

Dr. Asif Khan

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Personal Information

Married
U.S. Citizen with DOD Secret Clearance

University Education

Ph.D. Massachusetts Institute of Technology, 1979
M.Sc. University of Karachi (First Rank in the State), 1972
B.Sc. University of Karachi (First Rank in the State), 1970

Professional Experience

2003 – Present *Carolina Distinguished Professor (chaired professorship)*
2001 – 2006 *Chair, Department of Electrical Engineering, University of South Carolina, Columbia, SC*
1997 – Present *Director, Photonics & Microelectronics Lab, Department of Electrical Engineering, University of South Carolina, Columbia, SC*
1997 – 2004 *Distinguished Professor of Engineering (chaired professorship)*
1987 - 1997 *Vice President, Optoelectronics, APA Optics Inc., Blaine, Minnesota*
1985 - 1987 *Product Development/Technical Marketing Manager, Minnesota Manufacturing and Mining Company (3M), Saint Paul, Minnesota*
1979 - 1985 *Senior Principal Research Scientist, Honeywell Research Center, Honeywell, Inc., Minneapolis, Minnesota*
1977 - 1978 *Visiting Scientist, Optics Section, Corporate Research Center, Honeywell, Inc.*
1974 – 1977 *Research Assistant, Physics Department, M. I. T.*
1972 – 1973 *Lecturer, University of Karachi*

Consultant, Rockwell, Northrup Grumman, APA Optics, SET, Inc.

Professional and Honorary Societies

- IEEE Fellow
- Member, Sigma Xi
- Member, Southeastern Center for Electrical Engineering Education (SCEEE)
- Member, American Association for the Advancement of Science (AAAS)
- Member, American Society for Engineering Education (ASEE)
- Member, Electrical and Computer Engineering Department Heads Association (ECEDHA)

- Member, The International Society for Optical Engineering
- Member, Materials Research Society
- Member, U.S. Commission D, International Union of Radio Sciences, 1994 - 1998
- Member, Electrochemical Society member
- Member, American Physical Society
- Listed in *Who's Who in Technology*
- Listed in *Who's Who in the East*

Honors and Awards

- Plenary Speaker, Indo-US Workshop on Visible and Ultraviolet Sources for Solid State Lighting and Water Purification, Chennai, India 2009
- Japanese Journal of Applied Physics Best Paper Award by Japanese Society of Applied Physics for "Room Temperature Stimulated Emission from AlN at 214 nm", JJAP, Vol.45, No. 49, pp. 1286-1288, 2006 2006
- Plenary Speaker, International Symposium on Blue Laser and Light Emitting Diodes (ISBLLED), Montpellier, France 2006
- 2006 IEEE Fellow Award (awarded late 2005) 2005
- Best Research Paper Award for 2004 by Japanese Applied Physics Society for "Continuous Wave Milliwatt Power AlGaIn Light-Emitting Diodes at 280 nm" 2005
- Plenary Speaker, MRS Intl. Workshop on Nitrided Semiconductors, Pittsburgh 2004
- Northrop Grumman Silver Supplier Award for 2003 (awarded 2004) 2004
- DARPA SUVOS Award for Outstanding Performance 2003
- Carolina Distinguished Professor Award 2003
- Plenary Speaker, ICNS-5, Nara, Japan, 2003 2003
- Russell Research Award for Science, Math and Engineering, 2002 2002
- USC College of Engineering Research Award, 2002 2002
- Best Invited Paper – Selected for Publication In Advanced Workshop on "Frontiers in Electronics" (WOFE)-02 Proceedings, "Strain Energy band Engineering approach to AlN/GaN/InN Heterojunction Devices" by Asif Khan, J.W. Yang, G. Simin, R. Gaska, and M.S. Shur, 2002. 2002
- Best Paper – Selected of Publication in WOFE-02 Proceedings, "Low Frequency Noise in Gallium Nitride Field Effect Transistors" by S.L. Rumyanstev, M.S. Shur, R. Gaska, M.E. Levinshstein, M.A. Khan, G. Simin, and J.W. Yang, 2002. 2002
- Plenary Talk at ESCRM, 2000 2000
- Research Citation, "Visible Light Emitting Diodes on Silicon Substrates", *Science Magazine*, 287, pp. 561-562, 2000. 2000
- Best Materials Research Society Poster Award, 1999. 1999
- Commendation for Excellence in Technical Communication, "GaN-AlGaIn Ultraviolet Detectors", *Laser Focus World*, June 1999. 1999
- Member, International Advisory Committee, International Conference on Nitride Semiconductors, (1997 - present). 1997-2003
- Member, Organizing Committee International Workshop on Gallium 1995-2003

- Nitride Materials, (1995 – present).
- Eminent Speaker, University of Virginia, 1995 1995
- Gold Medal, First Rank in State, M.S., 1972 1972
- Gold Medal, First Rank in State, B.Sc., 1970 1970
- Gold Medal, First Rank in State, High School, 1966 1966

Awards Received by Student Advisees

- Outstanding Dissertation Graduate Student Award USC, 2004 Alex Koudymov
- Outstanding Dissertation Graduate Student Award USC, 2003 Xuhong Hu
- Outstanding Thesis Graduate Student Award USC, 2003 Fatima Husna
- Outstanding Graduate Student in Microelectronics, USC, 2002 Ahmad Tarakji
- Outstanding Graduate Student in Electrical Engineering, USC, 2001 Vinod Adivarahan
- Best Graduate Student, College of Engineering and Information Technology, USC, 2000 Vinod Adivarahan

Sponsored Research and Development and Technology Transfer

Dr. Khan also has extensive experience in originating leading edge research in the III-V semiconductor technology area. These innovative concepts form the basis of numerous proposals that he has successfully marketed to various DOD agencies. In the past five years, his research funding has averaged around \$4 Million per year. More than 70 grants and contracts over the years totaling more than \$40 million from National Science Foundation (NSF), Office of Naval Research (ONR), the Defense Advanced Research Project Agency (DARPA), Missile Defense Agency (MDA), Air Force Office of Scientific Research, (AFOSR), Jet Propulsion Laboratory (JPL), National Aeronautics and Space Administration (NASA) Space and Missile Defense Command (SMDC), Central Intelligence Agency (CIA), Rockwell, TRW, Triquint, SET, Inc., and GE. Some of the recent key grants and selected past grants are listed below.

