Denis Mamaluy

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Department of Electrical Engineering

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EDUCATION

- B. Verkin Institute for Low Temperature Physics & Engineering,
  Ph.D. in Physics and Mathematics, Kharkov, Ukraine, November 2000.
- Kharkov State University, Physics Department, division of theoretical physics,
  M.S. in Physics (with honor), Kharkov, Ukraine, June 1997.
- UNESCO at Kharkov University,
  M.A. in Philosophy of Communications and Management, Kharkov, Ukraine, May 1997.

APPOINTMENTS

2006-present: Research Assistant Professor, Dep. of Electrical Engineering, Arizona State University

2005-2006: Faculty research associate, instructor of EEE533 "Semiconductor Device and Process Simulations" class at Fulton School of Engineering, Arizona State University

2002-2005: Research associate, Department of Electrical Engineering, Arizona State University, Tempe, Arizona.

2000-2002: Post-doctorate fellow, Walter Schottky Institute, Technische Universität München, Munich, Germany

PRINCIPAL AREAS OF RESEARCH

- Quantum transport simulation in nano-structures and nano-devices:
  - ultra-scaled FinFETs, Tri-gate FETs, double-gate MOSFETs
  - nanowires, including:
    - Si NW and NW heterostructures that can provide ultrasensitive, label-free, real-time detection of biological and chemical species.
    - InAs/InP NWFETs that have demonstrated highest to date mobility rate (~12000 cm2/Vs)
    - Ge/Si core/shell NW heterostructures for high-performance FETs (in partnership with Charles Lieber group)
  - quantum dots (in partnership with Walter Schottky Institute)
  - single-electron transistors (SETs) in partnership with an experimental group from NIST

  (more details can be found at http://www.public.asu.edu/~dmamaluy/research.htm)
- Theoretical study of efficient numerical algorithms for non-equilibrium Keldysh Green's function formalism and nano-device modeling, Contact Block Reduction (CBR) method.
- Semiconductor device modeling, including effects of source-drain tunneling, gate leakage, discrete doping, surface roughness, quantum confinement, phonon scattering and impurities.
- Nano-device optimization and process variation analysis (optimized 10 nm FinFET)
- Surface electromagnetic waves in dielectrics and ferroelectrics induced by magneto-electric interactions

RESEARCH PUBLICATIONS

FIVE RECENT SIGNIFICANT PUBLICATIONS IN REFEREED ARCHIVAL JOURNALS

1. "Simulation of the Impact of Process Variation on the Optimized 10-nm FinFET", H. Khan, D. Mamaluy, D. Vasileska, IEEE Trans El. Dev. **55**, pp. 2134-2141 (2008).
2. "Approaching Optimal Characteristics of 10 nm High Performance Devices: a Quantum Transport Simulation Study of Si FinFET",
   H. Khan, D. Mamaluy and D. Vasileska, IEEE Trans El. Dev. **55**, pp. 743-753 (2008).
3. "Quantum Transport Simulation of Experimentally Fabricated Nano-FinFET",
   H. Khan, D. Mamaluy, D. Vasileska, IEEE Tran. El. Dev. **54**, pp. 784-796 (2007).
4. "Contact block reduction method for ballistic transport and carrier densities of open nanostructures",
   D. Mamaluy, M. Sabathil, T. Zibold, D. Vasileska, P. Vogl, Phys. Rev. B **71**, 245321 (2005).
5. "Efficient method for the calculation of ballistic quantum transport",
   D. Mamaluy, M. Sabathil, P. Vogl, J. App. Phys. **93**, 4628 (2003).

