

Sufian Abedrabbo

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EDUCATION

New Jersey Institute of Technology/ Rutgers, Newark, NJ
Doctor of Philosophy in Applied Physics, Aug. 1998
Master of Science in Applied Physics, Oct. 1997
Rutgers/ New Jersey Institute of Technology, Newark, NJ
Bachelor of Art and Science in Applied Physics, May 1993

SUMMARY OF POSITIONS HELD

2002 - PRESENT: Assistant Professor - University of Jordan, Department of Physics
2007-PRESENT: Visiting Research Professor (Summer) - New Jersey Institute of Technology
2006-2009: Advisor - Volunteer (Part time) - CEO of Jordan Investment Board
2001 – 2002: Member of Technical Staff - Kirana Networks
2000 – 2001: Member of Technical Staff - JDS Uniphase
1998 - 2000: Senior Engineering Specialist - Kearfott Guidance and Navigations

AWARDS: Recipient of 2008 TMS Electronics, Magnetic & Photonic Division Education Resource Award

GRANTS: Awarded two mid-size grants on Research Topics related to active impurity centers in silicon structures

ACADEMIC EXPERIENCE:

University of Jordan:

9/2002 – Now

- Teaching full load of 12 credits of Undergraduate and Graduate Physics.
 - *Teaching tasks include various Undergraduate level courses from freshman to senior year in Physics and Materials Science; and many Graduate courses at the M.S. and Ph.D level.*
- Principal Investigator on two major grants focusing on Silicon Light Emitting Diodes (Si-LED).
- Performing studies on II-VI, IV, and III-V candidates for successful, efficient, and low cost PV candidates.
- Leading research efforts to include engineered band-gap structures and impurity centers to form up-Conversion to serve enhancing photovoltaic efficiency and expanding bandwidth response.
- Processing Silicon and Rare-Earth Metals structures as LED candidates.
- Forming Silicon on Insulators (Oxides and Nitrides) by Implantation.
- Performing studies on specialty doped glass for multiple applications.
- Performing and processing Si-Ge structures and shallow junctions (Processing and Analyzing) for Photovoltaic Applications.
- Performing various processing and characterization techniques.
- Collaborating with NJIT, Rutgers and Bell Labs and the National Renewable Energy Labs to utilize available capabilities.

Graduate Students Supervision:

Fall 05 – Jun. 08

Thesis Advisor and supervisor of Four M.S. Students, University of Jordan:

- a) Thesis Title: "Opto-Electrical Study of Processed Silicon Thin Films" - Student: Fadi Abu Sa'an.
- b) Thesis Title: "Enhancement of Light Emission from Silicon by Incorporation of Rare-Earth Metals" - Student: Qais Younis.
- c) Thesis Title: "Effect of Adding Ytterbium (Yb) as a Co-Dopant to Erbium (Er) on light Emission Efficiency of Silicon" - Student: Mohammad Jubran.

- d) Thesis Title: "Enhancement of External Quantum Efficiency of Silicon by Addition of Proper Co-Dopants to Erbium in Silicon Matrix" - Student: Asma'a Haddad.
- e) Thesis Title: "Study of Silicon-Germanium Co-Doped with Proper Rare-Earth Metals" – Student: Khalil Al-Bazz.

New Jersey Institute of Technology:

- Visiting Research Professor Summer 2007 - Now
 - Involved in Proposal drafting, research activities and teaching tasks
- Adjunct Professor of Physics/Research Professor, New Jersey Institute of Technology Summer 2006
- Member of Physics Doctoral Thesis Committee Aug. 2008
 - Jesse Appel
- Member of Physics Masters of Science Thesis Committee (4 graduate students) May - Aug. 2002
 - Samrat Gowda
 - Sridhar Madishetty.
 - Vishal R. Mehta.
 - Aravind Balakrishnan.
- Member of Physics Doctoral Thesis Committee May to Dec. - 2001
 - Y. Zhang.
- Adjunct Professor of Physics / Research Professor Spring 1999
 - Physics – III, “Fundamentals of Physics” – Topics Covering Waves and Vibrations.
- Research Assistant, New Jersey Institute of Technology 9/95 - 1998
 - Optical measurements and modeling of electronic materials.
 - MOS processing and device characterization.
 - Hands-on silicon process development in class 10 clean room.
 - Rapid Thermal Processing (RTP) applications to CMOS technology.
 - Dielectric science and technology.
 - Shallow junction formation, silicidation, device characterization.
- Teaching Assistant of Physics, New Jersey Institute of Technology/Rutgers Fall '94 - Spring '96
 - Physics – I & II, “Fundamentals of Physics”.

