Azher Majid Siddiqui
Lecturer
Department of Physics
Faculty of Natural Sciences
Jamia Millia Islamia (*Central University*),
New Delhi 110 025

Curriculum Vitae*

Full name	:	Azher Majid Siddiqui
Place of birth	:	Hyderabad, India
Nationality	:	Indian
Marital status	:	Married
Native address	:	16-3-986/1 Chanchalguda Hyderabad 500 024 India
Email	:	azherms@jamia-physics.net, azherms@yahoo.com
<u>Current Position</u>	:	Lecturer, Department of Physics, Jamia Millia Islamia, New Delhi.
<u>Previous Positions</u>	:	Research Associate with Dr. D.K. Avasthi Materials Science Group, Nuclear Science Centre, New Delhi.
		Extended SRF/Research Associate with Prof. Anand P Pathak, School of Physics, University of Hyderabad.
		Senior Research Fellow, Council for Scientific and Industrial Research, INDIA.
		Junior Research Fellow, Inter University Consortium for DAE Facilities, INDIA.

*Updated on Friday the 31^{st} December, 2004

CAREER OBJECTIVE:
Faculty Member in Departments of Physics in Universities, Institutes of Technology or Engineering Colleges with research in Accelerator Based Materials Science.

EDUCATION:
B.Sc. Honours(Phys.) - 1988 - Osmania University, Hyderabad
M.Sc.(Phys.) - 1991 - Aligarh Muslim University, Aligarh
M.Phil (Phys.) - 1993 - School of Physics, University of Hyderabad, Hyderabad.
Title of dissertation: **Pion-Muon Channeling in Crystals with Imperfections**
Ph.D - 2000 - School of Physics, University of Hyderabad, Hyderabad.
Under the supervision of Prof Anand P Pathak

Title of Thesis:
Effects of Defects and Strain on Ion Channeling in Solids

Course Work	:	The M.Phil course consisted of a regular course in Classical Mechanics, Quantum Mechanics and Statistical Mechanics. Ph.D and M.Phil are on topics intimately related tied to semiconductors, the back bone of Electronics.
Computer Experience	:	Familiar with varioud softwares on both Windows and Linux platforms.
Language Proficiency	:	Spoken and Written English-Proficient; used as the medium of instruction since kindergarten.
Teaching Experience	:	Optics, Structure of Matter for Undergraduate AND Characterization Tools for the Post-Graduate students apart from laboratory work in Electronics. Enthusiastic about using New Technologies as teaching aids. To this end: preparing the required Lecture Notes and Question Banks, for posting at the Campus Computer Network.
Awards and Honours	:	Invited Lecture at the Young Physicists' Colloquium, Saha Institute of Nuclear Physics, Kolkatta, August 2001 (YPC 2001). Recommended for Theoretical Physics Seminar Circuit (TPSC) to deliver seminar lectures at various TPSC centres in India. Invited Lecture at the *National Seminar on Physics of Materials*, Department of Physics, University of Jammu, Jammu, November 23-24 2004.
Biographical Listing	:	**2000 Outstanding Scientists of the 21st Century** Vol. 1 Edition 1, Page 341 International Biographical Centre, Cambirdge CB2 3QP England.
Secretarial Experience	:	Involved in Organizing several National/International Conferences (21st International Conference on Nuclear Tracks in Solids, 20th International Conference on Atomic Collisions in Solids, 14th National Laser Symposium, etc.)
Editorial Experiences	:	Actively participated in editing the Proceedings of the above confs.

References:

Prof Anand P Pathak
Thesis Supervisor
School of Physics
University of Hyderabad
Hyderabad 500 046
E-Mail: appsp@uohyd.ernet.in

Prof B N Dev
Institute of Physics
Sachhivalaya Marg
Bhubaneswar 751 005
E-Mail: bhupen@iopb.res.in

Dr. D K Avasthi
Nuclear Science Centre
Aruna Asif Ali Marg
New Delhi - 110 067
E-Mail:dka@nsc.ernet.in

Dr. D. Kanjilal
Nuclear Science Centre
Aruna Asif Ali Marg
New Delhi - 110 067
E-Mail:dk@nsc.ernet.in

Research Outline

(For details, please see the PUBLICATIONS list)

