

Dr. Sanjeev Kumar Gupta



Contact Address:

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My Strength:

- Self Confidence
- Positive approach
- Analytical approach in problem solving
- Strive to keep abreast with the latest knowledge of subjects
- Good team spirit

Area of Interest:

- Fabrication and simulation high power devices
- Wide band gap semiconductors
- MEMS Technology
- Nano-electronics devices
- Epitaxial Graphene

Major Achievement:

Fabrication of 4H-SiC Schottky Diode detector-first in country

Personal Data:

Date of Birth : 29-08-1982
Sex : Male
Nationality : Indian
Marital Status : Single
Languages Known : English, Hindi

Objective

Looking for an opportunity to work as a Post Doctorate Fellow/Research Associate in the field of Nanoscaled semiconductor devices thereby contributing to the latest developments in Science and Technology.

Profile

- Working as **Research Associate**, awarded by Council of Scientific and Industrial Research (CSIR) Government of India at Sensors and Nano-Technology Group, Central Electronics Engineering Research Institute (CEERI), Pilani, India.
- Good knowledge of Silicon, Silicon Carbide (SiC) and MEMS technology.

Educational Qualification

- Ph.D. in Applied Physics (2010) on "A study of oxidation mechanism in 4H-SiC for Schottky diode fabrication" from A.M.U. Aligarh/ CEERI, Pilani, India.
- M.Sc in Physics (2004) from D.D.U. Gorakhpur University, Gorakhpur, India.
- B.Sc in Physics (2002) from D.D.U. Gorakhpur University, Gorakhpur, India.

Work Experience

- Working as Research Associate April 2011 to date at CEERI, Pilani.
- Worked as a Research Fellow from May 2006 to April 2011 at CEERI, Pilani.
- Worked as Project Assistant from August 2005-October 2006 at CEERI, Pilani.

Fellowships awarded

- CSIR- Research Associate (RA) awarded by CSIR.
- CSIR- Senior Research Fellowship (SRF) awarded by CSIR.
- UGC- University Research Fellowship (URF) of AMU awarded by UGC.

Fabrication Skills

- Thermal oxidation, Diffusion, Ion implantation, Photolithography, LPCVD, PECVD, APCVD, Thermal annealing, Reactive Ion Etching, Anisotropic etching using KOH/TMAH, Metallization, Wire Bonding, Packaging and Characterization.
- Layout Design, Simulation and modeling.
- Good command on handling and maintenance of fabrication Equipments and systems.

Computational Skills

Design/Simulation Tools : SILVACO (Atlas, Athena), L-Edit and ANSYS
Computational Tools : LabVIEW, Origin
Language : C, C++ (Limited Exposure)

Handling capability of Equipments/Systems

- Varian's e-Beam evaporation unit
- Thermco's Oxidation furnace
- MA-56 Mask aligner and spin coater
- Talyer Hobson's Talytstep
- West Bond's ball to wedge wire bonder
- Keithely's 236 and 238 source meter unit
- Agilent 4284A LCR meter and HP 4140B pA meter/DC voltage source

Projects/Research Experience

1. Design and fabrication of 4H-SiC Schottky diode detector.

Duration : 2 year (August 2005-July 2007)

Role : Project Assistant/Research Fellow

Description : Involved in design, fabrication and characterization of 4H-SiC Schottky barrier diode detector. 4H-SiC Schottky diode array of varying area equipped with field plate and guard ring edge terminations, has been designed and fabricated to achieve breakdown voltage beyond 800 volts and reverse leakage currents in the range of pA.

Silent features : (I) The vacuum annealed thermal oxide with capping of thick PECVD oxide has been finally adopted as a field plate edge termination and Ni metal has been used as field ring in this novel processing.
(II) Breakdown voltage, reverse leakage current, ideality factor, Schottky barrier height was found to >800V, 1-5 nA at -200V, 1.21 and 1.4 eV respectively.

Responsibilities:

- Layout design and simulation
- Device fabrication
- Characterization

2. Oxidation mechanism in 4H-SiC for Schottky diode fabrication.

Duration : 4 Year (November 2006-September 2010)

Role : Research Fellow

Description : Working as research fellow to enhance the technological aspect of thermal oxidation mechanism in Silicon carbide (SiC) for device applications.