Advisory – Consulting TASKS:

- Advisor to CEO of Jordan Investment Board (JIB) – Volunteer Amman, Jordan
- ◆ Evaluating various thin-film, and crystalline technologies for potential Photovoltaic devices projects in Jordan
 - ◆ Working with various companies in the Photovoltaic area on fabrication facility project in Jordan
 - ◆ Assisting in investments related to semiconductor and communications
 - ◆ Assisting in preparing an investment map for the country of Jordan
 - ◆ Traveling with CEO of JIB seeking investment collaboration in high technology related areas.

INDUSTRIAL RESEARCH EXPERIENCE:

Member of Technical Staff, Kirana Networks 3/01 - 5/02

- ◆ Lead a team for vendors and devices selection for Kirana’s two All-Optical Cross-Connect, Add/Drop communication systems.
- ◆ Established optical lab at Kirana.
- ◆ Designed testing algorithms at the component and sub-system level.
- ◆ Evaluated and examined different technologies and approaches for various optical components based on technologies including MEMS, polymer based, liquid crystal based, holographic grating, silica-on-silicon, silicon-on-silicon, including all kinds of passive and active optical components.
- ◆ Managing and handling new vendor accounts and products from starting contact point through quotation stage and loaner test, communicating test results and after purchase feedback.
- ◆ Member of Architecture team for two optical systems including but not limited to optical budget.
- ◆ Specifying optical and mechanical specifications of optical components for Kirana’s Products that comply with system requirement document.

Member of Technical Staff, JDS Uniphase

5/00 - 3/01

- ◆ Lead of several Erbium Amplifier testing projects.
- ◆ Performed light-current (LI) curve and VOA at board level and gain, tilt and noise figure (NF) measurement on circuit packs and final products.
- ◆ Generated full test specifications tables for Nortel and Qtera projects in cooperation with optical and production engineers.
- ◆ Involved in early stage studies of Raman amplifiers and four wave mixing effects.
- ◆ Self Studying of Optical Networking (second generation optical networks).

Senior Engineering / Scientist Specialist, Kearfott Guidance and Navigation

8/98 - 2000

- ◆ Plasma source ion implantation (PSII) to improve wear and corrosion resistance.
- ◆ Non-linear behavior of microelectromechanical gyroscopic sensors (MEMS).
- ◆ Failure analysis, device optimization of sensors.
- ◆ Electrical and mechanical evaluation of systems.
- ◆ Evaluation of system capabilities, thermal and mechanical constraints.

SKILLS SUMMARY

Optics: Emissometry of electronic and opto-electronic materials, i.e. Si, GaAs, and dielectrics including SiO₂ and Er₂O₃. Fiber optics, Active and passive optical components characterization.

Advanced Silicon Processing: Single-crystal growth. Crystalline defects. Basics of thin films including electrical and mechanical properties. Rapid Thermal Processing of Si. CVD of amorphous and polycrystalline films. Thermal oxidation of Si. Ion implantation of Si for VLSI lithography. Thin film characterization including general knowledge of XRD, SEM, XPS, SIMS, AES.

VLSI Design and Electronic Devices: Low-power VLSI design. Low voltage process technology. Diodes and bipolar junction transistors. FET transistors and biasing. Amplifiers.

General Physics: General mechanics including torque, Hamiltonian and Lagrangian analysis. Classical electrodynamics including EM boundary value problems, wave theory. Quantum mechanics including Schroedinger and Dirac wave equations. Boundary value problems. Laser theory and fiber optic communications. Solid-state physics including Drude theory of metals, classical and quantum theory of the harmonic crystal.

Compiled and Non-compiled Languages: C++, Pascal, Fortran, MathCad, Excel, some MATLAB and LABVIEW, RBS simulation package (SIMNRA).

COLLABORATORS

SEMATECH, Applied Materials, Lucent Technologies, Steag-AST, Varian Semiconductors, Advanced Micro Devices, Emcore, the National Renewable Energy Labs (NREL), Intel Corp, and NJIT.

PROFESSIONAL AFFILIATIONS

Institute of Electrical and Electronics Engineers [IEEE], Member (1997).

The Minerals, Metals and Materials Society [TMS], Member (1998).

