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EDUCATION

- Ph.D. in Physics**, University of Massachusetts, Lowell, MA. **2007**
Dissertation: "Surface Preparation of GaSb and InSb for MBE Growth & Development of Sb alloys based devices"
- M.S. in Physics**, University of Massachusetts, Lowell, MA. **2005**
Dissertation: "Br-IBAE of GaSb substrates for MBE Growth"
- M.Sc. in Physics**, Osmania University, Hyderabad, India. **1998**
Specialization: Materials Science

RESEARCH EXPERIENCE

Post-Doctoral Research Fellow **01/2008-present**
Photonics Center, University of Massachusetts, Lowell

MBE growth and characterization of Sb alloy based heterostructures for the development of infrared photodetectors

Co-Investigator, Sponsor: Air Force Research Labs/RYHC, Hanscom AFB

The major goal of the proposed work is to demonstrate Sb alloy based photodetectors in the 1.7-4.5 μm range by 1) developing various MBE growth schemes for the InAsSb/InGaAsSb/AlGaAsSb heterostructures grown lattice matched to GaSb substrates 2) establishing process technologies and 3) establishing the appropriate device characterization techniques.

THz quantum cascade lasers

Lead Research Fellow, Sponsor: US ARMY National Ground Intelligent Center (in Collaboration with Sub-millimeter Wave Technology Labs, UMass Lowell)

The goal is to perform the epitaxial growth of various THz single mode QCLs based on either bound-to-continuum or resonant-phonon designs. These devices would be used to develop a QCL local oscillator (LO).

MBE growth of $\text{In}_{2-x}\text{CrO}_3$ metamaterials

Sponsor: NSF (in Collaboration with Dept. of EE of UMass Lowell)

Establish growth schemes for InO_x and Cr-doped In_2O_3 using recently converted oxygen plasma assisted MBE for developing metamaterials based on magnetic semiconductors for THz frequency regime. Evaluate and refine the epitaxial growth process.

Ultra-low doped GaSb material evaluation to extend the infrared transmission capability for VLWIR sensor applications

Lead Research Fellow, Sponsor: The Missile Defense Agency (in Collaboration with Galaxy Compound Semiconductors, Inc. Spokane, Washington)

Low doped GaSb substrates will be characterized for doping levels, mobilities (Hall Method), and band edge properties using FTIR transmission and reflection measurements. GaSb substrates will then be evaluated for epitaxial growth and subsequent infrared device fabrication.

Characterization of InSb substrates for affordable large format mid-IR imagers

Lead Research Fellow, Sponsor: Air Force Research Labs, Hanscom AFB (in Collaboration with Galaxy Compound Semiconductors, Inc. Spokane, Washington)

InSb epi growth on (100), (111), (100) $\pm 2^\circ$, (111) $\pm 2^\circ$, (111)A, (111)B, possibly (110). ESCA analysis of the Bi particle inclusions on the InSb surfaces. Continue to explore InSb photonic device fabrication.

Research Assistant

09/2002-12/2007

Photonics Center, University of Massachusetts, Lowell

- Development of Sb alloys AlGaAsSb/InGaAsSb based avalanche photodiode structures for long wavelength IR applications
- GaAs/AlGaAs based THz quantum cascade lasers using MBE
- MBE growth and characterization of Sb based alloys (AlGaAsSb, InGaAsSb, and InAsSb) and GaSb p-n and p-i-n diode structures
- Surface preparation and growth of InSb based homoepitaxial structures. Demonstration of final polishing methods for producing “epi-ready” GaSb substrates using ion beam processing.
- Fabrication and characterization of nano and micro structures in GaSb, GaAs, and InAs produced with Br-IBAE and MBE.
- Developed photolithographic techniques and etching techniques to fabricate MEM type microbeams on semi conducting materials

SKILLS

- MBE Growth of quantum cascade lasers, complex oxides, quantum dots, Sb-based quaternary alloys; Custodian of Riber 2300 Oxide MBE and Riber 32 & Veeco Gen-II MBE systems. Maintenance includes installation of new components, source replacement, leak-checking, baking, and sample preparation. In situ RHEED monitoring and RGA analysis.
- X-ray photoelectron spectroscopy of oxides/III-V compounds and Casa XPS analysis; Ellipsometry.
- XRD and PL measurements for epitaxial material characterization.
- Hands-on experience with JEOL field emission scanning electron microscopy, DI Nanoscope atomic force microscopy, and Topcon EM 002B transmission electron microscopy.
- Comsol Multiphysics and NI Labview programming ability; Silvaco ATLAS device modeling suite.

