CURRICULUM VITAE

Maria Fernanda Villa Bracamonte

Ph.D.

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EDUCATION

Doctor of Philosophy in Electrical Engineering August 2020 – August 2025
Master of Science in Electrical Engineering August 2020 – December 2023
The University of Texas at San Antonio; San Antonio, USA.
Concentration: Microelectronics and Microdevices

Postgraduate Certificate in Fundamental Physics February 2019 – May 2019
University de Sonora; Hermosillo, Mexico.
Department of Research in Physics

Bachelor of Science in Electrical Engineering August 2014 – December 2018
Instituto Tecnológico de Hermosillo; Hermosillo, México.
Concentrations: Electric Power Systems
Thesis Project. Created user manuals to SIVEL and SIFOMED applications to validate and formalize energy profiles (Manuals applied nationwide, Mexico).

Technical Degree in Informatics August 2011 – Jun 2014
Centro de Bachillerato Técnico y de Servicios #11; Hermosillo, México.

TRAINING AND CERTIFICATES

The University of Texas at San Antonio
Lab Safety Certificates August 2020 – Present
Certificates in Hazardous Waste Generation, Hazard Communication and General Lab Safety, General Industrial Safety for Research Spaces, and Laser Safety.

EXPERIENCE

RESEARCH EXPERIENCE

Ph.D. Student August 2020 – August 2025
The University of Texas at San Antonio

Conducting research at the Microelectromechanical Systems Research Laboratory (MEMS Lab) under the supervision of Dr. Arturo Ayon. A 4600 ft^2, class-100 clean room facility which encompasses advanced tools for photolithography, thin film deposition, plasma etching, metallization and metrology. Established in the Microelectronics and Microdevices area in the Electrical and Engineering department. Conducting advanced optical modeling of perovskite solar cells to investigate degradation mechanisms and optical response. Techniques include spectroscopic ellipsometry alongside reflection, transmission, and absorption modeling to evaluate the evolution of optical constants. Complementary structural analyses using X-ray diffraction (XRD) and scanning electron microscopy (SEM) are performed to correlate optical behavior with material crystallinity and morphological changes, providing a comprehensive understanding of device stability. Working on collaboration

on advanced light management and spectral engineering strategies for maximizing photovoltaic energy conversion efficiency.

Internship – Summer Research Jun 2018 – August 2018
The University of Texas at San Antonio San Antonio, USA
Research Project: Influence of a Variety of Quantum Dots in a Solar Cell Efficiency.

- Elaborated synthesis and characterization of Cadmium Telluride (Cdte), Silicon (Si), Zinc Oxide (ZnO), Zinc Sulfide (ZnS) Quantum dots.
- Elaborated synthesis of magnetite nanoparticles.
- Studied and realized Optical characterization for U-V Visible spectroscopy for Photoluminescence and absorption.
- Estimated band gap by Tauc Method and estimated size particle by Brus equation.
- Analyzed x-ray diffraction (XRD) for CdTe and Si quantum dots.
- Studied the variation and mixture of CdTe Quantum Dots by their reflux reaction with a determined pH.
- Studied possible application of above-mentioned Quantum Dots for photovoltaic devices.

Internship – Summer Research Jun 2017 – August 2017
Centro de Investigaciones en Optica (Optical Research Center) Leon, Mexico
Research Project: Design, Fabrication, and Electrical Optical Characterization of Organic Photovoltaic Cells.

- Fabricated organic solar cells with the structure: ITO/PEDOT:PSS/ACTIVE LAYER/PFN/FM.
- Used active layers: MEH-PPV:PC61BM, P3HT:PC61BM and P3HT:PC71BM.
- Realized electrical characterization by parameters: Open circuit voltage V_{oc}, short circuit current density J_{sc}, fill factor FF, and power conversion efficiency PCE.
- Realized optical characterization by Atomic force microscope AFM determining thickness, roughness, and morphology.