Silent features : (I) Exploration of recent research issues on thermal oxidation growth kinetics on both faces (Si and C-face) of 4H-SiC.
(II) Studies of current conduction mechanisms through grown thermal oxide on Si-face of 4H-SiC.
(III) Characterization of Metal-Oxide-Silicon carbide (MOSiC) structures of different oxide thickness.
(IV) Studies on the effect of post oxidation annealing, temperature and photonic light illumination on electrical behavior of grown oxide on Si-face of 4H-SiC.
(V) A novel thermal oxidation models have been proposed on the basis of experimental results
(VI) A novel experimental approach has been used to explain the removal of C-oxides during the thermal oxidation of 4H-SiC.
(VII) Finally, an optimized oxidation method has been implemented in the realization of High breakdown, low leakage 4H-SiC Schottky barrier diode for high temperature applications.

Responsibilities:

- Theoretical modeling and simulation
- Device fabrication
- Characterization

3. Development of SiC based Hydrogen sensors for high temperature and harsh environment applications.

Duration : On-going

Role : Research Associate

Description : Working as research associate to fabricate a highly sensitive Silicon carbide (SiC) based nanostructured Hydrogen sensors for clean energy applications.

Silent features : (I) Pd nanoparticle is being used for Hydrogen sensing on SiC thin layer .
(II) Porous pd nano structure is being used to enhance the sensitivity of Hydrogen sensors.
(III) Pd Schottky and Pd Metal-oxide-Silicon carbide (MOSiC) structure is being used to demonstrate Hydrogen sensors for high temperature and harsh environment applications.

Responsibilities:

- Simulation and theoretical modeling
- Device fabrication
- Characterization

4. Design and fabrication of Si Schottky diodes.

Duration : 6 month (August 2005-February 2006)

Role : Project Assistant

Description : Involved in design, fabrication and characterization of Si Schottky barrier diode in order to optimize the process step for 4H-SiC Schottky diode fabrication.

Silent features : (I) Number of metals like Au, Cr, Ni, Pt, Ti and NiCr was used for Schottky metal contact.
(II) barrier height and ideality factor of all Schottky metal contact was evaluated experimentally.

Responsibilities:

- Layout design and simulation
- Device fabrication
- Characterization

5. Chemical etching of 4H-SiC .

Duration : 6 month (October 2007-March 2007)

Role : Team Member

Silent features : (I) Molten Potassium Hydroxide (KOH) was used for preferential crystallographic etching at higher temperature (about 480°C to 570°C).

(II) It has been observed that the etch rate depends on the doping and crystallographic orientation of silicon carbide surface.

Responsibilities:

- Device fabrication processing
- Characterization of structures

6. Design and fabrication of piezoresistive pressure sensors using MEMS technology .

Duration : 1 year (August 2005-July 2007)

Role : Team Member

Silent features : A novel wet-etch method has been developed, which provides a uniform etching on the entire silicon wafer irrespective of its size and leads to economize the fabrication process in a batch production environment with improved yield.

Responsibilities:

- Layout design and simulation
- Device fabrication
- Characterization

7. Design and fabrication of Absolute micro pressure sensor using MEMS technology .

Duration : 1 year (August 2008-July 2009)

Role : Team Member

Description : Involved in project to realize the piezoresistive absolute micro pressure sensors using front side lateral etching technology.

Silent features : (I) A sub micrometer thin membrane of silicon nitride and silicon dioxide over an anisotropically etched double cavity in (100) silicon has been fabricated.
(II) PECVD silicon dioxide and Silicon nitride layers of compatible thicknesses followed by thermal annealing in nitrogen ambient at 1,000°C for 30 min, leads to stable membrane formation.
(III) Anisotropic etching of (100) silicon below the membrane through channels on the sides has been used with controlled cavity dimensions.

Responsibilities:

- Layout design and simulation
- Device fabrication
- Characterization

8. Development of e-beam assisted polysilicon thin films for MEMS applications.

Duration : 1 year (May 2010-to date)

Role : Team Member

Description : Involved in project to develop the feasibility of e-Beam assisted Polysilicon film for the fabrication piezoresistive pressure sensors using MEMS Technology.

Silent features : (I) The grain size of Poly-Si was analyzed using Scanning Electron Microscopy (SEM), which found to be around 45-50 nm

- (II) The sheet resistance of deposited film decreases continuously with doping temperature, which itself describes like the conventional polysilicon nature.

