanowires Tips for High Aspect Ratio Nanoscale Metrology/Confocal Microscopy,” WO2018102439A1, 10,840,092 T. (issued 11/17/2020, 2017-039-03)
- 2018** “Lattice-Matched Nano/Mesoporous Semiconductor Distributed Bragg Reflectors (DBRs) for Vertical Cavity III-Nitride Nanowire Emitters,” Pending Patent, 2018
- 2019** “Rugged, single crystal wide-band-gap-material scanning-tunneling-microscopy/lithography tips” Steven R.J. Brueck, Daniel Feezell, John Randall, Tito Busani, Joshua B. Ballard, Mahmoud Behazadirad and Ashwin Krishnan, US20210263069A1 (issued 05/11/2021)
- 2018** “Electrical impedance spectroscopy for non-destructive, real-time, tracking of relative water content and stress responses in plants” T. Busani, D. Hanson and M Behazirad, 2018-097-02\_7230302 pending
- 2021** “Devices Comprising Distributed Bragg Reflectors And Methods of Making The Devices” T. Busani, D. Feezell and M Behazirad, M MOrteza and M Sadaat, WO 2021/108772 A1 03/06/2021(International Application published)

## **HAWARDS**

- 2021** PVSC conference, Best Poster Award (R. Jeiswal student)
- 2021** Rainforest recipient
- 2012** Gold Medal at EUROINVENT conference for innovation
- 2006** ECS – Student Award

## **STUDENT SUPERVISED**

### **PhD**

- 2021- Ravi Kiran (Power ECE)
- 2020- Rahul Jeiswal (Power ECE)
- 2019- Isaac Stricklin (Optoelectronic at ECE)
- 2019- Arjun Aryal (OSE Physics)

2018- Co-advisor of Xumei Wang (OSE at UNM)

### **PhD graduated**

2018 Mahmoud Behazirad (OSE program at UNM)

2018 Moussavi Behnam (OSE program at UNM)

2017 Elizabeth Zamaudio (ECE UNM)

2013 Anca Mocafescu (University of Lisbon)

### **MS**

2018 Neal Wostbrok (ECE power graduated 2019)

2018 Abu Mitul (OSE at UNM)

2018 Kirt Nakagawa (OSE at UNM)

2016 Matt Erdman (ECE at UNM)

2012 Catarina Cortes (Materials Science at University of Lisbon)

2012 Rita Veiga (Material science at University of Lisbon)

2011 Tomas Calmeiro

### **Undergrad:**

2020- Sierra Quintana (ECE student)

2019-2020 Daniel Casas UNM Carrier in partnership with New Mexico Energy Consortium

2013-2014 E. Martin Kathleen (graduated)

### **High School:**

worked with 4 summer students 2 high school teachers

### **REFEREE WORK**

JAP, APL, Nanotechnology, Physical Review, Semiconductor Science and Technology and MRS journal, J. Of American Chemical Society and Nature Chemistry

### **TEACHING**

Fall 2021	ECE 371 Materials and devices
Spring 2021	ECE 484/584 Photovoltaics
Fall 2020	ECE 371 Materials and devices
Spring 2020	ECE 484/584 Photovoltaics
Fall 2019	OSE seminars
Spring 2018	ECE 484/584 Photovoltaic (UNM)
Spring 2018	OSE seminar series
Spring 2017	ECE 484/584 Photovoltaic (UNM)
Spring 2009-2012	500 Nanotechnology Materials (U. of Lisbon)

Fall 2009-2012

500 Device and Material analysis and characterization  
(U. of Lisbon)

Fall 2010-2012

600 AFM and SEM/FIB/EDS Seminars (U. of  
Lisbon)

### **OUTREACH ACTIVITIES**

- Working with AIMS high school student to develop a 3D printed lithography set up that can be used to teach basic microelectronic process at high and middle school level
- 3D Masks for COVID-19

### **COMMUNITY, STATE, AND NATIONAL SERVICE**

- Serving as a Board of Director of the Parish Community Church "John XXIII"
- Merit Badge for Nuclear and Sustainability for the Boy Scouts of America (BSA Girl troop 220)

### **ENTREPRENEURSHIP**

- Invited by NSF iCorps about N-95 UV integrated mask project for COVID-19 (see proposal submitted)