Current Research

- InGaN Based High Power Visible Lasers 2007-2010 \$1.5 M DARPA
- AlGaN Based Deep Ultraviolet Injection Lasers 2006-2010 \$3 M Navy
- High Frequency and High Power Electronics Using High Quality AlN Layers and Substrates 2006-2010 \$2.3 M MDA
- III-Nitride MOSHFET Based Advanced RF Circuit 2005-2008 \$4.3 M USA SMDC

➤ AlGa_N/Ga_N Microsensor 2005-2008 \$60 K JPL

Selected Past Research Grants:

- AlInGa_N MOSDH_FET Based RF Circuits 2003-2006 \$4.3 M USA SMDC
- Deep UV Emitters Based on Quaternary AlInGa_N Multiple Quantum Well Heterostructures 2002-2006 \$1.9 M DARPA
- High Performance Ultraviolet Detectors Based on Quaternary AlInGa_N Layers and Heterojunctions 2001-2004 \$3 M NASA
- WBG_S Epitaxial Materials Development and Scale-up for RF/Microwave –Millimeter Wave Devices 2002-2004 \$825 K DARPA
- Strain Energy Band Engineering in Quaternary AlInGa_N Compounds: Scaled-up Material and Novel Device Development 2000-2003 \$8.1 M MDA
- AlGa_N Thin Film Battery 2000-2001 \$307 K CIA
- Ga_N Transistors 2000-2001 70 K Raytheon
- AlGa_N-SiC Materials & Device 1998-2000 \$4.5 M ONR
- High Field Characterization Nitride Devices 1996-2001 \$819 K USA SMDC
- Ga_N-AlGa_N CCD Detectors 1996-1998 \$900 K Air Force
- X-Band Power Amplifiers 1995-1998 \$2.5 M TRW
- Visible Laser and Detector Devices Based On AlGa_N 1994-1997 \$2.5 M DARPA
- Ga_N-AlGa_N High Temp. Transistors 1994-1995 \$200 K Navy
- AlGa_N Electro-Optic Waveguide Devices 1994-1996 \$850 K Air Force
- Ultraviolet Laser Devices Based on Ga_N 1994-1996 \$750 K Air Force
- AlN Bulk Crystal Growth 1994-1995 \$200 K DARPA
- Junction Based Detectors 1993-1995 \$500 K Air Force
- AlGa_N Materials Development 1993-1996 \$400 K Navy
- Ga_N-AlGa_N FET & HEMT Devices 1993-1995 \$600 K Air Force
- AlGa_N-GaAs Multilayer Devices 1991-1992 \$100 K Army
- AlGa_N High Speed Electronic Devices 1990-1992 \$550 K Navy
- AlGa_N Atomic layer Epitaxy 1989-1991 \$550 K Navy
- AlGa_N based Detectors 1989-1992 \$550 K Air Force
- AlGaAs-GaAs Directional Coupler Devices 1988-1990 \$550 K Army
- AlGaAs/GaAs waveguide modulator 1987-1989 \$550 K Army
- Ga_N Materials Development 1983-1986 \$750 K Air Force
- HgCdTe Nonlinear Optical Devices 1980-1983 \$750 K Air Force

➤ **Research and Development Commercialization**

Dr. Khan has been successful at transitioning the research and development to commercial product. This he was able to do at Honeywell, 3M, and APA Optics. The CD ROM optical recording discs at 3M included an interaction with chemists, material scientists, physicists, and mechanical and optical engineers. Similarly, the high speed modulator development at APA Optics included mechanical, optical and electrical engineers and material scientists. Dr. Khan

has led major interdisciplinary efforts which have had excellent results.

Through the years, Dr. Khan has been a colleague and collaborator of the two scientists at Rensselaer Polytechnic Institute who became involved in transferring technology from their research into a small business, Sensor Electronic Technology, Inc., based in New York. After Dr. Khan established his Photonics/Microelectronics Lab at the University of South Carolina, he worked to convince SET, Inc. to move to SC to be closer in collaborating – Dr. Khan felt South Carolina was ready to move toward being a new Silicon Valley. SET, Inc. did move to Columbia in 2001, thanks to Dr. Khan, and the company has been very successful with Dr. Khan's university research in RF electronics, lighting, and UV sensors being commercialized by SET (please see attached Missile Defense Agency pamphlet entitled "University of South Carolina / Sensor Electronic Technology, Inc"). A number of Dr. Khan's students have found employment with SET, Inc. at jobs in the range of \$60,000 annually. SET, Inc. is now employing 18 people, many of whom are scientists trained at USC.

The following is a brief listing of the commercial products and US patents resulting from Dr. Khan's research:

➤ **Commercial Products**

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|---|----------------|--------|
| • Deep Ultraviolet Light Emitting Diodes | SET, Inc. | (2004) |
| • 2, 3, & 4-inch MOSHFET/MOSDFET wafers | SET, Inc. | (2004) |
| • Ultraviolet Detectors for Flame Safety | Honeywell Inc. | (1984) |
| • CD-ROM and Magneto Optics Discs | 3 M Co. | (1987) |
| • High Speed GaAs/AlGaAs Modulators | APA Optics | (1991) |
| • Visible Blind UV Photovoltaic Detectors | APA Optics | (1994) |

➤ **Patents**

- International Patent Pending: PCT/US2007/087751 "Pulsed selective area lateral epitaxy for growth of III-Nitride materials over non polar and semi-polar substrates"
- International Patent Pending: PCT/US2007/087755 "A novel fabrication technique for high frequency, high power group III nitride electronic devices"
- International Patent Pending: PCT/US2007/086096 "Method and apparatus for growth of III-Nitride semiconductor epitaxial layers"
- International Patent Pending: PCT/US2007/084520 "Selectively doped semi-conductors and methods of making the same"
- U.S. Patent 7,348,606 "Nitride-based heterostructure devices" March 25, 2008
- U.S. Patent 6,878,593, "Metal Oxide Semiconductor Heterostructure Field Effect Transistor," April 12, 2005.
- U.S. Patent 6,764,888, "Method of producing nitride-based heterostructure devices," July 20, 2004.
- U.S. Patent 6,690,042, Metal Oxide Semiconductor Heterostructure Field Effect Transistor, February 10, 2004.
- U.S. Patent 5,278,435, "High Responsivity Gallium Nitride UV Detector," January 1994.

