Kai Ni

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EDUCATION

Vanderbilt University
Ph.D. in Electrical Engineering **07/2013 – 10/2016 (expected)**
Dissertation: *Radiation effects in III-V MOSFETs for logic applications*
Advisors: Prof. Ronald Schrimpf and Prof. Daniel Fleetwood
GPA: 3.9/4.0

Vanderbilt University **08/2011 – 07/2013**
M. S. in Electrical Engineering (Physics Minor)
Thesis: *A fully embedded integrated silicon-on-insulator total-ionizing-dose monitor*
Advisor: Prof. Ronald Schrimpf
GPA: 4.0/4.0

University of Science and Technology of China (USTC) **08/2007 – 06/2011**
B. S. in Electrical Engineering
Area: RF/Microwave engineering
GPA: 90.1/100 Rank: 4/153

RESEARCH INTERESTS

- Solid state physics and devices
- Analog/RF/microwave IC design, VLSI, antenna design
- Reliability and radiation effects in microelectronics
- Quantum computation and information

RESEARCH EXPERIENCE

Research Assistant, Radiation Effect & Reliability Group, Vanderbilt University, United States **01/2012 – present**

Solid state physics and devices

- Physics and reliability of III-V MOSFETs for logic applications
  - Bias temperature stability and total-ionizing-dose effect for InGaAs quantum-well MOSFETs
  - Broadbeam heavy ion irradiation and femtosecond two-photon-absorption (TPA) laser irradiation in InGaAs quantum-well MOSFETs
  - Broadbeam heavy ion irradiation and TPA laser irradiation in GaAs surface-channel MOSFETs
  - Charge collection study on InGaAs FinFET devices through TPA laser irradiation and heavy ion irradiation
- ZnO nanowire Resistive RAM (RRAM)
  - Fabrication of the ZnO nanowire RRAM
  - Characterization and analysis of the memory devices
- Carbon-based nanoelectronics
  - Operation principles of the diamond-based vacuum field emission devices
  - Modeling of nanodiamond field emission diode

TCAD simulation of semiconductor devices

- Calibration of III-V material properties, calibration of III-V MOSFETs with experimental data, and simulations of charge collection process
- Reverse leakage current simulations in SiC power schotty diode
- Single event effects simulations in 20 nm 3D planar nMOSFETs and 16 nm FinFET

Monte Carlo simulation of semiconductor devices

- Transport simulation of InGaAs quantum-well MOSFETs
- Simulation of impact ionization induced breakdown of a diode

SOI mixed-signal IC design measuring dose for space application

- Current controlled oscillator design with high linearity and wide input range using double relaxation capacitor topology
- Wide bandwidth voltage comparator design
- Bandgap voltage reference design
- Whole chip layout design

Research intern, Interuniversity MicroElectronics Center (IMEC), Belgium 07/2015 – 11/2015

TCAD simulation on electrical effects of a single extended defect in transistors

- Calibration of the dislocation parameters with experimental data and development of TCAD simulation setup for dislocation
- Simulation of dislocation in planar and FinFET devices

Research intern, Microsemi Corporation, CA, United States 08/2014 – 11/2014

Single event upset (SEU) simualtion

- Characterization of the FPGA SRAM cell SEU sensitivity by mixed mode TCAD simulation
- SEU error cross-section calculation and error rate calculation

SONOS nonvolatile memory

- Characterization of the SONOS nonvolatile memory device
- X-ray irradiation of the SONOS device, characterization, and analysis

Research Assistant, Applied Electromagnetics Group, USTC, China 06/2009 – 06/2011

MMIC design

- Coupled microstrip-line based bandpass filter design
- Four-terminal power divider design
- Power amplifier design

Antenna design and measurement

- Investigation and application of fractal geometry into the Yagi-Uda antenna
- Measurement and characterization of horn antenna parameters

Computational electromagnetics

- Programming based on moment of method (MoM) to solve the current distrubtion and impedance matrix of the Koch fractal antenna and the Sierpinski fractal patch antenna

TECHNICAL SKILLS

- Programming: C (since 2007), Python (since 2011), MATLAB (since 2007), Assembly Language (since 2007), VHDL (since 2008)

- CAD Tool: HFSS (since 2010), ADS (since 2010), IE3D (since 2010), Cadence (since 2011)
- TCAD simulation: Sentaurus TCAD (since 2011), Silvaco TCAD (since 2011), DAMOCLES (since 2013)
- Scanning Electron Microscope (since 2013), Electron Beam Lithography (since 2013)
- Characterization: Semiconductor Parameter Analyzer (since 2012), RF/Microwave Measurement by Vector Network Analyzer (since 2015), Impedance Analyzer (since 2013), High Speed Oscilloscope (since 2013), Low Frequency Noise Measurement (since 2013), Femtosecond Laser Testing (since 2013)