KEY PUBLICATIONS

- [1] "Optical Activity at 1.55 μm in Si:Er:O Deposited Films", S. Abedrabbo, and A.T. Fiory, to be published in DIRASAT (Acceptance – November 16, 2009; Publication – February, 2010).
- [2] "Processing for Optically Active Erbium in Silicon by Film Co-Deposition and Ion-Beam Mixing", S. Abedrabbo, A.T. Fiory, 255 (2009) 4503-4511.
- [3] "*Optically Active Erbium with Co-dopants in Silicon*", S. Abedrabbo, A. Haddad, K. Albath, Q. Younis, A. T. Fiory, and N.M. Ravindra, 2008 March Meeting of the American Physical Society New Orleans, La., March 10-14, 2008, Abstract J35.00012 (meetings.aps.org/Meeting/MAR08).
- [4] "*Characterization of Silicon Doped with Rare-Earth Metals*", S. Abedrabbo, A. Haddad, Q. Mohammed, A. Fiory, and N. Ravindra, 137th Annual Meeting and Exhibition of the Minerals Metals and Materials Society, New Orleans, La., March 9-13, 2008, Technical Program, p. 27 (www.tms.org/annualmeeting.html).
- [5] "Radiative Properties of AlN and Al₂O₃", N.M. Ravindra, S. Shet, V. Dhir, V.K. Challa, S. Abedrabbo and A.T. Fiory, Glass and Optical Materials, Materials Science and Technology (MS&T) 2006: MATERIALS AND SYSTEMS - Volume 1, *Organized by S.W. Martin, A. Jha, and N.M. Ravindra* pp.575-582, Oct. 2006.
- [6] "Processing and Characterization of Nanostructures of Silicon-on-Dielectrics", S. Abedrabbo, D.-E. Arafah, L.S. Wielunski, M. Gharaibeh, and N.M. Ravindra, *TMS Lett.*, Vol. 3, 2, pp. 33-34, 2006.
- [7] "Ion Beam Mixing for Processing of Nanostructure Materials", S. Abedrabbo, D.E. Arafah, O. Gokce, L.S. Wielunski, M. Gharaibeh, O. Celik, and N.M. Ravindra, *Journal Electronic Materials*, pp. 834-839, May, 35, 2006.
- [8] "Ion beam mixing of silicon-germanium thin films", Sufian Abedrabbo, D. -E. Arafah, S. Salem, and N.M. Ravindra, *Journal Electronic Materials*, pp.468-473, May, 34, 5, 2005.
- [9] "Ion beam mixing of silicon-germanium for solar cell applications", S. Abedrabbo, S. Salem, D. Arafah, A. Fiory, B. Sopori and N.M. Ravindra, Thirteenth Workshop on Crystalline Silicon Solar Cell Materials and Processes, Vail, Colorado, August 2003.
- [10] "Emissivity measurement and modeling of silicon related materials: An overview", N.M. Ravindra, B.Sopori, O.H. Gokce, S.X. Cheng, A. Shenoy, L. Jin, S. Abedrabbo, W. Chen and Y. Zhang, *International Journal of Thermophysics*, Vol.22, No.5, September, 2001.
- [11] "Evidence from spectral emissometry for conduction intraband transitions in the intrinsic regime for silicon", S. Abedrabbo, J.C. Hensel, A.T. Fiory and N.M. Ravindra, *Journal of Electronic Materials*, pp. 1390-1393, December, 1999.
- [12] "Emissivity measurements and modeling in silicon – some observations", N.M. Ravindra, B.L. Sopori, S. Abedrabbo, W. Chen, J.C. Hensel and A.T. Fiory, Ninth Workshop on Crystalline Silicon Solar Cell Materials and Processes, pp.213-217, Colorado, August 1999.
- [13] "Rapid thermal magnetic annealing as an emerging technology in field-annealing of thin magnetic films for recording heads", F. Roozeboom, S. Abedrabbo, N.M. Ravindra, H. Walk and M. Falter, *Materials Science in Semiconductor Processing*, Vol.1, No. (3,4), pp.303-315, 1999.
- [14] "Perspectives on emissivity measurements and modeling in silicon", S. Abedrabbo, J.C. Hensel, A.T. Fiory, B.L. Sopori, W. Chen and N.M. Ravindra, *Materials Science in Semiconductor Processing*, pp.187-193, 1998.
- [15] "Wafer emissivity independent temperature measurements", S. Abedrabbo, F.M. Tong, O.H. Gokce, N.M. Ravindra, J. Gelpy, S. Marcus and A.T. Fiory, *Journal of Electronic Materials*, pp.1323-1328, December, 1998.
- [16] "Modeling emissivity of rough and textured silicon wafers", B.L. Sopori, W. Chen, S. Abedrabbo and N.M. Ravindra, *Journal of Electronic Materials*, pp.1341-1346, December, 1998.

