Hesameddin **Ilatikhameneh**

Device Physics Expert · Electrical Engineer · Simulation Professional

218 Nimitz Dr., Apt. 15

(+1) 224-419-2418 | hesam.ilati2@gmail.com | hilatikh@purdue.edu | Hesameddin Ilatikhameneh

"Don't look for water, increase your thirst." Rumi

Education

Purdue University — *West Lafayette, IN*

PhD, Electrical and Computer Engineering, (GPA 4/4) — *8/2011 - PRESENT*

- Atomistic simulations of steep transistors (quantum electron and phonon transport), quantum dots, and qubits.
- Co-developed NEMO5 and educational tools for nanohub which being used by +20,000s users.
- Published +18 journal and +25 conference papers/posters/presentations and 2 patents. (h-index: 8, citations: +177).

Sharif University — *Tehran, IRAN*

MSc, Microelectronics, Electrical Engineering (GPA 3.67/4) — *9/2005-12/2007*

- Analysis and simulation of Plasma Enhanced Chemical Vapor Deposition of polysilicon and Si3N4 [J19].

Technical Skills

Programming	C/C++, Matlab, COMSOL, Visual basis, Labview, Python, LaTeX
Solid-state devices	HEMTs, Ultra-scaled TFETs and MOSFETs, Quantum dots, Superconducting devices, Qubits, super-lattice source
High vacuum systems	Design and implementation of UHV pressure gauges. Operating and maintaining UHV systems.
Quantum Transport	Non-equilibrium greens function (NEGF), Recursive green's function (RGF), quantum transmitting boundary method (QTBM), WKB, Drift-Diffusion.
Band-structure	Tight-binding, DFT, Extended Huckel, K dot P.
Solid-state physics	Superconductivity, quantum field theory, 2nd quantization, electron-electron interaction, phonons.

Experience

Purdue University, School of Electrical and Computer Engineering — *Lafayette, IN, USA*

Research Assistant — *5/2011–4/2016*

- Co-developed multi-physics tool NEMO5 for phonon and electron quantum transport and strain relaxation.
- Proposed novel transistors and evaluated their performance by quantum transport modeling and developed analytic models for transport, quantum dots and transistors.
- Collaborated on weekly basis with several experimental groups at Purdue and Notre dame Universities to analyze and understand the experimental results of 2D material and Nitride based devices.

YNS, UHV systems — *Tehran, Iran*

Senior high vacuum system designer — *12/2007–12/2008*

- Designed and implemented high vacuum systems
- Implemented a full prototype of a ultra high vacuum pressure sensors based on plasma currents.

HSim, Simulation softwares — *Tehran, Iran*

Founder and Software developer — *12/2008–1/2011*

- Developed a general partial differential solver for non-linear differential equations (called HSIM).
- Used HSIM to simulate flux flow in HTC superconductors, plasma, and HEMT.

Teaching Experience

Purdue University — *IN, USA*

Mentoring 4 graduate researchers — *2013-2016*

Sharif University *Tehran, Iran*

Teaching assistant of microelectronics fabrication lab for 2 semesters during MSc *2007*

KNTU University *Tehran, Iran*

Teaching assistant of micro-controllers lab for 2 semesters, BSc *2004*

Activities as a Referee

Referee of +25 manuscripts from:

- IEEE Electron Device Letters (EDL)
- IEEE Transaction on Electronic Devices (TED)
- Journal of Computational Electronics (JCEL)
- Applied Physics Letters (APL)

Honors & Awards

International

2016	**Ranked 1**, graduating class of PhD students in Purdue University	*West Lafayette, IN*
2015	**Golden reviewer**, IEEE Electron Device Letters	*Washington, DC*
2013	**Intel award**, Recognition of my work on development of NEMO5	*West Lafayette, IN*

Domestic

2007	**Finalist**, Nationwide Electrical Engineers Olympiad among 100 Universities	*Tehran, Iran*
2005	**3rd Award**, BSc graduating class of +200 students in KNTU University	*Tehran, Iran*
2006	**Ranked 35**, Among +10,000 electrical engineers in nationwide graduate school entrance exam	*Tehran, Iran*

Research Highlights

Novel transistors

1) New transistor structures

- Dielectric Engineered (DE-) TFET [P1, J1]: Record ON-current for a steep transistor.
- Anisotropic TFET [P2, J2]: Homojunction TFET scalable to 2nm channel length.
- Dynamic BandGap (DBG-) FET [J4, C21, C22]: New mechanism to obtain steep I-V.
- Bilayer graphene Electrically Doped (BED-) TFET [J8]: Ultra-low power transistor with supply voltage of 0.1V.