WORK EXPERIENCE

Internship August 2018 – December 2018
Centro National de Control de Energia (National Center of Energy Control) Hermosillo, Mexico
Project: Created and Elaborated User Manuals of SIVEL and SIFOMED Applications used by the Regional Control Administrations to Validate and Formalize the Energy Profiles used for Liquidations of the Electrical Wholesaler Market.

- Understood and studied electrical wholesaler market theoretical foundation (Loading zones, liquidations cycles, measuring systems and official measuring sources).
- Reviewed liquidations process on the System of Energy for Liquidations SIVEL and the Measurements Formalization System SIFOMED.
- Established methodology to the user manuals elaboration of SIVEL and SIFOMED applications.
- Presented user manuals in innovative and interactive style to encourage a faster process of Energy profiles liquidations and formalization.
- Significant improvement seen in energy profiles liquidations and formalization in the electrical wholesaler market.
- **Manuals applied nationwide (Mexico).**

ACADEMIC EXPERIENCE

Physics and Mathematics Instructor — University Entrance Preparation Program 2016 - 2018
Instituto Tecnológico de Hermosillo Hermosillo, Mexico

Taught intensive Physics and Mathematics exam-preparation courses for students applying to undergraduate programs at universities in Hermosillo, including the Universidad de Sonora, Instituto Tecnológico de Hermosillo,

Escuela Normal del Estado de Sonora, Universidad Estatal de Sonora, and Universidad Tecnológica de Hermosillo. The course is offered annually during spring break and has a two-week duration.

Graduate and Undergraduate Student Mentor 2020 - 2025
The University of Texas at San Antonio San Antonio, Texas
MEMS Research Laboratory

Provided instructional support to undergraduate and graduate students in engineering and physics courses and laboratory research settings. Trained students in data analysis, mathematical modeling, error propagation, and quantitative reasoning. Guided students through problem-solving approaches, interpretation of experimental results, and application of mathematical concepts to engineering and physical systems. This experience reinforced my ability to explain complex ideas clearly and support students' academic development in STEM fields.

SKILLS AND QUALIFICATIONS

Proficient in Microsoft Office (Word, Excel, Access, PowerPoint), word processing (LaTeX), and reference managers (Mendeley), analysis graphic program (Origin), PLC programing (Labview), analysis of power systems (PowerWorld), and drawing software application (AutoCAD). Knowledge in mathematical analysis programs (Matlab, Maple, and Matcad). Utilized a variety of scientific and engineering programs (ImageJ, Match!, FluidSIM, Multisim, Opal2).

SPECIAL SKILLS

Experienced in microfabrication and clean room environment: Synthesis of a variety of nanoparticles including CdTe, C, Si, ZnS, ZnO, Fe_3O_4. Thin film deposition (Atomic layer deposition (ALD), sputtering, dip-coating, spin-coating, drop-casting and chemical bath deposition).
Proficient in metrology tools: Ellipsometers, Ultraviolet-visible (UV-Vis) spectroscopy, Time resolved and steady state fluorescence spectroscopy, Raman spectroscopy, Fourier Transform Infrared Spectroscopy (FTIR), Dynamic Light Scattering (DLS), X-Ray diffractometry (XRD), Interferometers, Profilometers, Four-point probes, Solar cell testing simulators, Atomic force microscopy (AFM), Scanning electron microscope (SEM), Transmission electron microscope (TEM), Quartz crystal microbalance (QCM).

JOURNAL PAPERS

1. **Villa-Bracamonte, M. F**., Montes-Bojorquez, J. R., & Ayon, A. A. (2024). Complex Refractive Index and Complex Dielectric Function Modelling of Film Stack in Perovskite Solar Cells Using Spectroscopic Ellipsometry. *Results in Optics.*
2. Montes-Bojorquez, J. R., Castillo, O. J., **Villa-Bracamonte, M. F**., & Ayon, A. A. (2024). Silicon solar cell efficiency improvement employing electrostatically assembled polyelectrolyte-quantum dot multilayers. *Results in Optics.*
3. Kevin J. Knebel, Montes-Bojorquez J. R., **Villa-Bracamonte, M. F**., & Ayon, A. A. (2026). *$CuInS_2$* Quantum Dots for the Performance Enhancement of Commercial Si Solar Cells. *Materials Research Express.* (*Under Review*)
4. **Villa-Bracamonte, M. F**., Montes-Bojorquez, J. R., Kevin J. Knebel, & Ayon, A. A. (2026). Optical Properties Characterization of Lead Iodide films for Applications in Perovskites. (*Under preparation*)