PUBLICATIONS

1. **K. Ni**, E. X. Zhang, R. D. Schrimpf, D. M. Fleetwood, R. A. Reed, M. L. Alles, J. Lin, and J. A. del Alamo, "Gate bias and geometry dependence of total-ionizing-dose effects in InGaAs quantum-well MOSFETs," *IEEE, Trans. Nucl. Sci.*, (pending submission)
2. **K. Ni**, G. Eneman, E. Simoen, A. Mocuta, N. Collaert, A. Thean, R. D. Schrimpf, R. A. Reed, and D. M. Fleetwood, "Electrical effects of a single extended defect in MOSFETs," (submitted to *IEEE Trans. Electron Devices*)
3. **K. Ni**, E. X. Zhang, I. K. Samsel, R. D. Schrimpf, R. A. Reed, D. M. Fleetwood, A. L. Sternberg, M. W. McCurdy, S. Ren, T. P. Ma, L. Dong, J. Y. Zhang, and P. D. Ye, "Charge collection mechanisms in GaAs MOSFETs," *IEEE, Trans. Nucl. Sci.*, Vol. 62, no. 6, pp. 2752-2759, Dec. 2015
4. **K. Ni**, E. X. Zhang, N. C. Hooten, W. G. Bennett, M. W. McCurdy, A. L. Sternberg, R. D. Schrimpf, R. A. Reed, D. M. Fleetwood, M. L. Alles, T. W. Kim, J. Lin, and J. A. del Alamo, "Single event transient response of InGaAs MOSFETs," *IEEE, Trans. Nucl. Sci.,* Vol. 61, pp. 3550-3556, Dec. 2014
5. H. Zhang, H. Jiang, T. R. Assis, S. Ball, **K. Ni**, J. S. Kauppila, R. D. Schrimpf, L. W. Massengill, B. L. Bhuva, B. Narasimham, S. Hatami, A. Anvar, A. Lin, and J. K. Wang, "Temperature dependence of soft-error-rates for FF designs in 20-nm bulk planar and 16-nm bulk FinFET technologies," *IEEE International Reliability Physics Symposium* (submitted)
6. Y. S. Puzyrev, X. Shen, **K. Ni**, C. X. Zhang, J. Hachtel, B. Choi, M. F. Chisholm, D. M. Fleetwood, R. D. Schrimpf, and S. T. Pantelides, "Memristive switching of self-assembled ZnO nanorods," *J. Appl. Phys.* (pending submission)
7. S. Ren, H. Wu, R. Jiang, M. Bhuiyan, **K. Ni**, J. Chen, E. X. Zhang, R. A. Reed, D. M. Fleetwood, P. D. Ye and T. P. Ma, "Total ionizing dose effects in ultra-thin body Ge on insulator (GOI) junctionless CMOSFETs with recessed source/drain and channel," *IEEE, Trans. Nucl. Sci.*, (pending submission)
8. S. Ren, M. Bhuiyan, J. Zhang, M. Si, R. Jiang, **K. Ni**, X. Wan, S. Chang, E. X. Zhang, R. A. Reed, D. M. Fleetwood, P. D. Ye, and T. P. Ma, "Total ionizing dose effects in GaAs MOSFETs with La based epitaxial gate dielectrics," *IEEE, Trans. Nucl. Sci.*, (pending submission)
9. C. Claeys, E. Simoen, G. Eneman, **K. Ni**, A. Hikavyy, R. Loo, S. Gupta, C. Merckling, A. Alian, and M. Caymax, "Review-device assessment of electrically active defects in high-mobility materials," *ECS J. Solid State Sci. Technol.* Vol. 5, pp. 3149-3165, 2016
10. T. R. Assis, **K. Ni**, J. S. Kauppila, B. L. Bhuva, R. D. Schrimpf, L. W. Massengill, S. J. Wen, R. Wong, and C. Slayman, "Estimation of single-event induced collected charge for multiple transistors using analytical expressions," *IEEE, Trans. Nucl. Sci.*, Vol. 62, no. 6, pp. 2853-2859, Dec. 2015