Responsibilities:

- Layout design and simulation
- Device fabrication
- Characterization

Peer Reviewed Journal Papers (Published/Accepted)

1. Sanjeev K. Gupta, A. Azam and J. Akhtar "Experimental analysis of I-V and C-V characteristics of Ni/SiO₂/4H-SiC system with varying oxide thickness" *Microelectronics International*, Vol. 27, No. 2, pp. 106-112, 2010.
2. Sanjeev K. Gupta, A. Azam and J. Akhtar "Experimental analysis of current conduction through thermally grown SiO₂ on thick epitaxy 4H-SiC employing Poole-Frenkel mechanism" *PRAMANA-Journal of Physics*, Vol. 74, No. 2, pp 325-330, 2010.
3. Sanjeev K. Gupta, A. Azam and J. Akhtar, "Improved electrical parameters of vacuum annealed Ni/4H-SiC (0001) Schottky barrier diode", to be appear in *Physica B*.
4. Sanjeev Kumar Gupta, Ameer Azam and Jamil Akhtar "Surface topographical analysis of face terminated wet thermal oxidation of 4H-SiC substrate", *International Journal of Chemical Sciences (IJCS)* Vol. 7, No. 3, pp. 1987-1999, 2009.
5. Sanjeev K. Gupta, A. Azam and J. Akhtar "Variation of interface trap level charge density within the bandgap of 4H-SiC with varying oxide thickness)" *PRAMANA-Journal of Physics.*, Vol. 76, No. 1, pp 165-172, 2011.
6. Sanjeev Kumar Gupta, Ameer Azam and Jamil Akhtar "Wet Thermal oxidation of epitaxial 4H-SiC: an experimental process for devices fabrication", *ICFAI University Journal of Science and Technology* Vol. 5 No. 1, pp. 7-15, 2009.
7. Kulwant Singh, Sanjeev Kumar Gupta, Amir Azam and Jamil Akhtar "A wet etch method with improved yield for realizing polysilicon resistors in the batch fabrication of MEMS pressure sensor", *Sensor Review*, Vol. 29 No. 3, pp 260-265, 2009.
8. Sheba Jamil, Sanjeev K. Gupta, K. Anbalagan and J. Akhtar, "E-beam assisted physical vapour deposition (PVD) of polysilicon" to be appeared in *Material Sciences in Semiconductor processing*.
9. N Shashank, Sanjeev K Gupta, Vikram Singh, J Akhtar, K V Madhu, R Damle, "DLTS Study of Annihilation of Oxidation Induced Deep Level Defects in Ni/SiO₂/n-Si MOS Structures", Accepted in *Bulletin of Material science*.
10. N. Shashank, Vikram Singh, Sanjeev K Gupta, K V Madhu, J Akhtar, R Damle, "DLTS and In-situ C-V Analysis of Trap Parameters in Swift 50 MeV Li³⁺ Ion Irradiated Ni/SiO₂/Si MOS Capacitors", Accepted in *Radiation Effects and Defects in Solid*.
11. Monika Poonia, Sumita Choudhari, Sheba Jamil, Sanjeev K. Gupta, Jitendra Singh and J. Akhtar, "Development of polycrystalline diffused piezoresistors using e-beam evaporation method for MEMS applications" *International Journal of Advancements in Technology*, Vol 2, No. 1, pp. 108-116, 2011.

Invited Book Chapter

12. Sanjeev Kumar Gupta and Jamil Akhtar, "Thermal oxidation of Silicon Carbide (SiC); experimentally observed fact", accepted for the publication in book entitled "Silicon Carbide" ISBN: 978-953-307-348-4 (Intech open access publisher), 2011.

Journal Papers (Submitted)

13. Sanjeev K. Gupta, A. Azam and J. Akhtar "Effect of post oxidation annealing on electrical characteristics of Ni/SiO₂/4H-SiC capacitor with varying oxide thickness" Submitted to *J of Semiconductor* (Springer Publication).

Journal Papers (to be submitted)

14. Sanjeev K. Gupta, A. Azam and J. Akhtar "Experimental evidence of removal of carbon-oxides during the thermal oxidation of 4H-SiC" In preparation for *International Journal*.
15. Sanjeev K. Gupta, Nirmal Pradhan, J. Akhtar and Chandra Shekhar "Design and fabrication of 4H-SiC Schottky diode with field plate and field ring" In preparation for *International Journal*.
16. Sanjeev K. Gupta, A. Azam and J. Akhtar "Frequency dependent electrical characteristics of Ni/SiO₂/4H-SiC MOS Capacitors" In preparation for *International Journal*.