- U.S. Patent 5,296,395, “Method of Making a High Electron Mobility Transistor,” March 1993.
- U.S. Patent 5,192,987, “High Electron Mobility Transistor with GaN/Al_xGa_{1-x}N Heterojunctions,” March 1993.
- U.S. Patent 5,321,713, “Aluminum gallium nitride laser” granted June 1994.
- U.S. Patent 5,182,670, “Narrow band AlGa_xN filter”, granted January 1993.
- U.S. Patent 5,146,465, “Aluminum gallium nitride laser”, September 1992.
- U.S. Patent 4,616,248, “UV photocathode using negative electron affinity in Al_{0.5}Ga_{0.5}N,” October 1986.
- U.S. Patent 4,614,961, “A tunable cut-off UV Detector based on AlGa_xN,” September, 1986.
- U.S. Patent 4,316,147, “Apparatus for determining the composition of HgCdTe and other alloy semiconductors,” February 1982.

➤ Key Research Accomplishments

First Deep UVLED on pulse lateral epitaxy AlN	JJAP 2007
First MOHVPE of AlN	JJAP 2007
First Deep UVLED on MOHVPE AlN	JJAP 2007
First 1.6 KV AlGa _x N/GaN HFET	EDL 2006
First Pulsed lateral epitaxy of AlN	APL 2006
First ultra-high power stable MOSHFET with 20 W/mm Output	El. Lett., July 2005
First deep UV LED based white light source	PSS(c), 2005
First milliwatt power continuous wave 280 nm deep UV LED	JJAP Lett. 2004, APL, 2004
First optically pumped a-plane AlGa _x N based laser	APL, 2004
First 250 nm deep UV LED	APL, 2004
First III Nitride p-channel Field Effect Transistor	EDL, 2002
First sub 300-340 nm deep UV LED	JJAP Lett., 2002
First sub 280 nm deep UV LED	APL, Dec., 2002
First AlGa _x N/InGa _x N/GaN DHFET	JJAP Lett., 2001
First quaternary based deep UV LED (305nm)	JJAP Lett., 2001
First MOSHFET Device in AlGa _x N over SiC	APL, 2000
First MOSHFET Device in AlGa _x N over sapphire	EDL, 1999
First GaN-InGa _x N LED over Silicon	APL, 1999
First Quaternary Barrier InGa _x N LEDs	APL, 2000
First GaN-AlN SIS Junction Detectors	APL, 1995
First High Temperature Vertical Cavity Lasing	Elect. Lett., 1995
First Voltage Controlled Photoconductive Detectors	Elect. Lett., 1995
First GaN High Temp. High Frequency Transistors	APL, 1995
First GaN-AlGa _x N Memory Elements	Elect. Lett., 1995
First GaN pn-Junction Detector	Elect. Lett., 1995
First InGa _x N Vertical Cavity Stimulated Emission	APL, Aug. 1994
First GaN-AlGa _x N Sub-micron Gate Transistor	APL, Nov. 1994
First GaN-AlGa _x N HEMT Transistor	APL, Aug. 1993
First GaN MESFET Transistor	APL, Apr. 1993
First p-GaN Photovoltaic Detector	APL, May 1993
First GaN-AlGa _x N Short Period Superlattice	APL, Dec. 1993

First GaN Photoconductive Detector	APL, Jun. 1992
First GaN Vertical Cavity Stimulated Emission	APL, Apr. 1991
First GaN-AlGaN Multilayer UV Mirrors	APL, May 1991
First AlN Atomic Layer Epitaxy	APL, Nov. 1992
First GaN-AlGaN 2 D Electron Gas	APL, Jun. 1992
First GaN-AlGaN Quantum Wells	APL, Mar. 1990
First GaN Atomic Layer Epitaxy	APL, Apr. 1992
First AlGaN Low Pressure MOCVD	APL, Sep. 1983
First GaN Low Pressure MOCVD	APL, Mar. 1983

Book Chapters

5. “Insulated Gate III-N Heterostructure Field-Effect Transistors”, G. Simin, M. Shur, M. Asif Khan, R. Gaska, *in: GaN-based Materials and Devices, “Selected Topics in Electronics and Systems”*, V.33, Edited by M. S. Shur and R. F. Davis, World Scientific Publishing Co., Singapore, ISBN 981-238-844-3, 2004.
4. “GaN and AlGaN Devices: Field Effect Transistors and Photodetectors “, M. S. Shur and M. A. Khan, *Series Optoelectronic Properties of Semiconductors and Superlattices*, Gordon and Breach Science Publishers, Vol. 7, pp. 47-92, S. Pearton, Editor, 2000.
3. M. S. Shur, A. D. Bykhovski, R. Gaska, and A. Khan, GaN-based Pyroelectronics and Piezoelectronics, in *Handbook of Thin Film Devices, Volume 1: Heterostructures for High Performance Devices*, Edited by Colin E.C. Wood, Handbook edited by Maurice H. Francombe, pp. 299-339, Academic Press, San Diego, 2000.
2. M. S. Shur and M. Asif Khan, GaN and AlGaN Ultraviolet Photodetectors, *Academic Press, Semiconductors and Semimetals*, vol. 57, pp. 407-439, T. Moustakos and J. Pankove, Editors (1998).
1. “GaN Based Field Effect Transistors”, M. S. Shur, A. Khan, *High Temperature Electronics*, ed. M. Willander and H. Hartnagel, Chapman, London, 1996.

