

ARVINDER SINGH CHADHA

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EDUCATION

PhD, Electrical Engineering, University of Texas at Arlington, *Expected Graduation 05/2014*, **GPA: 4.0/4.0**

Thesis Title: Towards perfect light coupling and absorption in nanomembranes with omni-directional anti-reflection and photonic crystal structures

Master of Science, Electrical Engineering, University of Colorado at Boulder, December 2008, **GPA: 3.6/4.0**

Bachelor of Engineering, Electronics Engineering, University of Mumbai, India, May 2006, *Equivalent GPA: 3.5*

Relevant Coursework: Micro Fabrication Laboratory (Semiconductor), Semiconductor Physics and Devices, Electromagnetics, Optics, Optical Properties of Materials and Devices, Nanophotonics, Solid State Physics

ENGINEERING SKILLS

Processes: Electron beam Lithography (*EBL*), Focused Ion Beam (*FIB*), nanoimprint, transfer printing, self assembly using colloidal chemistry, electroplating, electro-etching, oxidation, diffusion, photolithography, sputtering, evaporation, dry/wet etching, spin coating, lift off

Process Equipment: PECVD, DC magnetron-sputtering, deep reactive ion etch (*DRIE*), mask aligner, III-V etcher, e-beam evaporator, thermal evaporator

Measurement Equipment: Scanning electron microscope (*SEM*), Fourier transform infrared spectrometer (*FTIR*), interference microscope, Energy dispersive X-ray spectroscopy (*EDAX*), parametric analyzer, probe station, transmission (visible/NIR) spectrometer, ellipsometer, integrating sphere, oscilloscope.

Software: RSOFT, FDTD, FEMLAB, COMSOL, MEEP, MATLAB, PSPICE, CAD, RCWA, Microsoft Office. Familiarity with C/C++, Verilog/VHDL, LabVIEW, Assembly language.

PATENT AND PUBLICATIONS

- Filed 1 patent (CU3134B, entitled "Micro-Integrated Smart Film") at the University of Colorado at Boulder.
- Published over five papers and reviewed nine papers in peer reviewed journals. Published eight papers in conference proceedings. Three manuscripts for journal publications are in preparation. Please refer to appendix for details.

WORK EXPERIENCE

Research Assistant, NanoFAB Research Center (Class 100 Clean room)

Photonics Device Laboratory, University of Texas at Arlington

08/09 – present

- **Fano Resonance Enhanced Spectrally Selective Metal Semiconductor Metal (MSM) Infrared (IR) Photodetector**
 - Designed dry etch recipes with straight & smooth sidewalls for GaAs/InP/InGaAs using Cl₂/BCl₃ plasma
 - Stacked 40 nm InGaAs nanomembrane (NM) on transfer printed 2D silicon Fano filter on glass substrate
 - Demonstrated absolute absorption of 78% from 40 nm thin InGaAs NM & absorption enhancement of 26
 - Fabricated spectrally selective MSM IR Photodetector with Responsivity enhancement of 3.8 at 1523 nm
 - Designed multi-spectral high quality factor (Q > 1000) filters with near perfect absorption (> 95%)
- **Optical Waveguide Coupler For An Out-Of-Plane Surface Normal To In-Plane Vertical Coupling**
 - Designed a fourth order surface normal vertical to in-plane grating coupler with 88% total coupling efficiency and 3 dB bandwidth of 42 nm
 - Fabricated the fourth order grating coupler via electron beam lithography
 - Measured 20% single side (40% total) coupling efficiency with a 52 nm 3 dB bandwidth
 - Designed grating reflector for dual direction emission from vertical cavity surface emitting laser (VCSEL)
- **Near Perfect Anti-Reflection Coating For Minimizing Front Surface Reflection**
 - Designed nanostructures to provide reflection less than 1.5% for 400 – 850 nm broadband wavelength spectrum with 120° incident cone angles
 - Demonstrated large area nano-imprint pyramid surface texture on commercially available flexible amorphous silicon solar cells. Demonstrated an efficiency enhancement of 7% at surface normal incidence to 22% at 60° incident angle due to effective light trapping
- **Photonic Nanomembrane Reflector To Minimize Back Surface Transmission**
 - Designed an ultra-thin (340 nm) 2D Si NM broadband reflector with a bandwidth of 200 nm
 - Analyzed the dispersion characteristics to study the polarization and angle dependence of the NM reflector
 - Demonstrated polarization independent 180 nm broadband reflection at surface normal incidence
 - Demonstrated high reflectivity at 45° oblique incidence with 30° angular tolerance of an incident beam plane
 - Investigated the size dependence of the 1D grating and 2D photonic crystal reflectors