Ion channeling is widely used to study the defect densities and their location in crystalline materials; it also allows determination of the strain in epitaxial layered structures. A detailed knowledge of interatomic potentials for such channeled particles is needed for proper understanding and interpretation of various observations in the field of channeling. A model for the description of long-range electron-ion interactions affecting the potentials due to heavy impurities see by external probe particles in otherwise perfect crystals can be derived. The resulting formulation will envisage the modifications in the screening functions. Utilization of the ion channeling for characterizing synthetically modulated structures like semiconductor superlattices is another area of special interest. Strained Layer Superlattices (SLS) have unique electronic and opto-electronic properties and find wide ranging applications in many frontier areas of science and technology. These are layered structures of alternating composition of materials having lattice mismatch ($\sim 0.1\%$ *to* 2.0%) which is accommodated by biaxial (compressive or tensile) strains in the plane of the layers; each layer acquires a perpendicular lattice constant due to strain accommodation. Beyond a critical thickness, the strain in the layers relaxes giving rise to misfit dislocations. The presence of defects deteriorates the performance of these devices and thus it is important to characterize strain and strain-relief mechanisms and also the limits of strained-layer growth in the structures. My thesis work is an effort to address these two problems and hence is divided into two parts; (i) theoretical work on the interatomic potential for a positively charged particle channeled in a crystal with point defects and (ii) characterization of Strained-Layer Superlattices by Ion Channeling in comparison with other characterization techniques like XRD and Raman Spectroscopy. Samples for this experimental work are grown using the OMVPE facility at Tata Institute of Fundamental Research (TIFR), Mumbai, and studied at the Institute of Physics (IoP), Bhubaneswar, Indian Institute of Technology (IIT), Kanpur, Indira Gandhi Centre for Atomic Research (IGCAR), Kalpakkam and Alabama A & M University, Alabama, USA.

Reserach Plans

An ion beam of a given fluence can cause intermixing of atomic layers at the interface, a phenomenon called **Ion Beam Mixing** which has long been recognized as an alternative to high dose ion implantation in various metal-insulator, metal-metal and metal-semiconductor alloys. Ion beam mixing can cause structural changes at the interface in SLS, resulting in a change in the band gap. With a controlled dosage **band gap engineering** or **band gap tuning** of the SLS can be achieved. Swift Heavy Ion beam induced mixing is more suitable for the integration of optoelectronic devices because of the advantage that interface mixing can be confined to a narrow region at the interface as against the lateral straggling effects in low energy ion irradiation.

We have carried out high-energy ion irradiation on SLS and characterized the samples by and ion channeling and high resolution XRD for the strain measurements before and after the irradiation. The basic thrust of this work viz. the growth, characterization and band gap tuning of SLS, is to utilize the advantages of unusual transport, optical and opto-electronic properties.

In parallel, the Ion Beam Induced Amorphization and Re-crystallization is taken up. This is a promising alternative to all the thermal growth methods because it proceeds at temperatures lower than those necessary for thermal processes. Also, the formation of planar defects and microtwins, which are characteristic residual defects after thermal processes, can be avoided. The samples thus irradiated can be characterized by various characterization techniques, like RBS/Channeling or HRXRD. Swift Heavy Ions (*SHI*) are more suitable for improved resolution and sensitivity. The microscopic mechanisms controlling the complex processes of amorphization and re-crystallization are not yet understood. Both the processes depend upon the generation of point defects during irradiation. The physical motivation to take up this study is to envisage these phenomena of amorphization and/or re-crystallization of semiconductors due to SHI irradiation.