- [17] "Radiative properties of SIMOX", N.M. Ravindra, S. Abedrabbo, O.H. Gokce, F.M. Tong, A. Patel, V. Rajasekhar, G. Williamson and W. Maszara, IEEE Transactions on Components, Packaging, and Manufacturing Technology, vol. 21, no.3, pp. 441-449, September, 1998.
- [18] "Perspectives on emissivity measurements and modeling in silicon", S. Abedrabbo, J.C. Hensel, A.T. Fiory, B.L. Sopori, W. Chen and N.M. Ravindra, Materials Science in Semiconductor Processing, pp.187-193, 1998.
- [19] "Issues in emissivity of silicon", S. Abedrabbo, J.C. Hensel, O.H. Gokce, F.M. Tong, B. Sopori, A.T. Fiory and N.M. Ravindra, Material Research Society Proceeding, April, 1998.
- [20] "Temperature dependent emissivity of silicon related materials and structures", N.M. Ravindra, S. Abedrabbo, W. Chen, F.M. Tong, B.L. Sopori, A.K. Nanda and T. Speranza, IEEE Transactions on Semiconductor Manufacturing, vol. 11, no. 1, pp. 30-39, February, 1998.
- [21] "Temperature and wavelength dependent emissivity of SIMOX", N.M. Ravindra, O.H. Gokce, F.M. Tong, S. Abedrabbo, V. Rajasekhar, A. Patel, G. Williamson, W. Maszara, A. Nanda and T. Speranza, Third International Workshop on Thermal Investigation of ICs and Microstructures, pp. 40-42, Cannes "Cote d'Azur", France, September, 1997.
- [22] "Effect of annealing on CVD W-Si-N/SiO₂/Si structures", O.H. Gokce, S. Amin, A. Patel, V. Rajasekhar, S. Abedrabbo and N.M. Ravindra, J.G. Fleming, P.J. Zanzucchi, R.J. Paff and D.J. Szostak, Fifth International Conference on Advanced Thermal Processing of Semiconductors RTP'97, New Orleans, Louisiana, pp. 412-419, September, 1997.
- [23] "Experimental methodology and modeling approaches to emissivity of silicon related materials", S. Abedrabbo, N.M. Ravindra, O.H. Gokce, F.M. Tong, M. Beggans, A. Patel, V. Rajasekhar, D. Pattnaik, A.T. Fiory, B. Nguyenphu, A. Nanda, M. Yam and B. Peuse, Fifth International Conference on Advanced Thermal Processing of Semiconductors RTP'97, New Orleans, Louisiana, September, 1997.
- [24] "Temperature dependent emissivity of non-silicon materials", N.M. Ravindra, O.H. Gokce, F.M. Tong, S. Abedrabbo, S. Amin, A. Patel, V. Rajasekhar, K. Linga, C.S. Wang, I. Ferguson and F. Roozeboom, Fifth International Conference on Advanced Thermal Processing of Semiconductors RTP'97, New Orleans, Louisiana, September, 1997.
- [25] "Radiative properties of silicon", N.M. Ravindra, S. Abedrabbo, W. Chen, F.M. Tong, O.H. Gokce, R. Eby and B.L. Sopori, Seventh workshop on the role of impurities and defects in silicon device processing, Vail, Colorado, August, 1997.
- [26] "Temperature dependent emissivity of multilayers on silicon", S. Abedrabbo, N.M. Ravindra, W. Chen, V. Rajasekhar, T. Golota, O.H. Gokce, A.T. Fiory, B. Nguyenphu, A. Nanda, T. Speranza, W. Maszara and G. Williamson, Material Research Society Proceeding, vol. 470, pp. 69-79, April, 1997.
- [27] "Emissivity studies on polycrystalline silicon and a-Si/SiO₂/Si", W. Chen, M. Oh, S. Abedrabbo, F.M. Tong, W. Schmidt, S. Narayan, B.L. Sopori and N.M. Ravindra, Material Research Society Proceedings, pp. 81-89, April, 1997.
- [28] "Spectral emissometer - A novel diagnostic tool for semiconductor manufacturing", N. M. Ravindra, F.M. Tong, W. Schmidt, W. Chen, S. Abedrabbo, A. Nanda, T. Speranza and A.M. Tello, Fifth International Symposium on Semiconductor Manufacturing ISSM'96, Tokyo, Japan, pp. 101-104, October, 1996.
- [29] "Applications of spectral emissometry to silicon related materials", N. M. Ravindra, F.M. Tong, S. Abedrabbo, W. Chen, A. Schmidt, A. Nanda, T.Speranza and A.M. Tello, Fourth International Conference on Rapid Thermal Processing RTP'96, Boise, Idaho, pp. 190-204, September, 1996.
- [30] "Emissivity measurements of silicon related materials and structures – applications to rapid thermal processing", N.M. Ravindra, F.M. Tong, W. Chen, S. Abedrabbo, W. Schmidt and S. Narayanan, Sixth Workshop on The Role of Impurities and Defects in Silicon Device Processing, Snowmass, Colorado, pp.236-241, August, 1996.