Professional Research Assistant, Colorado Nanofabrication Lab (Class 100 Clean room)

QUEST Product Development Corporation

01/09 – 09/09

- Developed process for fabricating shape memory alloys, polymers, metals and silicon together
- Studied the electrical and the mechanical properties of thin film silicon on a SOI wafer
- Designed circuitry for the embedded electronics to control the movement of an active catheter
- Designed the layout and extracted MOS parameters of fabricated embedded electronics

Research Assistant, University of Colorado at Boulder**National Institute of Standards and Technology (NIST)**

05/07 – 11/08

- o Modeled and analyzed RF antennas structures using finite element method software FEMLAB
- o Fabricated RF antennas using photolithography, thermal evaporation, lift off and electroplating

Nanophotonics Research Laboratory (Class 100 Clean room)

01/07 – 05/08

- o Synthesized gold nanoshells & silica particles (190 nm – 420 nm) with less than 5% size distribution
- o Synthesized inverse opals (face centered cubic closed packed silica spheres) via polymer infiltration
- o Characterized the size and the optical properties of nano shells, spheres and opals

Research Intern, Indian Institute of Technology at Bombay

03/05 – 03/06

- o Developed a software in C++ for feature extraction & matching of stereo images from satellite platform

TEACHING EXPERIENCE**Teaching Assistant, University of Texas at Arlington**

09/09 – 12/09

- o Supervised laboratory sessions for introductory circuit courses for undergraduate students

Lead Teaching Assistant, University of Colorado at Boulder

05/07 – 05/08

- o Doubled the number of student representatives of Electrical Engineering Department through publicity
- o Increased the participation of the students in the professional & the teaching development workshops

Teaching Assistant, University of Colorado at Boulder

01/07 – 05/07

- o Taught PSPICE and electronic circuits involving semiconductor devices – diodes, transistors, MOS

HONORS AND ACTIVITIES

- **Doctoral Dean's Scholarship (2009 – 2013), STEM Fellowship (2009 – 2014), Travel Grants (2012 – 2014)**
- **Technical Head, Student Chapter IEEE, University of Mumbai (05/05 – 05/06)**
 - o Organized technical seminars, industrial visits and technical competitions
 - o Increased the sponsorship by fifty percent for the technical competitions
- First prize at Mechanical Design Contest and Maximum load carrying structure, Indian Institute of Technology, Mumbai (IIT Mumbai) National Competition, 2003
- Second prize in Industrial Design Workshop (SAE) and Robotics, University of Mumbai, 2003
- Member of IEEE – Eta Kappa Nu, IEEE (2003 – 2006, 2013 – present), Member of OSA(2007 – 2011)