CONFERENCES

Next-generation Microelectronics and Interface Engineering for Integration, Workshop, Houston, Texas, Nov 3-4, 2025

1. **Villa-Bracamonte, M. F.**, Montes-Bojorquez, J. R., Knebel, K. J., & Ayon, A. A.
   Advanced Optical Characterization and Modeling of Multilayer Thin Films For Perovskite Photovoltaics.
2. Montes-Bojorquez, J. R., **Villa-Bracamonte, M. F.,** Knebel, K. J., & Ayon, A. A.
   Optimization of Semiconductor Quantum Dots Multilayers for Nanostructured Photovoltaic Devices.
3. Knebel, K. J., Montes-Bojorquez, J. R., **Villa-Bracamonte, M. F.,** & Ayon, A. A.
   $CuInS_2$ Quantum Dots for the Enhancement of Commercial Si Solar Cells.

52nd IEEE Photovoltaic Specialists Conference, Seattle, Washington, June 9-14, 2024

4. **Villa-Bracamonte, M. F.**, Montes-Bojorquez, J. R., Knebel, K. J., & Ayon, A. A.
   Optical Modeling of Roughness and Degradation Effects in Perovskite Solar Cells.
   (Best Poster Award-Area: Characterization Methods)
5. Montes-Bojorquez, J. R., **Villa-Bracamonte, M. F.,** Knebel, K. J., & Ayon, A. A.
   Exploiting the Optical Limits of Down-Shifting Enhanced Solar Cells.
6. Knebel, K. J., Montes-Bojorquez, J. R., **Villa-Bracamonte, M. F.,** & Ayon, A. A.
   Investigation of Cd Pb Free Quantum Dots for the Application of Dye Sensitized Solar Cells.

50th IEEE Photovoltaic Specialists Conference, San Juan, Puerto Rico, June 11-16, 2023

7. **Villa-Bracamonte, M. F.**, Montes-Bojorquez, J. R., Lopez-Becerra, A., & Ayon, A. A.
   Carbon Quantum Dots and their Possible Application in Perovskites Passivation.
8. Montes-Bojorquez, J. R., **Villa-Bracamonte, M. F.**, Knebel, K. J., & Ayon, A. A.
   Combining perovskites and quantum dots: application in solar cell.

8th World Conference on Photovoltaic Energy Conversion (WCPEC-8), Milan, Italy, September 26-30, 2022

1. **Villa-Bracamonte, M. F.,** Montes-Bojorquez, J. R., & Ayon, A. A.
   Modeling the Optical Properties of a Perovskite Solar Cell Film Stack.
2. Montes-Bojorquez, J. R., **Villa-Bracamonte, M. F.,** & Ayon, A. A.
   Efficient Light-Harvesting Employing Size-Gradient Quantum Dot Film.

32nd International Conference on Diamond and Carbon Materials, Lisbon, Portugal, September 4-8, 2022

1. Montes-Bojorquez, J. R., Vasquez-Briseño, A. R., **Villa-Bracamonte, M. F.,** Lopez-Becerra, A., & Ayon, A. A.
   Utilization of Graphene Quantum Dots for Silicon Solar Cells Applications.

49th IEEE Photovoltaic Specialists Conference, Philadelphia, PA, June 5-10, 2022

1. **Villa-Bracamonte, M. F.,** Montes-Bojorquez, J. R., & Ayon, A. A.
   Complex Refractive Index and Complex Dielectric Function Modelling of Film Stack in Perovskite Solar Cells Using Spectroscopic Ellipsometry.
2. Montes-Bojorquez, J. R., **Villa-Bracamonte, M. F.,** & Ayon, A. A.
   Designing a Multi-Quantum-Dot Array for Efficient Light Harvesting in Solar Cells.
   (Best Poster Award-Area 1: Quantum Structures, Hot Carriers and Novel Materials)

SPIE OPTO, San Francisco, CA, January 22-27, 2022

1. **Villa-Bracamonte, M. F.,** Montes-Bojorquez, J. R., & Ayon, A. A.
   Determination of the Complex Refractive Index of Glass/ITO/PEDOT:PSS/MAPbI3 Film Stack for Perovskite Solar Cells Applications.