Publications

Total refereed journal publications in excess of 300. Total conference presentation and publications in excess of 200.

➤ Publications 2008

349. [“Temperature-Dependent RF Large-Signal Model of GaN-Based MOSHFETs”](#)

Deng, J., Wang, W., Halder, S., Curtice, W. R., Hwang, J. C. M., Adivarahan, V., Khan, M. A., *IEEE Transactions on Microwave Theory and Techniques*, Volume 56, Issue 12, Part 1, Page(s):2709 – 2716, Dec. 2008

348. [“RF large-signal model for SiO₂/AlGa_N/Ga_N MOSHFETs”](#) Deng, J.; Wang, W.; Halder, S.; Curtice, W. R.; Hwang, J. C. M.; Adivarahan, V.; Khan, A.; *Microwave Symposium Digest, 2008 IEEE MTT-S International*, Page(s):1417 – 1420, 15-20 June 2008.
347. [“Vertical conduction strategy cranks up UV LED output power”](#), Asif Khan, *Compound Semiconductor Magazine*, April 1, 2008.
346. [“Present Status of Deep UV Nitride Light Emitters”](#) Krishnan Balakrishnan, Asif Khan, *Materials Science Forum*, Vol. 590, pp. 141-174, 2008.
345. [“Ultraviolet light-emitting diodes based on group three nitrides”](#) Asif Khan, Krishnan Balakrishnan, Tom Katona, *Nature Photonics*, Vol. 2, pp. 77-84, February 2008.
344. [“Double-Recessed High-Frequency AlInGa_N/InGa_N/Ga_N Metal–Oxide Double Heterostructure Field-Effect Transistors”](#) Adivarahan, V., Gaevski, M.E., Islam, M.M., Bin Zhang, Yanqing Deng, Khan, M.A., *IEEE Transactions on Electron Devices*, Volume: 55, Issue: 2, pp. 495-499, Feb. 2008.

➤ **Publications 2005 - 2007**

343. [“Robust 290 nm Emission Light Emitting Diodes over Pulsed Laterally Overgrown AlN”](#) V. Adivarahan, Q. Fareed, M.D.M. Islam, T. Katona, B. Krishnan, and A.Khan, *Japanese Journal of Applied Physics*, Volume 46 (2007) pp. L877-L879.
342. [“Silicon Dioxide-Encapsulated High-Voltage AlGa_N/Ga_N HFETs for Power-Switching Applications”](#), N. Tipirneni, V. Adivarahan, G. Simin, A. Khan, *IEEE Electron Device Letters*, Volume 28, (9), pp. 784-786, Sept. 2007.
341. ["Metal-Organic Hydride Vapor Phase Epitaxy of AlGa₁N Films over Sapphire"](#), Qhalid Fareed, Vinod Adivarahan, Mikhail Gaevski, Thomas Katona, Asif Khan, USC and Jin Mei, Fernando Ponce, ASU, *Japanese Journal of Applied Physics*, Volume 46, No. 31, pp. L752-L754, August 3, 2007.
340. ["Dislocation generation at the coalescence of aluminum nitride lateral epitaxy on shallow-grooved sapphire substrates"](#), J. Mei, F.A. Ponce, R.S. Qhalid Fareed, J.W. Yang, and M. Asif Khan, *Applied Physics Letters*, Volume 90, 221909, May 31, 2007.
339. ["Robust 285 nm Deep UV Light Emitting Diodes over Metal Organic Hydride Vapor Phase Epitaxially Grown AlN/Sapphire Templates"](#), Vinod Adivarahan, Qhalid Fareed, Surendra Srivastava, Thomas Katona, Mikhail Gaevski, and Asif Khan, *Japanese Journal of Applied*

Physics, Volume 46, No. 23, 2007, pp. 537-539 (June).

338. ["Photoluminescence dynamics in highly nonhomogeneously excited GaN"](#), E. Kuokstis, G. Tamulaitis, K. Liu, M.S. Shur, J.W. Li, J. W. Yang, M. Asif Khan, *Applied Physics Letters*, Volume 90, 161920, April 16, 2007.
337. ["Advanced GaN-related devices and materials interactions"](#), Microscopy of Semiconducting Materials XV Conference Proceedings, Cambridge, England, April 2, 2007.
336. ["Selectively doped high-power AlGa_N/InGa_N/Ga_N MOSDHfet"](#), V. Adivarhan, M. Gaevski, A. Koudymov, J. Yang, G. Simin, M. A. Khan, *IEEE Electron Device Letters* 28 (3), 192-194, March 2007.
335. ["Fine Structure of AlN/AlGa_N superlattice grown by pulsed atomic-layer epitaxy for dislocation filtering"](#), W. H. Sun, J. P. Zhang, J. W. Yang, H. P. Maruska, M. Asif Khan, R. Liu, F. Ponci, *Applied Physics Letters*, Volume 87, 211915 (3 pages), November 21, 2005.
334. ["Growth of AlN films and their characterization"](#), R. Jain, Y. Gao, J. Zhang, R.S. Qhalid Fareed, R. Gaska, J. Li, A. Arjunan, E. Kuokstis, J. Yang, M. Asif Khan, *physica status solidi (c)* Vol. 3, Issue 6, pp. 1491-1494, 2006.
333. ["Non-catalyst growth and characterization of a-plane AlGa_N nanorods"](#), M. Gaevski, W. Sun, J. Yang, V. Adivarahan, A. Sattu, I. Mokina, M. Shatalov, G. Simin, M. Asif Khan, *physica status solidi (a)*, Vol. 203, Issue 7, pp. 1696-1699, 2006.
332. ["AlGa_N multiple quantum well based deep UV LEDs and their applications"](#), M. Asif Khan, *physica status solidi (a)*, Vol. 203, Issue 7, pp. 1764-1770, 2006.
331. ["The 1.6 kV AlGa_N/Ga_N HFETs"](#), N. Tipirneni, A. Koudymov, V. Adivarahan, J. Yang, G. Simin, M. Asif Khan, *IEEE Electron Device Letters*, V. 27, N9, 716-718, September 2006.
330. ["Room-Temperature Stimulated Emission from AlN at 214 nm"](#), V. Adivarahan, M. Gaevski, M. Asif Khan, M. Shatalov, *Japanese Journal of Applied Physics*, Vol. 45, No. 49, pp. L1286-L1288, 2006.
329. ["High-Power Switching Using III-Nitride Metal-Oxide-Semiconductor Heterostructures"](#), G. Simin, M. Asif Khan, M. S. Shur, R. Gaska, *Selected Topics in Electronics and Systems*, Vol. 41. *Frontiers in Electronics (With CD-ROM)*, pp. 776, August 2006.
328. ["III-nitride transistors with capacitively coupled contacts"](#), G. Simin, Z. J. Yang, A. Koudymov, V. Adivarahan, J. Yang, M. Asif Khan, *Applied Physics Letters*, vol. 89 (3), 033510, July 17, 2006.
327. ["High-Power Switching Using III-Nitride Metal-Oxide-Semiconductor Heterostructures"](#), G. Simin, M. Asif Khan, M. S. Shur, R. Gaska, *Int. Journal. of High Speed Electronics and*