2) Scaling transistors to sub-12nm channels

- MOSFETs [J10, C28]: High effective mass channel materials resolve source-to-drain tunneling leakage in sub-12nm
- TFETs [J6, J7]: Low bandgap and high effective mass channel materials can provide high ON-current and low leakage.

3) Novel materials

- Phosphorene [J7]
- Transition metal dichacogenides: e.g. WSe2, MoS2 [J3, J5, J1, C23, C24]
- Bilayer graphene [J8, C25, C26]
- Nitride hetero-structures [C27, J9]

Analytic modeling

- New analytic modeling of TFETs [J11] and Schottky barriers [J13]
- Scaling theory of 2D TFETs [J5]

Atomistic quantum transport model development in NEMO5

- Full band transport models for electrons [C29, J12, C20] and phonons [C31]
- Mode-space approach for tight binding [C30]
- Phonon spectra calculation and phonon transport [C31, J16, J17]
- Strain relaxation [J15, J18, C33, C34, C35]
- Bandstructure unfolding method [J16, J17]
- Scattering models

Fabrication process simulation and design

- Simulation of PECVD [J19]
- Plasma simulation in UHV conditions
- Fluid flow and chemical reaction modeling in CVD process

Invited Talks

StarNET E-Workshop *Purdue University, IN, USA*

H. Ilatikhameneh *2016*

- Novel steep transistors

Steep transistors workshop *Notre Dame University, IN, USA*

H. Ilatikhameneh et al. *Oct., 2015*

- STEEP Transistor Modeling with NEMO5

Patents

[P1] Dielectric Engineered Tunnel Field-Effect Transistor *IN, USA*

H. Ilatikhameneh, R. Rahman, and G. Klimeck *7/27/2015*

US-patent application 62/197,513

[P2] Tunnel field effect transistor having anisotropic effective mass channel *IN, USA*

H. Ilatikhameneh, T. Ameen, B. Novakovic, R. Rahman, and G. Klimeck *4/4/2016*

US-patent application 62/317835.

Publications

Journal papers

[J1] H. Ilatikhameneh, T. Ameen, G. Klimeck, J. Appenzeller, and R. Rahman, *"Dielectric Engineered Tunnel Field-Effect Transistor,"* IEEE Electron Device Letters (2015), 10.1109/LED.2015.2474147.

[J2] H. Ilatikhameneh, T. Ameen, B. Novakovic, Y. Tan, G. Klimeck, and R. Rahman, *"Saving Moore's Law Down To 1nm Channels With Anisotropic Effective Mass,"* Submitted to Nature Nano (2016).

[J3] H. Ilatikhameneh, Y. Tan, B. Novakovic, G. Klimeck, R. Rahman, J. Appenzeller, *"Tunnel Field-Effect Transistors in 2D Transition Metal Dichalcogenide Materials,"* IEEE Exploratory Solid-State Computational Devices and Circuits, vol. 1, no. 1, pp. 12-18 (2015).

[J4] T. Chu, H. Ilatikhameneh, G. Klimeck, R. Rahman, Z. Chen, *"Electrically tunable bandgaps in bilayer MoS2,"* Nanoletter, 15 (23), pp. 8000-8007 (2015).

[J5] H. Ilatikhameneh, G. Klimeck, J. Appenzeller, and R. Rahman, *"Scaling Theory of Electrically Doped 2D Transistors,"* IEEE Electron Device Letters, vol. 36, no. 7, pp. 726-728 (2015), DOI:10.1109/LED.2015.2436356.

[J6] H. Ilatikhameneh, G. Klimeck, and R. Rahman *"Can Homojunction Tunnel FETs Scale Below 10nm?"* IEEE Electron Device Letters, vol. 37, no. 1, pp. 115-118 (2016).

[J7] T. A. Ameen, H. Ilatikhameneh, G. Klimeck, and R. Rahman *"Few-layer Phosphorene: An Ideal 2D Material For Tunnel Transistors,"* submitted to Scientific Reports,[Online.] arXiv:1512.05021 (2015).