- Device processing techniques including but not limited to: photolithography, e-beam evaporation, wet/dry etching, oxide deposition.

TEACHING EXPERIENCE

- University of Massachusetts Lowell, MA
Adjunct Faculty, Dept. of Physics and Applied Physics **09/2008 - Present**
- University of Massachusetts, Lowell, MA
Teaching Assistant, Dept. of Physics **09/2001- 05/2003**
- Chaitanya Bharathi Institute of Technology, Hyderabad, India
Assistant Professor, Dept. of Physics **01/1999 – 07/2001**

FUNDING

1. Co-Investigator, “MBE growth and characterization of Sb alloy based heterostructures for the development of infrared photodetectors”. Funded by AFRL/SNHC Hanscom AFB, FY 2008-2010
2. Co-investigator for “Acquisition of a Versatile High-Resolution X-Ray Diffractometer”, Proposal submitted to AFOSR DURIP Grant (FY2009), Approval denied
3. Instrumental in securing AFOSR DURIP (FY2007) award for approximately \$110K for Sb₂ valved cracker and atomic hydrogen source package

AWARDS

- Outstanding Graduate Student, Department of Physics, University of Massachusetts, Lowell, 2006.
- Division of Sciences Graduate Research Scholar Award, College of Arts and Sciences, University of Massachusetts, Lowell, 2005 and 2004.

OTHER

- Reviewer for JVST-B, Journal of Crystal Growth, and MRS.

PUBLICATIONS

1. V. Mathur, **S.R. Vangala**, X. Qian, W.D. Goodhue, B. Haji-Saeed, J. Khoury, “All optically driven MEMS deformable mirrors via direct cascading with wafer bonded GaAs/GaP PIN photodetectors,” Proceedings of IEEE Photonics Society - Optical MEMs and Nanophotonics, 2009.
2. P. Flint, L.P. Allen, G. Dallas, D. Bakken, K. Blanchet, **S.R. Vangala**, W.D. Goodhue, D. Bliss, H. Dauplaise, “CMP process comparison for 150mm larger area InSb (111)B focal plane array substrates” Proceedings of SPIE-Europe, Optical Materials in Defense Systems Technology, **7487** (2009).
3. X. Qian, **S.R. Vangala**, K. Termkoa, D. Wasserman, and W.D. Goodhue, “Enhanced optical emission from encapsulated nanosphere lithographic InGaAS quantum dots using GaAs mass transport”, Proceeding of NAMBE 2009 (*to be published in Journal of Vacuum Science and Technology B*).
4. B. Passmore, D. Allen, E.A. Shaner, **S. R. Vangala**, W.D. Goodhue, and D. Wasserman, “Doping tunable mid-infrared extraordinary transmission of InSb”, Optics Express, **17(12)**, 10223 (2009).

5. L.P. Allen, P. Flint, G. Dallas, D. Bakken, K. Blanchet, G.J. Brown, **S.R. Vangala**, W.D. Goodhue, K. Krishnaswami, "GaSb substrates with extended IR wavelength for advanced space based applications," Proceedings of SPIE, Infrared Technology and Applications, **7298** (2009).
6. K. Krishnaswami, **S.R. Vangala**, H. Dauplaise, L.P. Allen, G. Dallas, D. Bakken, D. Bliss, G. Dallas, D. Bakken, K.S. Jones, and W. D. Goodhue, "Molecular beam epitaxy on gas cluster ion beam prepared GaSb substrates: towards improved surfaces and interfaces," Journal of Crystal Growth, **310**, 1619 (2008).
7. **S.R. Vangala**, H. Dauplaise, C. Santeufemio, C. Lynch, P. Alcorn, L.P. Allen, G. Dallas, K. Vaccaro, D. Bliss, and W.D. Goodhue, "Atomic hydrogen cleaning of epi-ready InSb (100), (111)B, and GCIB processed InSb (111)B surfaces," Digest of papers, International Conference on Compound Semiconductor Manufacturing Technology, 113 (2007).
8. L.P. Allen, G. Dallas, K. Blanchet, **S.R. Vangala**, C. Santeufemio, W.D. Goodhue, E. Roehl, C.E. Jones, J. Barton, B. Zide, V. Difilippo, K.S. Jones, "Successful MWIR FPA fabrication using gas cluster ion beam InSb surface finishing," Proceedings of SPIE, **6542**, Infrared Technology and Applications XXXIII, 65423P (2007).
9. J. Li, X. Qian, W. Liu, **S. R. Vangala**, W. D. Goodhue, A. A. Danylov, J. Waldman, R. H. Giles, and K. J. Linden, "2.4-2.5 THz Quantum Cascade Lasers Obtained by Tuning the Thicknesses of a Structure Emitting at 2.9 THz", 20th Annual Meeting of the IEEE Laser and Electro-Optics Society, 860 (2007).
10. R. Bhatia, M. Grzesik, **S.R. Vangala**, K. Vaccaro, W. Goodhue, and C. Armiento, "Avalanche photodetector design for the mid-infrared using GaSb-based alloys," PIERS Proceedings, 2102 (2007).
11. **S.R. Vangala** et al., "MBE growth and morphological studies of homoepitaxial layers on CMP processed InSb(111)B and InSb(100) substrates," Journal of Vacuum Science and Technology B, **24**(3), 1634 (2006).
12. **S.R. Vangala** et al., "HBr-based gas cluster ion beam smoothing as a final polish for the production of MBE-epi-ready GaSb wafers," Digest of papers, International Conference on Compound Semiconductor Manufacturing Technology, New Orleans, R14.4 (2005).
13. K. Krishnaswami, D.B. Fenner, **S.R. Vangala**, C. Santeufemio, M. Grzesik, L.P. Allen, G. Dallas, and W.D. Goodhue, "Roughness analysis of episurfaces grown on ion-beam processed GaSb wafers," Materials Research Society Symposium Proceedings, **829**, B6.3.1 (2005).
14. K. Krishnaswami, **S.R. Vangala**, et al., "Epitaxial growth on gas cluster ion beam processed GaSb substrates using molecular beam epitaxy," Journal of Vacuum Science and Technology B, **22** (3), 1455 (2004).
15. **S.R. Vangala** et al., "Preparation and patterning of GaSb surfaces with Br-IBAE for antimonide based molecular beam epitaxy," Materials Research Society Symposium Proceedings, **792**, R.9.2.1 (2004).