11. S. Ren, M. W. Si, **K. Ni**, X. Wan, J. Chen, S. Chang, X. Sun, E. X. Zhang, R. A. Reed, D. M. Fleetwood, P. D. Ye, S. Cui, and T. P. Ma, "Total ionizing dose effect in extremely scaled ultra-thin channel nanowire gate all around InGaAs MOSFETs," *IEEE, Trans. Nucl. Sci.*, Vol. 62, no. 6, pp. 2888-2893, Dec. 2015
12. I. K. Samsel, E. X. Zhang, A. L. Sternberg, **K. Ni**, R. A. Reed, D. M. Fleetwood, M. L. Alles, R. D. Schrimpf, D. Linten, J. Mitard, L. Witters, and N. Collaert, "Charge collection mechanisms of Ge-channel bulk pMOSFETs," *IEEE, Trans. Nucl. Sci.*, Vol. 62, no. 6, pp. 2725-2731, Dec. 2015
13. B. Narasimham, S. Hatami, A. Anvar, D. M. Harris, A. Lin, J. K. Wang, I. Chatterjee, **K. Ni**, B. L. Bhuva, R. D. Schrimpf, R. A. Reed, and M. W. McCurdy, "Bias dependence of single-event upsets in 16nm FinFET D-flip-flops," *IEEE, Trans. Nucl. Sci.*, Vol. 62, no. 6, pp. 2578-2584, Dec. 2015
14. E. X. Zhang, I. K. Samsel, N. C. Hooten, W. G. Bennett, E. D. Funkhouser, **K. Ni**, D. R. Ball, M. W. McCurdy, D. M. Fleetwood, R. A. Reed, M. L. Alles, R. D. Schrimpf, D. Linten, and J. Mitard, "Heavy-Ion and Laser Induced Charge Collection in SiGe Channel pMOSFETs," *IEEE, Trans. Nucl. Sci.,* Vol. 61, pp. 3187-3192, Dec. 2014

PRESENTATIONS

1. **K. Ni**, G. Eneman, E. Simoen, A. Mocuta, N. Collaert, A. Thean, R. D. Schrimpf, R. A. Reed, and D. M. Fleetwood, "Electrical effects of a single extended defect in MOSFETs," *IMEC Program Technical Week*, Leuven, Belgium, Oct. 2015
2. **K. Ni**, E. X. Zhang, I. K. Samsel, R. D. Schrimpf, R. A. Reed, D. M. Fleetwood, A. L. Sternberg, M. W. McCurdy, S. Ren, T. P. Ma, L. Dong, J. Y. Zhang, and P. D. Ye, "Charge collection mechanisms in GaAs MOSFETs," *IEEE Nuclear Science and Space Radiation Effects Conference*, Boston, MA, July 2015
3. **K. Ni**, E. X. Zhang, N. C. Hooten, W. G. Bennett, M. W. McCurdy, A. L. Sternberg, R. D. Schrimpf, R. A. Reed, D. M. Fleetwood, M. L. Alles, T. W. Kim, J. Lin, and J. A. del Alamo, "Single event transient response of InGaAs MOSFETs," *IEEE Nuclear Science and Space Radiation Effects Conference*, Paris, France, July 2014
4. I. K. Samsel, E. X. Zhang, **K. Ni**, R. A. Reed, R. D. Schrimpf, D. M. Fleetwood, R. A. Weller, M. W. McCurdy, and M. L. Alles, "Physical mechanisms for radiation-induced effects in non-silicon channel CMOS devices," *GOMACTech*, St. Louis, Mo, March 2015 (***best poster award***)

TEACHING EXPERIENCE

Department of Electrical Engineering and Computer Science, Vanderbilt

Teaching assistant on electromagnetics — Fall 2011

Guest lecture on solid state devices (graduate level) — Spring 2016

PROFESSIONAL AFFILIATIONS

Membership

- IEEE Nuclear and Plasma Science Society (NPSS)
- IEEE Electron Devices Society

HONORS AND AWARDS

- Best poster award in the 40th *GOMACTech* conference — 2015
- Vanderbilt tuition scholarship and research assistantship — 2012-present
- Vanderbilt graduate student travel grant — 2014-2015

- USTC excellent graduated students scholarship 2011
- USTC outstanding student scholarship 2010
- Chinese academy of science institute of microsystem and information technology scholarship 2009
- USTC outstanding student scholarship 2008
- USTC outstanding student scholarship for freshmen 2007

REFERENCES

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My advisor and Ph.D. committee chair.

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My co-advisor and Ph.D. committee

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My Ph.D. committee and taught me "Condensed Matter Physics" course