Systems, v.16, N2, p.455-468 , June 2006.

326. ["Digital oxide deposition of SiO₂ layers for III-nitride metal-oxide semiconductor heterostructure field-effect transistors"](#), V. Adivarahan, S. Rai, N. Tipirneni, A. Koudymov, J. Yang, G. Simin, M. Asif Khan, *Applied Physics Letters*, Volume 88, 182507 (3 pages), May 5, 2006.
325. ["Low Threshold AlGaIn/ GaN MOSHFET using Zirconium Dioxide as the gate dielectric"](#), S. Rai, V. Adivarahan, P. Huang, N. Tipirneni, F. Husna, G. Simin, J. W. Yang, M. A. Khan, *Japanese Journal of Applied Physics* , Vol. 45, No. 6A, pp. 4985–4987, 2006.
324. ["Pulsed lateral epitaxial overgrowth of AlN on sapphire substrates"](#), Z. Chen, R.S.Q. Fareed, M. Gaevski, V. Adivarahan, J.W. Yang, J. Mei, F.A. Ponce, M. Asif Khan, *Applied Physics Letters* , vol. 89 (8), 081905, August 21, 2006.
323. ["Role of Alloy Fluctuations in Photoluminescence Dynamics of AlGaIn Epilayers"](#), E. Kuokstis, W. Sun, M. Shatalov, J. Yang, M. Asif Khan, *Applied Physics Letters*, vol. 88 (26), 261905, June 27, 2006.
322. ["Optical power degradation mechanisms in AlGaIn based 280 nm deep ultraviolet light-emitting diodes on sapphire"](#), Z. Gong, M. Gaevski, V. Adivarahan, W. Sun, M. Shatalov, M. Asif Khan, *Applied Physics Letters*, Vol.1 88, 121106, March 20, 2006.
321. ["Matrix addressable micro-pixel 280 nm deep UV LED"](#), S. Wu, S. Chhajed, L. Yan, W. Sun, M. Shatalov, V. Adivarahan, M. Asif Khan, *Japanese Journal of Applied Physics*, Volume 45, Issue 12, pp. L352-L354, March 17, 2006.
320. ["Reduction of threading dislocation densities in AlN/sapphire epilayers driven by growth mode modification"](#), J. Bai, M. Dudley, W. H. Sun, H. M. Wang, M. Asif Khan, *Applied Physics Letters*, Volume 88, 051903-1-3, January 30, 2006.
319. ["Nanoscale capacitance-voltage characterization of two-dimensional electron gas in AlGaIn/GaN heterostructures"](#), G. Koley, L. Lakshamanan, N. Tipirneni, M. Gaevski, A. Koudymov, G. Simin, M. A. Khan, H. Y. Cha, M. G. Spencer, *Japanese Journal of Applied Physics*, Vol. 44, No. 44, pp. L1348-L1351, October 21, 2005
318. ["Lifetime of nonequilibrium carriers in high-Al-content AlGaIn epilayers"](#), J. Mickevičius, R. Aleksiejūnas, M. S. Shur, G. Tamulaitis, Q. Fareed, J. P. Zhang, R. Gaska, M. A. Khan, *physica status solidi (a)*, Vol. 202, Iss. 1, pp. 126-130, 2005.
317. ["High-power AlGaIn/InGaIn/AlGaIn/GaN recessed gate heterostructure field-effect transistors"](#), Q. Fareed, Y. Hu, A. Tarakji, J. Deng, R. Gaska, M. S. Shur, M. A. Khan, *Applied Physics Letters*, 86, 143512-1 (4 April 2005).