[J8] F. W. Chen, H. Ilatikhameneh, G. Klimeck, Z. Chen, and R. Rahman, *"Configurable Electrostatically Doped High Performance Bilayer Graphene Tunnel FET,"* IEEE Journal of the Electron Devices Society (2016).

[J9] W. Li, S. Sharmin, H. Ilatikhameneh, R. Rahman, Y. Lu, J. Wang, X. Yan, A. Seabaugh, G. Klimeck, D. Jena, P. Fay, *"Polarization-Engineered III-Nitride Heterojunction Tunnel Field-Effect Transistors,"* IEEE Exploratory Solid-State Computational Devices and Circuits, vol. 1, no. 1, pp. 28-34 (2015).

[J10] M. Salmani-Jelodar, S. Mehrotra, H. Ilatikhameneh, and G. Klimeck, *"Design Guidelines for Sub-12 nm Nanowire MOSFETs,"* IEEE Trans. on Nanotechnology, vol. 14, no. 2, pp. 210-213 (2015).

[J11] R. B. Salazar*, H. Ilatikhameneh*, R. Rahman, G. Klimeck, J. Appenzeller, *"A predictive analytic model for high-performance tunneling field-effect transistors approaching non-equilibrium Green's function simulations,"* Journal of Applied Physics, 118, 164305 (2015).

[J12] J. E. Fonseca, T. Kubis, M. Povolotskyi, B. Novakovic, A. Ajoy, G. Hegde, H. Ilatikhameneh, Z. Jiang, P. Sengupta, Y. Tan, G. Klimeck, *"Efficient and realistic device modeling from atomic detail to the nanoscale,"* Journal of Computational Electronics, vol. 12, no. 4, pp. 592-600 (2013).

[J13] H. Ilatikhameneh, R. B. Salazar, G. Klimeck, R. Rahman, J. Appenzeller, *"From Fowler-Nordheim to Non-Equilibrium Green's Function Modeling of Tunneling"*, (2015) [Online.] arXiv/1509.08170

[J14] M. Salmani-Jelodar, H. Ilatikhameneh, S. Kim, K. Ng, and G. Klimeck, *"Optimum High-k Oxide for the Best Performance of Ultra-scaled Double-Gate MOSFETs,"* (2015), [Online.] arXiv:1502.06178.

[J15] Hesameddin Ilatikhameneh, Tarek Ameen, Gerhard Klimeck, Rajib Rahman, *"Universal Behavior of Strain in Quantum Dots"* arXiv:1509.08004.

[J16] Timothy Boykin, Arvind Ajoy, Hesameddin Ilatikhameneh, Michael Povolotskyi, Gerhard Klimeck, *"Brillouin zone unfolding method for effective phonon spectra"* Physical Review B (2014).

[J17] Timothy Boykin, Arvind Ajoy, Hesameddin Ilatikhameneh, Michael Povolotskyi, Gerhard Klimeck, *"Unfolding and effective bandstructure calculations as discrete real-and reciprocal-space operations"* Physica B Condensed Matter, Volume 491, 15, pp. 22-30 (2016).

[J18] T. Ameen, H. Ilatikhameneh et al., *"Theoretical study of strain-dependent optical absorption in Stranski-Krastanov grown InAs/InGaAs/GaAs/AlGaAs quantum dots"* arXiv:1502.07726.

[J19] M. Bavafa, H. Ilatikhameneh et al., *"Comprehensive simulation of the effects of process conditions on plasma enhanced chemical vapor deposition of silicon nitride"* Semiconductor Science and Technology 23 (9), 09502 (2008).

Conference presentations/proceedings

[C20] J. Sellier, et al., *"Nemo5, a parallel, multiscale, multiphysics nanoelectronics modeling tool,"* SISPAD, (2012).

[C21] Hesameddin Ilatikhameneh, Bozidar Novakovic, Yaohua Tan, Tillmann Kubis, Michael Povolotskyi, Rajib Rahman, Gerhard Klimeck, *"Transport properties of 2D material transistors,"* 17th International Workshop on Computational Electronics (IWCE), Paris, France, (2014).

[C22] Hesameddin Ilatikhameneh, Bozidar Novakovic, Yaohua Tan, Mehdi Salmani-Jelodar, Tillmann Kubis, Michael Povolotskyi, Rajib Rahman, Gerhard Klimeck, *"Transport properties of 2D material transistors,"* TECHON 2014, October 1-3, Santa Clara, CA (2014).