FIVE OTHER SIGNIFICANT PUBLICATIONS IN REFEREED ARCHIVAL JOURNALS

6. "Strong nonreciprocity of phonon polaritons of insulator at its boundary with ideal metal or superconductor in magnetic field",
   I. E. Chupis and D. A. Mamaluy, J. Phys.: Condensed Matter **12**, 1413 (2000).
7. "Surface polaritons in a dielectric at its boundary with a metal in crossed electric and magnetic field", D. A. Mamaluy and I. E. Chupis, JETP **90**, 153 (2000).
8. "Rectification of surface polaritons in a dielectric at its boundary with a metal in magnetic field", I. E. Chupis and D. A. Mamaluy, Low Temp. Phys. **25**, 833 (1999).
9. "Surface polaritons in a dielectric in constant electric field at the boundary with a metal", I. E. Chupis and D. A. Mamaluy, JETP Letters **68**, 922 (1998).
10. "Influence of dynamic magnetoelectric interaction on surface polaritons in ferroelectrics", I.E.Chupis and D. A. Mamaluy, Low Temp. Phys. **24**, 762 (1998).

OTHER PUBLICATIONS IN REFEREED ARCHIVAL JOURNALS

11. "3D NEGF quantum transport simulator for modeling ballistic transport in nano FinFETs", H. R. Khan, D. Mamaluy and D. Vasileska, J. Phys.: Conf. Ser. **107**, pp. 1-13 (Published online: 9 April, 2008).
12. "Fully 3D self-consistent quantum transport simulation of Double-gate and Tri-gate 10 nm FinFETs", H. Khan, D. Mamaluy and D. Vasileska, J. Comp. El. **7**, pp. 346-349 (2008).
13. "Can Silicon FinFETs Satisfy ITRS Projections for High Performance 10 nm Devices?", H. Khan, D. Mamaluy and D. Vasileska, J. Comp. El. **7**, pp. 284-287 (2008).
14. "Influence of Interface Roughness on Quantum Transport in Nano-Scaled FinFET", H. Khan, D. Mamaluy and D. Vasileska, J. Vac. Sci. Technol. B **25**, pp. 1437-1440 (2007).
15. "Assessment of the CBR quantum transport simulator on Experimentally fabricated nano-FinFET", H. Khan, D. Mamaluy and D. Vasileska, ECS Transactions, Vol. 6(4), pp. 197-203 (2007).
16. "Self-consistent Treatment of Quantum Transport in 10 nm FinFET Using Contact Block Reduction (CBR) Method", H. Khan, D. Mamaluy, D. Vasileska, J. Comp. Electronics **6**, pp. 77-80 (2007).
17. "3D quantum transport simulator for next generation devices", D. Mamaluy, H. Khan and D. Vasileska, J. Phys.: Conf. Ser. **38**, pp. 196-199 (2006).
18. "Ballistic Quantum-Mechanical Simulation of 10nm FinFET Using CBR Method", H. Khan, D. Mamaluy, D. Vasileska, J. Phys.: Conf. Ser. **38**, 200 (2006).
19. "Calculation of carrier transport through quantum dot molecules", T. Zibold, M. Sabathil, D. Mamaluy, and P. Vogl, AIP Conf. Proc. **722**, 799 (2005).

20. "Contact block reduction method and its application to 10-nm MOSFET device", D. Mamaluy, D. Vasileska, M. Sabathil, P. Vogl, Semicond. Sci. and Technol. **19**, S118 (2004).
21. "Electron density calculation using the contact block reduction method", D. Mamaluy, A. Mannargudi, D. Vasileska, J. Comp. Electronics **3**, 45 (2004).
22. "Efficient Computational Method for Ballistic Currents and Application to Single Quantum Dots", M. Sabathil, S. Birner, D. Mamaluy and P. Vogl. J. Comp. Electronics **2**, pp. 269-275 (2004).
23. "Prediction of realistic quantum logic gate using the contact block reduction method", M. Sabathil, D. Mamaluy, P. Vogl, Semicond. Sci. and Technol. **19**, S137-S140 (2004).

REVIEW PAPERS AND BOOK CHAPTERS

24. Chapter 4 (by Denis Mamaluy) in *Encyclopedia of Nanoscience and Nanotechnology*, Edited by H. S. Nalwa, American Scientific Publishers, Los Angeles (will be published in Spring 2009).
25. "Semiconductor device modeling" (review article), D. Vasileska, D. Mamaluy, H. R. Khan, K. Raleva, and S. M. Goodnick, Journal of Computational and Theoretical Nanoscience Vol. **5**, pp. 999–1030 (2008).