316. ["High Power Operation of III-N MOSHFET RF Switches"](#), Z. Yang, A. Koudymov, Vinod Adivarahan, J. Yang, G. Simin, Asif Khan, *IEEE Microwave and Wireless Components Letters*, Vol. 15, No. 12, pp. 850-852, December 2005.
315. ["Composite-layered solid-state field controlled emitter for a better control of the cathode surface barrier"](#), V. Semet, Vu Thien Binh, J. P. Zhang, G. Yang, M. A. Khan, R. Tsu, *Journal of Vacuum Science and Technology*, B, 23(2), Mar/Apr 2005.
314. ["Carrier diffusion and recombination in highly excited InGaN/GaN heterostructures"](#), K. Jarašiūnas, R. Aleksiejūnas, T. Malinauskas, M. Sūdžius, S. Miasojedovas, S. Juršėnas, A. Žukauskas, R. Gaska, J. P. Zhang, M. S. Shur, G. Yang, E. Kuokštis, M. A. Khan, *physica status solidi (a)*, 2005, Vol. 202, Iss. 5, pp. 820 - 823.
313. ["III-nitride UV devices."](#) M. Asif Khan, M. Shatalov, H. P. Maruska, H. M. Wang, and E. Kuokstis, *Japanese Journal of Applied Physics*, vol 44, No. 10, pp. 7191-7206 (2005). (Invited Review)
312. ["Fine structure of AlN/AlGaIn superlattice grown by pulsed atomic layer eiptaxy for dislocation filtering."](#) W. H. Sun, J. P. Zhang, J. W. Yang, H. P. Maruska, M. Asif Khan, R. Liu, F. A. Ponce, *Applied Physics Letters*, vol 87, 211915 (2005).
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14. "Properties and Ion Implantation of Al(x)Ga(1-x) N Films Prepared by Low Pressure MOCVD," Appl Phys Lett 43(5), 492 Sept 1983.
13. "Electrical Properties and Ion Implantations of Epitaxial GaN Grown by Low Pressure MOCVD," M. A. Khan, R. A. Skogman, R. G. Schulze, M. Gershenzon, Appl Physics Lett. 42(5), 430, March (1983).
12. "Non-resonant and Bandgap Resonant OPC in Hg_{0.784}Cd_{0.216}Te," CLEO 82, Phoenix, April 14-16, 1982 (with P.W. Kruse).
11. "Mechanisms of Optical Phase Conjugation in (Hg, Cd) Te" International Conference on Lasers '82, New Orleans, Dec. 13-17, 1982. (with P.W. Kruse) (by invitation).
10. "Phase Conjugation and Nonlinear Fabry-Perot Effect in HgCdTe Epilayer" CLEO 83, Baltimore, May 1983. (with P. W. Kruse, R. A. Wood, and Y. K. Park).
9. "Bandgap-resonant Optical Phase Conjugation in n-type Hg_{1-x}Cd_xTe at 10.6 micron." Optics Letters, 6,560 (1981) (with R.L.H. Bennet, P.W. Kruse).
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6. "Noncollinear Phase-Matched four-photon mixing in Hg_{0.77}Cd_{0.23}Te," Optics Letters, 5, 469 1980) (with T.J. Bogart, P.W. Kruse, and J.F. Ready).
5. "Optical Phase Conjugation in Hg_{1-x}Cd_xTe," Optics Letters, 5, 261 (1980) (with P.W. Kruse and J.F. Ready).
4. "Nonlinear Optical Effects in Hg_{1-x}Cd_xTe," Infr. Phys. 19, 497 (1979) (with P.W. Kruse and J. F. Ready).
3. "Resonant Four Photon and Higher Order Mixing in HgCdTe," Opt. Comm. 28,3742 (1979) (with P.W. Kruse and J.F. Ready).
2. "Dispersion of Nonlinear Optical Susceptibility in n-Ge," Optics Comm. 21, 154 (1979) (with R.A. Wood, P.A. Wolff and R.L. Aggarwal).
1. "Resonant Four Wave Mixing in n-Si," Optics Comm. 30, 206 (1977), with D.J. Melhner and P.A. Wolff).

Oral Presentations

Dr. Khan has established himself as one of the top researchers in the field of wide bandgap semiconductor materials and devices. His research group pioneered state-of-the-art research approaches to solve several key problems. Various research groups that followed in the field subsequently adopted these innovative approaches. The excellence of the research effort is well recognized and has resulted in numerous plenary and invited presentations, as listed below:

➤ Recent Invited Presentations

- | | | |
|---|-----------------------|------|
| • Indo-US Workshop on Visible and Ultraviolet Sources for Solid State Lighting and Water Purification | Chennai, India | 2009 |
| • IWN | Montreux, Switzerland | 2008 |
| • ISSLED | Phoenix, AZ | 2008 |
| • GOMACTech | Las Vegas, NV | 2008 |
| • SMC | Montreal, Canada | 2007 |
| • WOCSEMMAD | Savannah, GA | 2007 |
| • SIMC-XIV | Fayetteville, AK | 2007 |
| • INS | Las Vegas, NV | 2007 |
| • Japanese Applied Physics Society | Tokushima, Japan | 2007 |

➤ Past Invited Presentations

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|--|---------------------|------|
| • Intl LED Expo 2006 | Korea | 2006 |
| • 2006 ECS | Denver, CO | 2006 |
| • 2006 MRS Spring Meeting | San Francisco | 2006 |
| • Intl Wrkshp on Nanoscience/ICTP | Madras, India | 2006 |
| • ICMOVPE-XIII | Miyazaki, Japan | 2006 |
| • UK Nitride Consortium | Glasgow, Scotland | 2006 |
| • Intl Wkshp on Crystal Growth | Chennai, India | 2006 |
| • WBG Summer Wide Bandgap Mtg. | St. Louis, Missouri | 2005 |
| • ICAMD | Seoul, Korea | 2005 |
| • 4 th Intl Conf on Adv Materials/Devices | Jeju Is., Korea | 2005 |
| • IEDM | Washington, DC | 2005 |
| • 4th Intl Workshop Indus Tech Opt. Semi. | Gwangju., Korea | 2005 |
| • 5 th Akasaki Research Ctr. Symposium | Japan | 2005 |
| • 2005 MRS Fall Meeting | Boston | 2005 |
| • Japanese | Japan | 2005 |
| • CIFSSL '05 | Xiamen, China | 2005 |
| • ICAMD 2005 | Korea | 2005 |
| • Optics in the Southeast | Atlanta, Georgia | 2005 |
| • 6 th Intl Conf Nitride Semic (Plenary) | Bremen, Germany | 2005 |
| • Plenary Speaker, IEEE PESC | Recife, Brazil | 2005 |
| • 16 th ACCGE | Big Sky, Montana | 2005 |