[C23] Hesameddin Ilatikhameneh, Fan Chen, Rajib Rahman, Gerhard Klimeck, *"Electrically Doped 2D matertial tunnel transistor,"* International Workshop on Computational Electronics (IWCE) West Lafayette (2015).

[C24] Hesameddin Ilatikhameneh, Rajib Rahman, Joerg Appenzeller, Gerhard Klimeck, *"Atomistic Simulation of Electrically Doped WTe2 Tunnel Transistor,"* The International Conference on Simulation of Semiconductor Processes and Devices (SISPAD), Washington (2015).

[C25] Fan Chen, Hesameddin Ilatikhameneh, Tao Chu, Joerg Appenzeller, zhihong chen, Gerhard Klimeck, Rajib Rahman, *"Achieving a higher ON/OFF ratio in Bilayer Graphene FET– Strain Engineering"* SISPAD, Washington DC, USA, September 9-11, (2015).

[C26] Fan Chen, Hesameddin Ilatikhameneh, Rajib Rahman, Gerhard Klimeck, *"Transport properties of bilayer graphene field effect transistor"* TECHCON, Sept. 20-22, Austin, TX, United States (2015).

[C27] Hesameddin Ilatikhameneh, Saima Sharmin, Rajib Rahman, Gerhard Klimeck, *"Atomistic Simulation of GaN/InN/GaN Tunnel FETs"* Berkeley Symposium E3S (2013).

[C28] Mehdi Salmani-Jelodar, Hesameddin Ilatikhameneh, Prasad Sarangapani, Saumitra Mehrotra, SungGeun Kim, Kwok Ng, Gerhard Klimeck, *"Tunneling: The Major Issue in Ultra-scaled MOSFETs"* IEEE Nano, Rome, Italy, July 26-30, (2015).

[C29] Hesameddin Ilatikhameneh, Fan Chen, Saima Sharmin, Tarek Ameen, Yaohua Tan, Pengyu Long, Jun Huang, Zhengping Jiang, Michael Povolotskyi, Rajib Rahman, Gerhard Klimeck, Joerg Appenzeller, zhihong chen, Patrick Fay, Mark Rodwell, *"STEEP Transistor Modeling with NEMO5"* Steep Transistors Workshop, University of Notre Dame, Notre Dame, IN, October 5-6, (2015).

[C30] A. Afzalyian, J. Huang, H. Ilatikhameneh et al., *"Mode space tight binding model for ultra-fast simulations of III-V nanowire MOSFETs and heterojunction TFETs"* IEEE IWCE, West Lafayette (2015).

[C31] K. Miao, H. Ilatikhameneh et al., *"Thermal transport across strain relaxed Si/Ge interfaces",* IEEE IWCE, Paris (2014).

[C32] H. Ilatikhameneh et al., *"Simulation and Optimization of Nanoscale HEMTs With Finite Elements Method",* IEEE Int'l Nanoelectronics Conf. , Shanghai (2008).

[C33] Tarek Ameen*, Hesameddin Ilatikhameneh*, Daniel Valencia, Rajib Rahman, Gerhard Klimeck, *"Engineering The Optical Transitions of Self-Assembled Quantum Dots"* International Workshop on Computational Electronics (IWCE 2015) September 2, 2015 West Lafayette, Indiana USA, Pages: 1 - 4;doi:10.1109/IWCE.2015.7301940

[C34] Tarek Ameen*, Hesameddin Ilatikhameneh*, James Charles, Yuling Hsueh, Sicong Chen, Jim Fonseca, Michael Povolotskyi, Rajib Rahman, "Optimization of the Anharmonic Strain Model to Capture Realistic Strain Distributions in Quantum Dots" IEEE Nano, Toronto, 2014

[C35] Prasad Sarangapani, Daniel Mejia, James Charles, Woody Gilbertso, Hesameddin Ilatikhameneh, Tarek Ameen, Andrew Roche, Jim Fonseca, Gerhard Klimeck, "Quantum Dot Lab: An Online Platform for Quantum Dot Simulations" International Workshop on Computational Electronics (IWCE 2015) September 2, 2015 West Lafayette, Indiana USA