Other Publications

1. Virtual Journal of Nanoscale Science & Technology (August 13, 2007) "Influence of Interface Roughness on Quantum Transport in Nano-Scaled FinFET", H. Khan, D. Mamaluy [http://www.vjnano.org/]
2. Nanotech 2006: Technical Proceedings of the 2006 NSTI Nanotechnology Conference and Trade Show, Volume 1, "Self-consistent Quantum Mechanical Treatment of the Ballistic Transport in 10 nm FinFET Devices Using CBR Method", D. Mamaluy, K. Khan, D. Vasileska, pp. 54-57 (2006).
3. "Nextnano3 – a state-of-the-art simulation tool for 3D quantum nanodevices", S. Birner, S. Hackenbuchner, J.A. Majewski, D. Mamaluy, M. Sabathil, G. Zandler Annual Report 2001, Walter Schottky Institute, TU Munich (2002) [http://www.wsi.tu-muenchen.de/T33/research/projects/projects_2001/article_nn3.htm]
4. "Theoretical modeling of single quantum dot photodiodes" M. Sabathil, S. Hackenbuchner, S. Birner, D. Mamaluy, J.A. Majewski Annual Report 2001, Walter Schottky Institute, TU Munich (2002) [http://www.wsi.tu-muenchen.de/T33/research/projects/projects_2001/article_QDs.htm]
5. "The influence of the magneto-electric interaction on surface phonon polaritons in insulators", D. Mamaluy, **Ph.D. dissertation**, Kharkov, Ukraine, B. Verkin Institute for Low Temperature Physics and Engineering, November 2000.
6. "Stability analysis of magneto-hydrodynamic processes in industrial aluminum baths", D. Mamaluy, **Master's Thesis**, Kharkov, Ukraine, Kharkov State University, July 1997.

National Conference Proceedings Reviewed Papers, Abstracts and Presentations (since 2003):

1. IEEE IWCE-12 (International Workshop on Computational Electronics), UMass, Amherst, October 8-10, 2007. "Can Silicon FinFETs Satisfy ITRS Projections for High Performance 10 nm Devices?", H. Khan, D. Mamaluy and D. Vasileska.
2. IEEE IWCE-12 (International Workshop on Computational Electronics), UMass, Amherst, October 8-10, 2007. "Influence of Dimensionality on Quantum Transport in Nano-devices: 3D vs. 2D Modeling", H. Khan, D. Mamaluy and D. Vasileska.
3. Second International Conference on Transport Phenomena in Micro and Nanodevices, Il Ciocco Hotel and Conference Center, Barga, Italy, June 11–15, 2006. "Quantum Transport in Nano-scale FinFET Using Contact Block Reduction (CBR) Method", D. Mamaluy.
4. IEEE IWCE-11 (International Workshop on Computational Electronics), Vienna University of Technology, Technische Universität Wien, May 25-27, 2006. "Self-consistent Treatment of

Quantum Transport in 10 nm FinFET Using Contact Block Reduction (CBR) Method", H. Khan, D. Mamaluy and D. Vasileska.