• WOCSEMAAD	Miami	2005
• AFOSR Nitride Workshop	Anchorage, Alaska	2004
• 27 th Intl Conf. Physics Semiconductors	Flagstaff, AZ	2004
• 2004 Intl Workshop Nitride Semiconductors	Pittsburgh, PA	2004
• 12 th Intl. Symp. Nanostructures	St. Petersburg, Russia	2004
• ARO Workshop	Charlotte, NC	2004
• MRS Spring Conference	San Francisco	2004
• ECS 2004	Hawaii	2004
• Plenary Talk ICNS	Nara, Japan	2003
• MRS Int'l Symposium	Boston, MA	2003
• ECS Int'l Meeting	Paris	2003
• ASU Lawrence Symposium	Tempe, Arizona	2003
• TWHM Workshop	Okinawa, Japan	2003
• Photonics West	San Jose, CA	2003
• Mantech	Phoenix, AZ	2003
• 2003 ISDRS	Washington, DC	2003
• IEEE Sensors 2002	Orlando, Florida	2002
• ISCS 2002	Lausanne, Switzerland	2002
• WOCSDICE 2002	Moscow, Russia	2002
• EMRS 2002	Strasbourg, France	2002
• WOCSEMMAD 2002	Austin, TX	2002
• URSI 2002	Boulder, CO	2002
• Frontier Science Research Conf.	La Jolla, CA	2001
• MRS 2001 Fall	Boston, MA	2001
• ISCS 28 th Intl Symposium	Tokyo, Japan	2001
• ISDRS 2001	Charlottesville, VA	2001
• ICNS-4	Denver, CO	2001
• MRS 2001 Spring	San Francisco, CA	2001
• GOMAC 2001	San Antonio, TX	2001
• ECS 2001	Philadelphia, PA	2001
• MRS 2000 Spring Meeting	San Francisco, CA	2000
• 6 th Wide Bandgap III Nitride Wkshop	Richmond, VA	2000
• 42 nd EMC 2000	Denver, CO	2000
• Device Research Conference 2000	Denver, CO	2000
• MRS 2000 Fall Meeting	Boston, MA	2000
• Bulk Substrates Workshop	Brazil	2000
• SiC & Related Materials Conference	Germany	2000
• Polarization Effects in Semiconductors	Glacier Park, MT	2000
• MRS Int'l Fall Meeting	Boston, MA	1999
• 1999 EMC	Santa Barbara, CA	1999
• Int'l Compound Semiconductor Mtg.	Japan	1998
• MRS Spring Meeting	San Francisco, CA	1998
• European SSDRC	Stuttgart, Germany	1997
• MRS Fall Meeting	Boston, MA	1997

• ISDRS	Charlottesville, VA	1997
• MRS Conference	San Francisco, CA	1997
• Int'l Semiconductor Conference	Berlin	1996
• European MRS Symposium C	France	1996
• International Device Symposium	Sapporo, Japan	1996
• Society Radio Eng. Conference	Colorado	1996
• European MRS Symposium A	France	1996
• ISDRS Workshop	Charlottesville, VA	1995
• SiC and Nitride Conference	Kyoto, Japan	1995
• III-N International Workshop	Nagoya, Japan	1995
• MRS Nitride Symposium	Boston, MA	1995
• Gordon Research Conference	New Hampshire	1995
• European MOVPE Workshop	Gent, Belgium	1995
• International III-N Workshop	Nagoya, Japan	1995
• International SiC Conference	Kyoto, Japan	1995
• SPIE Workshop	San Jose, CA	1995
• PCSI	Tucson, AZ	1995
• Gordon Research Conference	California	1994
• SPIE	San Francisco, CA	1994
• Materials Research Society	San Francisco, CA	1994
• Optical Society of America	Toronto, Canada	1994
• International OE Workshop	Bangalore, India	1994
• International OE Workshop	Mexico City, Mexico	1994
• Tropical OE Workshop	California	1994

Conference Presentations – 2004 - 2005

95. “AlGaN multiple quantum well based deep UV LEDs and their applications,” Invited Speaker, 6th International Conference on Nitride Semiconductors, Bremen, Germany, August 28 – September 2, 2005.
94. “Reliability and degradation modes of 280 nm deep UV LEDs on sapphire,” Z. Gong, S. Chhajed, M. E. Gaevski, W. Sun, V. Advivarahan, M. Shatalov and Asif Khan, Material Research Society (MRS) Fall Meeting 2005, November 28 – December 2, 2005, Boston, Massachusetts, USA.
93. “270 nm Deep UV LEDs with a Micro-Pixel Design,” S. Wu, A. Sattu, L. Yan, Y. Praveen, H. Faruq, W. Sun, M. Shatalov, V. Adivarahan and Asif Khan, Material Research Society (MRS) Fall Meeting 2005, November 28 – December 2, 2005, Boston, Massachusetts, USA.
92. “Failure Analysis and Reliability of 280 nm AlGaN based Deep UV LEDs”, Z. Gong, S. Chhajed, A. Sattu, M. E. Gaevski, W. H. Sun, S. Wu, V. Adivarahan, M. Shatalov, and M. Asif Khan, Optics in the Southeast 2005, October 6 - 8, 2005, Atlanta, Georgia, USA.

91. "Matrix Addressable Micro-Pixel AlGa_N based 280 nm Deep UV LED", S. Wu, S. Chhajed, A. Sattu, Y. Li, S. Srivastava, M. Islam, W. H. Sun, M. Shatalov, V. Adivarahan and M. Asif Khan, Optics in the Southeast 2005, October 6 - 8, 2005, Atlanta, Georgia, USA.
90. "Non-catalyst growth and characterization of a-plane AlGa_N nanorods", M. E. Gaevski, W. Sun, J. Yang, V. Adivarahan, A. Sattu, I. Mokina, M. Shatalov, G. Simin and M. Asif Khan, 6th International Conference on Nitride Semiconductors (ICNS-6), August 28 - September 2, 2005, Bremen, Germany.
89. "Deep ultraviolet light-emitting diode lamps", X. Hu, J. Deng, J. P. Zhang, A. Lunev, Y. Bilenko, T. Katona, M. Shur, R. Gaska, M. Shatalov and M. A. Khan, 6th International Conference on Nitride Semiconductors (ICNS-6), August 28 - September 2, 2005, Bremen, Germany.
88. "Formation of InGa_N Low Dimensional Structures Over a-plane Ga_N ELOG Template", M. E. Gaevski, C. Q. Chen, E. Kuokstis, J. Li, M. Shatalov, Z. Gong, V. Adivarahan, A. Sattu, I. Mokina, J. Yang and M. Asif Khan, Material Research Society (MRS) Spring Meeting 2005, March 28 – April 1, 2005, San-Francisco, California, USA.