List of Publications
A. Refereed Publications

1. **Double Screening Problem in Dechanneling by Point Defects**, Azher M. Siddiqui, V. Harikumar and A.P. Pathak, *Phys. Stat. Sol.* **b**, 185, 77-85, 1994.
2. **Scattering of Pions and Channeled Muons by Impurities in Single Crystals**, Azher M Siddiqui, V. Harikumar, L.N.S. Prakash Goteti and Anand P Pathak, *Modern Physics Letters* (**B**), 10, 745-751, 1996.
3. **Dechanneling by Ionized Point Defects in Solids: Double Screening Effects**, Azher M. Siddiqui, A. Kiran and Anand P. Pathak, *Modern Physics Letters* (**B**), 11, 1231-1239, 1996.
4. **Lattice Strain Measurement of Strained** $In_{0.1}Ga_{0.9}As/GaAs$ **heterostructures by RBS and Channeling**, Azher M. Siddiqui, Anand P. Pathak, B. Sundarvel, Amal K. Das, K. Sekar, B.N. Dev and B.M. Arora, *Nucl. Inst. and Meth.* (**B**), 142, 387-392, 1998.
5. **Quantum Models For Dechanneling By Point Defects And Extended Defects**, Anand P. Pathak, L.N.S. Prakash Goteti and Azher M. Siddiqui, American Institute of Physics (AIP), **475**, 765-768, 1999, Conf. Proc. *CAARI 15.*
6. **Defects and Strain Studies in Semiconductor Multilayers**, Anand P. Pathak, S.V.S. Rao and Azher M. Siddiqui, *Nucl. Inst. and Meth.* (**B**), 161-163, 488-491, 2000.
7. **Ion channeling, High Resolution X-Ray Diffraction and Raman Spectroscopy in Strained Quantum Wells**, Azher M. Siddiqui, S.V.S. N. Rao, Anand P. Pathak, V.N. Kulkarni, R. Keshav Murthy, Eric Williams, Daryush Ila, Claudiu Muntele and B.M. Arora, *Journal of Applied Physics*, 90, 2824-2830, 2001.
8. **Strain Measurements in Multi-layers by Ion Channeling, High Resolution XRD and Raman Spectroscopy**, Azher M. Siddiqui, S.V.S.N. Rao and Anand P. Pathak, American Institute of Physics (AIP), **576**, 476-479, 2001. Conf. Proc. *CAARI 16.*
9. **Ion Beam Studies in Strained Layer Superlattices**, Anand P. Pathak, Azher M . Siddiqui, G.B.V.S. Lakshmi, S.V.S.N. Rao, S.K. Srivastava, S. Ghosh, D. Bhattacharya, D.K. Avasthi, Dipak K. Goswami, P. Satyam B. N. Dev and A. Turos, *Nucl. Inst. and Meth.* (**B**), 193, 319-323, 2002.
10. **Automation of Channeling Experiment for Lattice Strain Measurements Using High Energy Ion Beams**, S.V.S.N. Rao, D.K. Avasthi, E.T. Subramanyam, Kundan Singh, G.B.V.S. Lakshmi, S.A. Khan, Azher M. Siddiqui, A. Tripathi, S.K. Srivastava, Sarvesh Kumar, T. Srinivasan, Umesh Tiwari, S.K. Mehta, R. Muralidharan, R.K. Jain and Anand P. Pathak, American Institute of Physics (AIP), **680**, 94-97, 2003, Conf. Proc. *CAARI 17.*
11. **Ion Beam Studies of Strains/Defects in Semiconductor Multilayers**, Anand P. Pathak, S.V.S.N. Rao, D.K. Avasthi, Azher M. Siddiqui, S.K. Srivastava, F. Eichhorn, R. Groetzschel, N. Schell and A. Turos, American Institute of Physics (AIP), **680**, 593-596, 2003, Conf. Proc. *CAARI 17.*
12. **Electronic Sputtering from Semiconducting HOPG: A Study of Angular Dependence**, A. Tripathi, S.A. Khan, S.K. Srivastava, M. Kumar, S. Kumar, S.V.S.N. Rao, G.B.V.S. Laxmi, N. Bajwa, H.S. Nagaraja, Azher M. Siddiqui, V.K. Mittal, A. Szokefalvi, M. Kurth, A.C. Pandey, D.K. Avasthi, and H.D. Carstanjen, *Nucl. Inst. and Meth.* (**B**), 212, 402-406, 2003.
13. **13.Ion Beam Characterization and Engineering of Strain in Semiconductor Multilayers**, S.V.S.N. Rao, Anand P. Pathak, Azher M. Siddiqui, D.K. Avasthi, Claudiu Muntele, Daryush Ila, B.N. Dev, R. Muralidharan, F. Eichhorn, R. Groetzschel and A. Turos, Nucl. Inst. and Meth. (**B**), 212, 442-450, 2003.
14. **Ion Beam Induced Modification of Lattice Strains in** $\mathbf{In_{0.1}Ga_{0.9}As/GaAs}$ **system**, S.V.S.N. Rao, A.K. Rajam, Anand P. Pathak, Azher M. Siddiqui, D.K. Avasthi, T. Srinivasan, Umesh Tiwari, S.K. Mehta, R. Muralidharan and R.K. Jain, *Nucl. Inst. and Meth.* (**B**), 212, 473-476, 2003.