5. Nanotech, Boston, MA, May 7-11, 2006. "Self-consistent quantum-mechanical treatment of the ballistic transport in 10 nm FinFET devices using CBR method", H. Khan, Mamaluy, Vasileska.
6. Seventh International Conference on New Phenomena in Mesoscopic Structures/Fifth International Conference on Surfaces and Interfaces of Mesoscopic Devices,Maui, Hawaii, USA, November 27-December 2, 2005. "3D quantum transport simulator for next generation devices", D. Mamaluy, H. Khan, D. Vasileska.
7. Second Joint International Conference on New Phenomena in Mesoscopic Systems and Surfaces and Interfaces of Mesoscopic Devices, Nov 27-Dec 2, 2005. "3D quantum transport simulator for next generation devices", D. Mamaluy, H. Khan, and D. Vasileska.
8. HCIS-14, Chicago IL, July 24-29, 2005. "Self-Consistent Quantum Mechanical Treatment of the Ballistic Transport in FinFET Devices Using CBR Method", D. Mamaluy, H. Khan, D. Vasileska.
9. IEEE IWCE-10, Purdue University, West Lafayette, IN, October 24-27, 2004, "Self-Consistent Contact Block Reduction Method for Ballistic Nanodevices", D. Mamaluy, D. Vasileska, M. Sabathil, P. Vogl.
10. Transport Phenomena in Micro and Nanodevices, Ohana Keauhou, Kona Coast, HI, October 17-21, 2004. "Ballistic Quantum Transport Simulations in Nano-Devices", D. Mamaluy.
11. 2004 IEEE Silicon Nanoelectronics Workshop, Honolulu, HI, June 13-14, 2004. "Open-system quantum ballistic transport calculation in 10 nm MOSFET device", D. Mamaluy, D. Vasileska.
12. First Joint International Conference on New Phenomena in Mesoscopic Systems and Surfaces and Interfaces of Mesoscopic Devices, Wailea Marriot Resort, Maui, HI, Nov 30-Dec 5, 2003. "An efficient method to calculate the ballistic quantum transport and its application to 10 nm MOSFET device", D. Mamaluy, A. Mannargudi, D. Vasileska.
13. HCIS-13 (13th International Conference on Nonequilibrium Carrier Dynamics in Semiconductors), Dipartimento di Fisica, UniMoRe, Modena , Italy, July 28 – August 1, 2003. "Contact block reduction method and its application to 25-nm MOSFET device", D. Mamaluy, D. Vasileska, M. Sabathil and P. Vogl.
14. IEEE IWCE-9 (International Workshop on Computational Electronics), Monte Porzio Catone, Rome, Italy, 25-28 May, 2003. "Efficient computational method for ballistic current and application to quantum dot RTD's", M. Sabathil, D. Mamaluy and P. Vogl.

INVITED TALKS

1. National Institute of Standards and Technology (Gaithersburg, MD), June 8th, 2007. "Approaching optimal characteristics of 10 nm Devices: a Quantum Transport Simulation Study of Si FinFET using CBR simulator", D. Mamaluy (*invited speaker*), H. Khan, D. Vasileska.
2. Freescale Semiconductor Inc., September 29, 2006, "Efficient modeling of quantum transport in nano-devices", D. Mamaluy (*invited speaker*), H. Khan, D. Vasileska.
3. Synopsys Inc., April 28-29, 2005. "3D Quantum Transport Simulator for the Next Generation Devices", D. Mamaluy (*invited speaker*). Two days of **invited lectures** at Synopsys Inc.
4. IEEE IWCE-10, International Workshop on Computational Electronics (Purdue University, October 24 – 27, 2004). "Self-Consistent Contact Block Reduction Method for Ballistic Nanodevices", D. Mamaluy (*invited speaker*) (http://www.iwce.nanohub.org/pgm_qt2.htm)
5. Purdue University, July 2004, "Contact Block Reduction method to calculate ballistic quantum transport in nanodevices", D. Mamaluy (*invited speaker*).
6. National Science Foundation, Workshop on Quantum and Many-Body Effects in Nanoscale Devices, (ASU, October 24 – 25, 2003). "CBR method for modeling nano-devices", D. Mamaluy (*invited speaker*) (http://www.eas.asu.edu/~nano/QMD.htm)

RESEARCH GRANTS (AWARDED)

1. Science Foundation Arizona (SFAz), Competitive Advantage Award, "Heterostructure Nanowire Simulation for Robust Manufacturing", D. Mamaluy (PI), 9/1/2008-8/31/2009, $133,000
2. National Science Foundation, Collaborative Research: "Quantum Simulator for Modeling Quantum Dot Photodetectors", D. Mamaluy (ASU), D. Vasileska (ASU), G. Klimeck (Purdue University), 5/1/2007-4/30/2010, $165,000.
3. Office of Naval Research AWARD No.: N000140610094 "3D Quantum Simulator for Nano-Device Modeling and Performance Evaluation", D. Vasileska (PI), D. Mamaluy (co-PI), 10/1/2005-9/30/2008, $380,000.