Conference Presentations 2003-2004

87. "255 nm Interconnected Micro-Pixel Deep Ultraviolet Light Emitting Diodes", M. Asif Khan, S. Wu, W. H. Sun, A. Chitnis, V. Adivarahan, M. Shatalov, J. W. Yang, International Electronic Device Meeting (IEDM-2004), December 13 - 15, 2004, San Francisco, California, USA.
86. "265 nm Deep Ultraviolet Emitters", W. H. Sun, V. Adivarahan, S. Wu, A. Sattu, A. Chitnis, M. Shatalov, M. Asif Khan, Material Research Society Fall Meeting 2004, November 29 - December 2, 2004, Boston, Massachusetts, USA.
85. "Reliability and Operation Lifetime Studies of sub-280 nm Ultraviolet Emitters on Sapphire Substrates", A. Chitnis, M. Shatalov, S. Wu, S. Saygi, W. H. Sun, V. Adivarahan, M. Asif Khan, Material Research Society Fall Meeting 2004, November 29 - December 2, 2004, Boston, Massachusetts, USA.
84. "Metalorganic Chemical Vapor Deposition of Non-Polar III-Nitride Films Over a-Plane SiC Substrates", J. Li, Z. Gong, C. Q. Chen, V. Adivarahan, M. Gaevski, E. Kuokstis, M. Shatalov, Y. Gao, Z. Zhang, A. Arjunan, T. S. Sudarshan, H. P. Maruska, J. W. Yang, M. Asif Khan, Material Research Society Fall Meeting 2004, November 29 - December 2, 2004, Boston, Massachusetts, USA.
83. "Deep UV LEDs for Water and Air Purification", M. S. Shur, J. P. Zhang, X. Hu, J. Deng, Y. Bilenko, A. Lunev, R. Gaska, M. Shatalov and Asif Khan, 2004 Joint International Meeting and 206th Meeting of The Electrochemical Society, October 3-8, 2004, Honolulu, Hawaii, USA

82. "Strain Energy Band Engineering for Nitride Based Deep UV LEDs", M. S. Shur, J. P. Zhang, X. Hu, J. Deng, Y. Bilenko, A. Lunev, R. Gaska, M. Shatalov, Asif Khan, 31st International Symposium on Compound Semiconductors (ISCS-2004), September 12 – 16, 2004, Seoul, Korea.
81. "White light generation using 280nm light emitting diode pumps", M. Shatalov, S. Wu, V. Adivarahan, W. H. Sun, A. Chitnis, J. W. Yang, Yu. Bilenko, R. Gaska, Asif Khan, International Workshop on Nitride Semiconductors, IWN 2004, July 19 - 23, 2004, Pittsburgh, Pennsylvania, USA.
80. "Influence of Stacking Faults on the Properties of GaN-based UV Light-Emitting Diodes Grown on Non-Polar Substrates", C. Q. Chen, V. Adivarahan, M. Shatalov, E. Kuokstis, J. W. Yang, H. P. Maruska, Z. Gong, M. Asif Khan, International Workshop on Nitride Semiconductors, IWN 2004, July 19 - 23, 2004, Pittsburgh, Pennsylvania, USA.
79. "Low Pressure MOCVD Deposition of High Quality AlGaIn Heterostructures for 250-280nm Deep Ultraviolet Light Emitting Diodes", V. Adivarahan, W. Sun, J. P. Zhang, M. Shatalov, A. Chitnis, M. Asif Khan, 12th International Conference on Metal Organic Vapor Phase Epitaxy, ICMOVPE 2004, May 30 - June 4, 2004, Lahaina, Maui, Hawaii, USA.
78. "Deep ultraviolet light emitting diodes with emission at 250nm", V. Adivarahan, W. H. Sun, J. P. Zhang, A. Chitnis, M. Shatalov, M. Asif Khan, 5th International Symposium on Blue Laser and Light Emitting Diodes, ISBLLED 2004, March 15-19, 2004, Gyeongju, Korea.
77. "265 nm to 340 nm UV LEDs grown by Migration Enhanced MOCVD", J. Zhang, X. Hu, J. Deng, A. Lunev, Y. Bilenko, R. Gaska, M. S. Shur, M. Shatalov, M. A. Khan, 5th International Symposium on Blue Laser and Light Emitting Diodes, ISBLLED 2004, March 15-19, 2004, Gyeongju, Korea.
76. "Deep Ultraviolet Light Emitting Diodes", W. H. Sun, V. Adivarahan, A. Chitnis, M. Shatalov, M. Asif Khan, Workshop on Compound Semiconductor Electronic Microwave Materials and Devices, WOCSEMMAD 2004, February 15-17, 2004, Pasadena, California, USA.
75. "Optically Pumped Lasing in Non-Polar A-Plane GaN Film", E. Kuokstis, C. Q. Chen, J.W. Yang, V. Adivarahan, M. Shatalov, M. A. Khan, Material Research Society Fall Meeting 2003, December 1-5, 2003, Boston, Massachusetts, USA.
74. "Modulation N Doping of AlGaIn for Improved Deep UV LEDs", J. P. Zhang, H. M. Wang, Z. Gong, M. Su, S. Wu, V. Adivarahan, M. Shatalov, A. Chitnis, C. Q. Chen, W. H. Sun, J. W. Yang, G. Simin, M. A. Khan, Material Research Society Fall Meeting 2003, December 1-5, 2003, Boston, Massachusetts, USA.
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