15. **Development of a Large Area Two Dimensional Position Sensitive $\Delta\mathbf{E}-\mathbf{E}$ Detector Telescope for Materials Analysis**, S.V.S.N. Rao, A. Kothari, G.B.V.S. Lakshmi, A. Tripathi, Azher M. Siddiqui, S.A. Khan, Anand P. Pathak and D.K. Avasthi, *Nucl. Inst. and Meth.* (**B**), 212, 545-550, 2003.
16. **Swift Heavy Ion Induced structural and optical modifications in LiF Thin Films**, M. Kumar, F. Singh, S.A. Khan, V. Baranwal, S. Kumar, D.C. Agarwal, Azher M. Siddiqui, A. Tripathi, A. Gupta, D.K. Avasthi and A.C. Pandey, *Journal of Physics* (**D**): *Appl. Phys.*, 38, 1-5, 2005.
17. Ion Beam Irradiation and Characterization of GaAs Based Hetero-structures, S. Dhamodaran, N. Satish, A.P. Pathak, S.V.S.N. Rao, Azher M. Siddiqui, S.A. Khan, D.K. Avasthi, T. Srinivasan, R. Muralidharan, C. Muntele, D. Ila and D. Emfietzoglou, *Nucl. Inst. and Meth.* (**B**), *In Press*.

B. Review Articles

1. Ion Beam Modifications and Characterization of Semiconductor Heterostructures, Azher M. Siddiqui, S. Dhamodaran, S.V.S. N. Rao, N. Sathish, D.K. Avasthi and Anand P. Pathak, (*In Press*).

C. In Proceedings and Preprints

- **Ion beam mixing in Au/Si system by Nitrogen ions**, D. K. Sarkar, S. Choudhary, Azher M. Siddiqui, S.K. Sinha, P. Magudapathy, K. Sekar, K.G.M. Nair, S. Panchapakesan, N.S. Thampi and K. Krishan, *Emerging trends of thin films Technology and device fabrication*, 27-29 Nov. 1995, Cochin University of Science and Technology, Cochin, India.
- **Development of RBS facility with 2MV Tandem Van de Graff accelerator at IGCAR, Kalpakkam**, S.K. Sinha, D.C. Kothari, P. Magudapathy, S. Panchapakesan, Azher M. Siddiqui and K.G.M. Nair, *The 4th National Seminar of Physics and Technology of Particle Accelerator and their Applications* (PATPAA) 26-29 Nov. 1996, IUC-DAEF, Calcutta, India.
- **Catastrophic Dechanneling Resonance Study of** $In_{0.1}Ga_{0.9}As/GaAs$ **Multilayers**, Azher M. Siddiqui and Anand P. Pathak, *Preprint IC/98/168*, The Abdus Salam International Centre for Theoretical Physics, Trieste, Italy.
- **Characterization of OMVPE Grown Strained-Layer Superlattices by Ion Channeling**, Azher M. Siddiqui, V.N. Kulkarni, Anand P. Pathak and B.M. Arora, *Preprint IC/98/169*, The Abdus Salam International Centre for Theoretical Physics, Trieste, Italy.
- **Swift Heavy Ion Mixing in** $\mathbf{In_{0.12}Ga_{0.88}As/GaAs}$ **Strained Layer Superlattice**, S.V.S. Nageswara Rao, G.V.B.S. Lakshmi, Azher M . Siddiqui, S. Ghosh, S.K. Srivastava, D.K. Avasthi, R.K. Jain, F. Eichhorn and Anand P. Pathak, Proc. *The Forty fourth DAE Solid State Physics Symposium*, (DAE SSPS'2001), 26-30 December 2001, Bhaba Atomic Research Centre, Mumbai, India, Editors: S.L. Chaplot, P.S.R. Krishna and T. Shakuntala, Conference Proceedings No. **44**, 505-506, 2001.

D. Contributed Chapters in Books

- **Channeling and Channeling Radiation in Semiconductor Superlattices**, Anand P. Pathak, Azher M. Siddiqui, L.N.S. Prakash Goteti and V. Harikumar in **Semiconductor Materials and Devices** edited by O.P. Agnihotri and V.K. Jain *Narosa Publishing House, New Delhi*, 241-258, 1998.
- **Ion Channeling in Semiconductor Superlattices**, Azher M. Siddiqui and Anand P. Pathak in **Condensed Matter Physics** edited by Bal Krishna Agrawal and Hari Prakash *Narosa Publishing House, New Delhi*, 89-94 1999.

- **Effects of Defects and Strain on Ion Channeling**, Azher M. Siddiqui, Physics Teachers, **43**, S35, 2001.
- **Theory of Charged Particle Probes to Modern Advanced Materials**, Anand P. Pathak, S.V.S. Nageswara Rao, Azher M. Siddiqui, L.N.S. Prakash Goteti and G.B.V.S. Lakshmi in **Accelerator Based Research in Basic and Applied Sciences** edited by Amit Roy and D.K. Avasthi, *Phoenix Publishing House Pvt. Ltd, New Delhi*, 173-184, 2002.