16. B. Krejca, **S.R. Vangala**, K. Krishnaswami, R. Kolluru, M.C. Ospina, C. Sung, W.D. Goodhue, "Fabrication of Nanotips and Microbeams in Antimonide Based Semiconductor Material using Bromine Ion Beam Assisted Etching," Materials Research Society Symposium Proceedings, **792**, R.7.7.1 (2004).
17. K. Krishnaswami, **S.R. Vangala**, B. Krejca, L.P. Allen, C. Santeufemio, H. Dauplaise, X. Liu, J. Whitten, M. Ospina, C. Sung, D. Bliss, and W.D. Goodhue, "Gas Cluster ion Beam Processing of GaSb and InSb Surfaces," Materials Research Society Symposium Proceedings, **792**, R.10.7.1 (2004).
18. K. Krishnaswami, B. Krejca, **S.R. Vangala**, M. Ospina, C. Sung, L.P. Allen, C. Santeufemio, K. Vaccaro, and W.D. Goodhue, "Determination of nano and sub-nano fluctuations in surface oxides of GaSb with Br-IBAE," Materials Research Society Symposium Proceedings, **786**, E.3.20.1 (2004).
19. M. Ospina, **S.R. Vangala**, D. Yang, J. A. Sherwood, C. Sung, and W.D. Goodhue, "Micromechanical Characterization of GaSb by Microbeam Deflection and using Nanoprobe and Finite Element Analysis," Materials Research Society Symposium Proceedings, **782**, A.5.14 (2004).

PRESENTATIONS (selected)

1. **S.R. Vangala** et al., "Performance of off-axis MBE grown THz QCLs" North American Molecular Beam Epitaxy Conference, Princeton, Aug 2009.
2. **S.R. Vangala** et al., "GaSb and InSb substrate and substrate/interface issues from an MBE perspective," The 15th International Conference on Crystal Growth, Salt Lake City, August 2007.
3. **S.R. Vangala** et al., "Atomic hydrogen cleaning of epi-ready InSb (100), (111)B, and GCIB processed InSb (111)B surfaces," International Conference on Compound Semiconductor Manufacturing Technology, Austin, May 2007.
4. **S.R. Vangala** et al., "MBE growth and morphological studies of homoepitaxial layers on CMP processed InSb(111)B and InSb(100) substrates," North American Molecular Beam Epitaxy Conference, Santa Barbara, November 2005.
5. **S.R. Vangala** et al., "HBr-based gas cluster ion beam smoothing as a final polish for the production of MBE-epi-ready GaSb wafers," International Conference on Compound Semiconductor Manufacturing Technology, New Orleans, April 2005.
6. **S.R. Vangala** et al., "Preparation and patterning of GaSb surfaces with Br-IBAE for antimonide based molecular beam epitaxy," Materials Research Society Fall Meeting, Session R, Nov 2003.