APPENDIX**Published in Journals**

1. W. Zhou, D. Zhao, Y. Shuai, H. Yang, S. Chuwongin, **A. S. Chadha**, J. Sea, K. Wang, V. Liu, Z. Ma and S. Fan, "Progress in photonics crystal Fano resonance photonics", *IEEE Progress in Quantum Electronics*, vol. 38, pp. 1-74, 2014.
2. Y. Shuai, D. Zhao, **A. S. Chadha**, J.-H. Seo, H. Yang, S. Fan, Z. Ma, and W. Zhou, "Coupled double-layer Fano resonance photonic crystal filters with lattice-displacement," *Applied Physics Letters*, vol. 103, pp. 241106, 2013.
3. **A. S. Chadha**, D. Zhao, S. Chuwongin, Z. Ma and W. Zhou, "Polarization- and angle-dependent characteristics in two dimensional photonic crystal membrane reflectors", *Applied Physics Letters*, vol. 103, pp. 211107, 2013.
4. R. D. McCormick, E. D. Cline, **A. S. Chadha**, W. Zhou, and A. D. Stiff-Roberts, "Tuning the Refractive Index of Homopolymer Blends by Controlling Nanoscale Domain Size via RIR-MAPLE Deposition," *Macromolecular Chemistry and Physics*, 2013.
5. J. Wang, Y.-J. Lee, **A. S. Chadha**, J. Yi, M. L. Jespersen, J. J. Kelley, H. M. Nguyen, M. Nimmo, A. V. Malko, R. A. Vaia, W. Zhou, J. W. P. Hsu, "Effect of Plasmonic Au Nanoparticles on Inverted Organic Solar Cell Performance", *Journal of Physical Chemistry C*, vol. 117, pp. 85-91, 2012.

Conference Proceedings

6. **A. S. Chadha**, D. Zhao, and W. Zhou, "An all dielectric broadband high transmission efficiency circular polarizer", Proceedings of SPIE, Photonics West, San Francisco, CA, Feb. 1 – 6, 2014.
7. **A. S. Chadha**, Y. Shuai, and W. Zhou, "Higher order grating coupler for high efficiency vertical to in-plane coupling", Proceedings of SPIE, Photonics West, San Francisco, CA, Feb. 1 – 6, 2014.
8. **A. S. Chadha**, and W. Zhou, "Inverted pyramid nanoimprint based efficiency enhanced flexible solar cell", University of Texas at Arlington Research Institute (UTARI), December 3, 2012.
9. **A. S. Chadha**, W. Zhou and E. D. Cline, "Design Criteria to Optimize the Near Perfect Anti-Reflection Coating", IEEE Photovoltaic Specialists Conference, Austin, TX, June 3-8, 2012.
10. **A. S. Chadha**, E. D. Cline, M. Tao and W. Zhou, "Large area imprinted surface textures for omnidirectional conformal AR Coatings on flexible amorphous silicon solar cells" IEEE Photovoltaic Specialists Conference, Austin, TX, June 3-8, 2012.
11. R. D. McCormick, A. D. Stiff-Roberts, E. D. Cline, **A. S. Chadha** and W. Zhou, "Tuning the refractive index of blended polymer films by RIR-MAPLE deposition", Proceedings of SPIE, San Francisco, CA, January 21-26, 2012.
12. **A.S. Chadha**, W. Yang, T. K. Saha, S. Chuwongin, Y. Shuai, W. Zhou, Z. Ma, and G. J. Brown, "Spectral selective absorption enhancement from stacked ultra-thin InGaAs/Si Fano resonance membranes", Proceedings of SPIE, Photonics West, San Francisco, CA, January 21-26, 2012.
13. **A.S. Chadha** and W. Park, "Metamaterial based RF antennas", Integrated Micro/Nano-Electromechanical Transducers, iMINT, Boulder, CO, March'08.

Manuscripts in Preparation

14. **A. S. Chadha**, S. Chuwongin, G. J. Brown, Z. Ma, and W. Zhou, "Fano resonance enhanced photonic crystal infrared photodetectors based on transfer printed InGaAs/Si nanomembranes, to be submitted at *Applied Physics Letters*
15. **A. S. Chadha**, Y. Shuai, and W. Zhou, "High performance fourth order surface normal vertical to in-plane optical coupler", to be submitted at *IEEE Photonics Technology Letters*
16. **A. S. Chadha**, Y. Shuai, D. Zhao and W. Zhou, "Fano resonance field induced absorption enhancement and spectrally selective photodetectors", to be submitted at *IEEE Journal of Quantum Electronics*