17. Sanjeev K. Gupta, A. Azam, S. Das, R. R. Bhatia, R. N. Soni and J. Akhtar "*Investigation of thermal induced variations in the barrier height of SiO₂/4H-SiC interface*" Presented at International workshop on Physics of Semiconductor Devices (IWPSD-2009), December 15-19, 2009 at JMI, New Delhi.
18. Sanjeev K. Gupta, A. Azam, S. Das, R. R. Bhatia, R. N. Soni and J. Akhtar "*Electrical Characterization thin thermally grown SiO₂ on thick epitaxial 4H-SiC (0001) substrate*" presented at International symposium on Microwave and Optical Technology (ISMOT-2009), December 16-19 at Ashoka Hotel, New Delhi.
19. Sanjeev K. Gupta, A. Azam and J. Akhtar "*Schottky emission across thermally grown SiO₂ in epitaxial 4H-SiC substrate*" presented at International conference on Multi functional Oxide Materials (ICMOM-2009), April 16-18, 2009 at H.P. University, Shimla.
20. Sanjeev K. Gupta, A. Azam and J. Akhtar "*Electrical characterization of thin thermally grown SiO₂ on epitaxial 4H-SiC (0001) substrate with varying oxide thickness*" Presented at International workshop cum conference on Nanoscience and Nanotechnology (AIT NANO-2009), October 12-16, 2009 at Ansal Institute of Technology (AIT), Gurgaon.
21. Sanjeev K. Gupta, A. Azam and J. Akhtar "*Influence of Vacuum annealing on electrical characteristics of Ni/4H-SiC Schottky barrier diode*" Presented at national symposium on Vacuum technology and its application to electronic devices and systems (IVSNS-2009), November 11-13, 2009 at CEERI Pilani, Rajasthan.
22. Sanjeev K. Gupta, A. Azam and J. Akhtar "*Validation of current conduction models in 4H-SiC metal-oxide semiconductor structures*", Presented at National Conference on Application specific trends of electronic devices circuit and systems (ASTECS-2009), February 6-7, 2009, at Lingaya's University, Faridabad.
23. Sanjeev K. Gupta, A. Azam and J. Akhtar "*Study of Fowler-Nordheim tunneling over different thickness of thermally grown SiO₂ in 4H-SiC* ", Presented at National Conference on Semiconductor material and Technology (NCSMT-08), October 16-18, 2008 at Gurukula Kangri Vishwavidyalaya, Haridwar.
24. Sanjeev K. Gupta, A. Azam and J. Akhtar "*Thermal oxidation of 4H-SiC; a morphological study* ", Presented at National Conference on Modern Trends in Electronics and communication system (MTECS-08), March 8-9, 2008 at AMU, Aligarh.
25. Sanjeev Kumar Gupta, Kulwant Singh, Mayank Tripathi, Surajit Das, A.K. Bagchi and J. Akhtar "*Optical Morphology of Si(100) Etched Surface in Aqueous KOH at elevated temperature*" Presented at National conference on Smart material, Structure and system (ISSS-MEMS 2007), November 16-17, 2007, at CEERI-BITS, Pilani.
26. Sanjeev K. Gupta, A. Azam, R. R. Bhatia, R. N. Soni and J. Akhtar "*Determination of wet thermal oxidation rates in 4H-SiC substrate*" presented at National Conference on Electronics Technologies (NCET-2010), April 16-17 at Goa College of Engineering, Goa, India.
27. Sheba Jamil, Sanjeev K. Gupta, Surajit Das and J. Akhtar "*Performance of MEMS pressure sensors based on LPCVD and e-beam deposited polysilicon*" presented at National Conference on Sensors and Actuators: Science to Technology (NCSA-2011), March 11-12 at Central Glass and Ceramic Research Institute (CGCRI), Kolkata, India.
28. Jitendra Singh, Sanjeev K Gupta, Satish Kumar and Jamil Akhtar, "*Ferroelectrics Tunable Microwave Device: Current Status*", Presented at International Conference on Microwaves, Antenna, Propagation and Remote Sensing (ICMARS-2010), December 14-17, 2010 at International Center for Radio Science (ICRS), Jodhpur.
29. Mayank Tripathi, Sanjeev K. Gupta and J. Akhtar "*Anisotropic etching of 4H-SiC in molten KOH* ", Presented at National Conference on Semiconductor material and Technology (NCSMT-08), October 16-18, 2008, Gurukula Kangri Vishwavidyalaya, Haridwar.
30. Shashank N., Sanjeev K. Gupta, Vikram Singh, J Akhtar, R. K. Nahar and R. Damle "*Generation and Annihilation of Process Induced Deep Level Defects in MOS Structures*" presented at National Conference on Electronics Technologies (NCET-2010), April 16-17 at Goa College of Engineering, Goa, India.
31. Jamil Akhtar, Sanjeev Kumar Gupta and Surajit Das "*4H-SiC Schottky diode technology for high temperature and harsh environment applications*" Presented at National conference on advances in sensors for aerospace application, (SENSORS-2007), December 14-15, 2007 at Reseach Center Imarat (RCI), Hyderabad.
32. A. Kumar, Pankaj Agrawal, Sanjeev Kr Gupta, S Das and D Kumar "*Low-roughness Ti/Au ultra films by e-beam evaporation for AFM based Nano-Lithography*" Presented at national symposium on Vacuum technology and its application to electronic devices and systems(IVSNS-2009), November 11-13, 2009 at CEERI, Pilani, Rajasthan.