RESEARCH GRANTS (PENDING)

1. National Science Foundation (DMA), "Heterostructure Nanowire and Single-electron Transistor Device Simulation for Robust Manufacturing", D. Mamaluy (PI), D. Vasileska (co-PI), 12/1/2008 – 12/30/2011, $435,000.
2. National Science Foundation (EFRI-BSBA), "Quantum Transport Simulations of Silicon Nanowire Biosensors", D. Vasileska, D. Mamaluy, C. Ringhofer, S. M. Goodnick 9/1/2009-8/31/2012, $1,205,074.
3. Semiconductor Research Corporation, "Vertically-Integrated Analog Design Space Exploration with Multi-Gate Transistors", Sule Ozev, Weimin Wu, Bertan Bakkaloglu, Gennady Gildenblat, Denis Mamaluy, Stephen Goodnick 8/1/2009-8/1/2011, $300,000.
4. National Science Foundation, "Shape Controlled Silicon Nanopillar Arrays for Advanced Thermoelectric Power Generation", S. Myhajlenko1, D. Mamaluy, and C. Tracy 8/1/2009-7/31/2012, $330,000.
5. National Science Foundation, IDR: "Robust Simulator for Modeling Self-heating Effects in Nano-devices", Denis Mamaluy, Stephen Goodnick, Dragica Vasileska 8/1/2009-7/31/2012, $348,000.

PROFESSIONAL AND SCIENTIFIC SERVICE

Scientific and Professional Society Memberships and Activities:

- IEEE (Member since 2005)
- IEEE Electron Devices Society (Member since 2005)

JOURNAL REFEREE SERVICE

- IEEE Transactions on Electron Devices
- Journal of Applied Physics
- Journal of Computational Electronics
- Microelectronic Engineering

PROPOSAL REVIEWER SERVICE

- Austrian Science Fund (FWF)
- National Science Foundation
- Research Councils in Great Britain (via FWF)

SYNERGISTIC ACTIVITIES

- Creation and development of the Contact Block Reduction method for quantum transport simulation in nano-structures and nano-devices
- Development of an efficient, parallel (OpenMP & MPI) **non-equilibrium Green's function code** (FORTRAN 90) for open quantum systems in 2D and 3D.
- Installation and administration of MS Exchange Server at the Walter Schottky Institute, Windows administration (J-script, Visual Basic Script, etc.)
- Investigation of the role of the dynamic magnetoelectric interaction in forming of surface electromagnetic wave of a new type
- Patent development on the effects of switching and rectification of surface electromagnetic waves [two corresponding **patents** were issued to D. Mamaluy and I. Chupis in the Ukraine].

COLLABORATORS AND OTHER AFFILIATIONS

A. Collaborators:

S. Goodnick (ASU), D. Ferry (ASU), M. Fischetti (UMass Amherst), O. Hartin (Freescale Semicon. Inc.), G. Klimeck (NCN, Purdue), S. Laux (IBM), O. Penzin (Synopsys Inc.), V. Mickevicius (Synopsys Inc.), M. Sabathil (Osram), D. Vasileska (ASU), P. Vogl (Walter Shottky Institute), N. Zimmerman (NIST).

B. Graduate and postdoctoral advisors of Denis Mamaluy:

Graduate advisor: A. M. Ermolaev, Kharkov State University, Ukraine.
Ph. D. study and thesis advisor: I. E. Chupis, ILTPE, Kharkov, Ukraine.
Postdoctoctoral advisor: P. Vogl, Walter Schottky Institute, Technische Universität München, Germany,
D. Vasileska, Arizona State University

C. Denis Mamaluy is the thesis adviser and post-graduate scholar sponsor for:

Ph.D.: Hasanur Khan (graduated Nov. 2007)

SCIENTIFIC HONORS (AWARDS)

- The Best Poster Presentation - 7th International Conference on Complex Media (Bianisotropics '98) "New types of surface polaritons in ferroelectrics induced by magnetoelectric interaction", D. A. Mamaluy and I. E. Chupis. Braunschweig, Germany, 1998.
- The Diploma with Honors, M.S. in Physics, Kharkov State University, Ukraine, 1997.

LANGUAGES: English; Russian, other Slavic languages.