7th Nano Today Virtual Conference, November 16-18, 2021

1. **Villa-Bracamonte, M. F.,** Montes-Bojorquez, J. R., & Ayon, A. A.
   Spectroscopy Ellipsometry Study of a Multilayer Film Stack in Perovskite Solar Cells.

2. Montes-Bojorquez, J. R., **Villa-Bracamonte, M. F.,** & Ayon, A. A.
Enhancing Silicon Solar Cells with Quantum Dot Luminescent Down-Shifting Layers.

2021 TechConnect World Innovation Conference, Washington, DC, October 18-20, 2021

1. **Villa-Bracamonte, M. F.,** Montes-Bojorquez, J. R., & Ayon, A. A.
Characterization of Perovskite Solar Cells Using Spectroscopic Ellipsometry.
2. Montes-Bojorquez, J. R., **Villa-Bracamonte, M. F.,** & Ayon, A. A.
Fabrication and Opto-Electronic Modeling of Down-Shifting Enhanced Photovoltaics.

SPIE OPTO, San Francisco, CA, February 2-7, 2019

1. Janeth Alexandra Garcia-Monge, Itzel Alexia Garcia-Monge, **Maria Fernanda Villa-Bracamonte,** Juan Adrian Zepeda-Galvez, and Arturo A. Ayón
Tailoring and Controlling Fermionic Properties in Heterogeneous Quantum Dot Colloidal Solutions

LXI Congreso Nacional de Física, Puebla, México, October 7-12, 2018

1. **María Fernanda Villa Bracamonte,** Janeth Alexandra García Monge, and Arturo A. Ayón.
Caracterización de Puntos Cuánticos y su Posible Aplicación en Dispositivos Fotovoltaicos

ACADEMIC PRESENTATIONS

Villa-Bracamonte, Maria F (2019). *The woman in research and development of technologies*. Talk presented in the week dedicated to the women in engineering by Rama Soles IEEE at Hermosillo Institute of Technology.

LANGUAGES

Fluent in English and Spanish, and basic French.

HONORS AND AWARDS

- **CONTEX Doctoral Fellowship 2024:** twelve months of full tuition and annual stipend to continue a doctoral degree program.
- **Best Poster Award**, 52nd IEEE Photovoltaic Specialists Conference 2024, Area 5: Characterization Methods.
- **Graduate School Professional Development Award**, The University of Texas at San Antonio, 2021-2022, 2022-2023, 2024: For attending major professional meetings.
- **Best Poster Award,** 49nd IEEE Photovoltaic Specialists Conference 2022, Area 5: Quantum Structures, Hot Carriers and Novel Materials.
- **Electrical and Computer Engineering Competitive Scholarship**, The University of Texas at San Antonio, 2020: For satisfactory academic performance.
- **CONACyT PhD International Scholarship**, 2020-2024: 4-year full tuition and annual stipend to study in an international institution.
- **Sociedad Mexicana de Física (SMF) Student Scholarship**, 2018: For select undergraduate students attending the National Conference in Physics as presenting authors.

SOCIETIES

Institute of Electrical and Electronics Engineers (IEEE)
IEEE Women in Engineering

Society of Photo-Optical Instrumentation Engineers (SPIE)

VIDEO DEMONSTRATIONS

- MEMS Lab UTSA (2018) Synthesis of CdTe Quantum Dots. YouTube (English and Spanish) (3150 views)

https://www.youtube.com/watch?v=xMEBYoZnLCI&feature=youtu.be
https://www.youtube.com/watch?v=6zSd8SZAnkk