33. A. Kumar, Pankaj Agrawal, S Das, Sanjeev Kr Gupta and A K sharma "AFM based Nano-patterning process integration micron size features" Presented at International conference on nano science and technology (ICONSAT-2010), February 17-20, 2010 at Indian Institute of Technology (IIT) Mumbai.
34. Sujit Kr Nayak, Anbalagan K., Apoorva Sharma, Sanjeev K. Gupta, Jitendra Singh and J. Akhtar "Fabrication of micro-inductor using MEMS Technology" presented at National Conference on Sensors and Actuators: Science to Technology (NCSA-2011), March 11-12 at Central Glass and Ceramic Research Institute (CGCRI), Kolkata, India.
35. Anjali Kulshreshtha, H. Saha, Ravi Raj Bhatia, Sanjeev K. Gupta and J. Akhtar "Fabrication of MEMS based co-planar micro heater for gas sensors" presented at National Conference on Sensors and Actuators: Science to Technology (NCSA-2011), March 11-12 at Central Glass and Ceramic Research Institute (CGCRI), Kolkata, India.
36. Shashank N, Jayadev, Nagaraj M, Sanjeev Gupta, Akhtar J, Mahesh H M "High frequency and low frequency C-V analysis of ⁶⁰CO-gamma irradiated -P-channel MOSFETs", Presented at National Conference on Application specific trends of electronic devices circuit and systems (ASTECS-09), Febraury 6-7, 2009, at Lingaya's University, Faridabad.
37. S.K.Lamichhane, Nirmal Pradhan, Sanjeev K. Gupta, P.A.Alvi, Satish Kumar, Kuldeep Singh, P.Sen and J.Akhtar "Boron thermal diffusion induced influences in LPCVD Polysilicon films", Presented at National conference Recent Advances in Material Sciences (RAMS-06), September 27-29, 2006 at Kurukshetra University, Kurukshetra.
38. Sapna Gupta, P. A. Alvi, Sumita Rani, S. K. Gupta, and S. Dalela "Alloy concentration variation effect on band structure of GaN/Al_xGa_{1-x}N Multilayer Nano Heterostructure" Presented at International conference on Electroceramics (ICE-2009), December 13-17, 2009 at Delhi University, New Delhi.
39. P.A.Alvi, S.K.Gupta, K.M.Lal and J.Akhtar "Yield degradation due to mask edge-misalignment in the fabrication of micro pressure sensor using front-side etching technology" Presented at National conference on first Indo-US workshop on spectroscopy; future trends in spectroscopy: Application to National security (IUWS-2006), January 9-11,2006 at Dept. of Physics B.H.U. Vanarasi.
40. Monika Poonia, Sumita Choudhari, Sheba Jamil, Anbalagan K, Sanjeev K. Gupta, Jitendra Singh and J. Akhtar " Realization of a novel polycrystalline diffused silicon resistors for MEMS applications", Presented at International Conference on Microwave Antenna and Remote Sensing (ICMARS-2010), December 14-17, 2010 International Center for Radio Science (ICRS), Jodhpur.

References

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