E. Others...

- **Ion Beam Channeling Studies and Accelerator Programmes in India**, Azher M. Siddiqui and Sameen Ahmed Khan, MRSI Newsletters, Vol. **B 02**, No. 4, 3-5, 2002.

Conference/Workshop/School Attended:

1. Participated in Workshop *Ion Beam Applications With Low Energy Accelerator Facility at MSD, IGCAR*, Particle Irradiation Facility, MSD, Indira Gandhi Centre for Atomic Research, Kalpakkam, 26 February-3 March 1994.
2. Participated in International Conference on *Defects in Condensed Media* (*DCM'95*), Materials Science Division, Indira Gandhi Centre for Atomic Research, Kalpakkam, 20-22 September 1995.
3. Participated in SERC School on *Computational Condensed Matter Physics*, Department of Physics, Himachal Pradesh University, Shimla, 30 October-18 November 1995.
4. Poster Presented at the International Conference on *Frontiers in Materials Modelling and Design* (*MATMOD'96*), Materials Science Division, Indira Gandhi Centre for Atomic Research, Kalpakkam, 20-23 August 1996.
5. Participated in National Conference on *Ion Beams in Materials Research* Department of Physics, University of Poona, Pune, 17-19 February 1997.
6. Participated in SERC School on *Materials for Advanced Research and Technology* (*SMART'97*), Crystal Growth Centre, Anna University, Chennai, 3-17 October 1997.
7. Posters Presented (*Proxy*) at the *15th International Conference on Applications of Accelerators in Research and Industries* (*CAARI'98*), Department of Physics, University of North Texas, Denton, TEXAS, USA, 4-7, November 1998.
8. Poster Presented at the Seminar on *Semiconductor Physics and Devices*, School of Physics, University of Hyderabad, Hyderabad, 5-7 March 1999.
9. Oral Presentation at the Mini-User Workshop on *Interface Engineering using Energetic Heavy Ions*, Department of Physics, Indian Institute of Technology, Kanpur, 3-4 April, 2000.
10. Posters Presented (*Proxy*) at the *16th International Conference on Applications of Accelerators in Research and Industries* (*CAARI'2000*), Department of Physics, University of North Texas, Denton, TEXAS, USA, 1-4 November 2000.
11. Posters Presented (*Proxy*) at the *19th International Conference on Atomic Collisions in Solids* (*ICACS'2001*), Laboratoire des Collisions Atomiques et Moleculaires, Universite Paris Sud, bat, 351, Orsay, France, 29 July-3 August 2001.
12. Invited Lecture at the *Young Physicists' Colloquium, 2001* (*YPC'2001*), Saha Institute of Nuclear Physics, Kolkatta, 23-24 August 2001.
13. Posters Presented at the *44th DAE Solid State Physics Symposium* (*DAE SSPS'2001*), Bhabha Atomic Research Centre, Trombay, Mumbai, 26-30 December, 2001.
14. Oral and Poster Presentation at the *20th International Conference on Atomic Collisions in Solids* (*ICACS'20*), Puri, India, 19-24 January 2003.
15. Participated in *International Workshop on Charged and Neutral Particles Channeling Phenomena*, (*Channeling 2004*), Istituto Nazionale di Fisica Nucleare (INFN) - Laboratori Nazionale di Frascati, Frascati (Roma) Italy, 2-6 November 2004.
16. Invited Lecture at the *National Seminar on Physics of Materials*, Department of Physics, University of Jammu, Jammu, November 23-24 2004.

Memberships of Scientific Societies

- **Indian Physical Society**
  `Life Membership No. LM/0632`
  Indian Association for Cultivation
  of Science Jadavpur
  KOLKATA (CALCUTTA) 700 032

- **Indian Laser Association**
  `Life Membership No. LM/518`
  Laser Research & Development Block-D
  Centre for Advanced Technology (**CAT**)
  INDORE 452 013

- **Indian Physics Association**
  `Life Membership No. DEL/LM/11888`
  Tata Institute of Fundamental Research
  Homi Bhabha Road, Colaba
  MUMBAI (BOMBAY) 400 005

- **Materials Research Society of India**
  `Life Membership No. LMB 160`
  Defence Metallurgical Research Laboratory
  P.O Kanchanbagh
  HYDERABAD 500 258