

# 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

1997 – Present *Director, Photonics & Microelectronics Lab, Department of Electrical Engineering, University of South Carolina, Columbia, SC*  
2003 – Present *Carolina Distinguished Professor (chaired professorship)*  
2001 – 2006 *Chair, 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

- |   |           |
|---|-----------|
| • Carolina Distinguished Professor  | 2003-2011 |
| • Plenary Speaker, Indo-US Workshop on Visible and Ultraviolet Sources for Solid State Lighting and Water Purification, Chennai, India  | 2009      |
| • Appointment of Honorary Lecturer, Chinese Academy of Sciences   | 2007      |
| • 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      |
| • IEEE Fellow Award   | 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"   | 2004      |
| • 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. Levinshtein, 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", <i>Science Magazine</i> , 287, pp. 561-562, 2000.   | 2000      |
| • Best Materials Research Society Poster Award, 1999.   | 1999      |
| • Commendation for Excellence in Technical Communication, "GaN-AlGaIn Ultraviolet Detectors", <i>Laser Focus World</i> , June 1999.   | 1999      |

- Member, International Advisory Committee, International Conference on Nitride Semiconductors, (1997 - present). 1997-2003
- Member, Organizing Committee International Workshop on Gallium Nitride Materials, (1995 – present). 1995-2003
- 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**

- AlGaN Development 2009-2010 \$257 K Osram Sylvania
- Indium Based III Nitride Semiconductor Devices 2009-2010 1.25 M Northrop Grumman
- Plasmons in III Nitrides and Nanoscale Devices 2008-2010 300 K NSF

➤ 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
➤ AlGaN/GaN Microsensor	2005-2008	\$60 K	JPL

### **Selected Past Research Grants:**

• AlInGaN MOSDHFET Based RF Circuits	2003-2006	\$4.3 M	USA SMDC
• Deep UV Emitters Based on Quaternary AlInGaN Multiple Quantum Well Heterostructures	2002-2006	\$1.9 M	DARPA
• High Performance Ultraviolet Detectors Based on Quaternary AlInGaN Layers and Heterojunctions	2001-2004	\$3 M	NASA
• WBGs Epitaxial Materials Development and Scale-up for RF/Microwave –Millimeter Wave Devices	2002-2004	\$825 K	DARPA
• Strain Energy Band Engineering in Quaternary AlInGaN Compounds: Scaled-up Material and Novel Device Development	2000-2003	\$8.1 M	MDA
• AlGaN Thin Film Battery	2000-2001	\$307 K	CIA
• GaN Transistors	2000-2001	70 K	Raytheon
• AlGaN-SiC Materials & Device	1998-2000	\$4.5 M	ONR
• High Field Characterization Nitride Devices	1996-2001	\$819 K	USA SMDC
• GaN-AlGaN 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 AlGaN	1994-1997	\$2.5 M	DARPA
• GaN-AlGaN High Temp. Transistors	1994-1995	\$200 K	Navy
• AlGaN Electro-Optic Waveguide Devices	1994-1996	\$850 K	Air Force
• Ultraviolet Laser Devices Based on GaN	1994-1996	\$750 K	Air Force
• AlN Bulk Crystal Growth	1994-1995	\$200 K	DARPA
• Junction Based Detectors	1993-1995	\$500 K	Air Force
• AlGaN Materials Development	1993-1996	\$400 K	Navy
• GaN-AlGaN FET & HEMT Devices	1993-1995	\$600 K	Air Force
• AlGaN-GaAs Multilayer Devices	1991-1992	\$100 K	Army
• AlGaN High Speed Electronic Devices	1990-1992	\$550 K	Navy
• AlGaN Atomic layer Epitaxy	1989-1991	\$550 K	Navy
• AlGaN 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
• GaN 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**

- |   |                |        |
|---|----------------|--------|
| • 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<sub>x</sub>Ga<sub>1-x</sub>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<sub>N</sub> 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<sub>sub.x</sub>Ga<sub>sub.1-x</sub>N,” October 1986.
- U.S. Patent 4,614,961, “A tunable cut-off UV Detector based on AlGa<sub>N</sub>,” 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 <sub>N</sub> /Ga <sub>N</sub> 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 <sub>N</sub> 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 <sub>N</sub> /InGa <sub>N</sub> /Ga <sub>N</sub> DHFET	JJAP Lett., 2001
First quaternary based deep UV LED (305 nm)	JJAP Lett., 2001
First MOSHFET Device in AlGa <sub>N</sub> over SiC	APL, 2000
First MOSHFET Device in AlGa <sub>N</sub> over sapphire	EDL, 1999
First Ga <sub>N</sub> -InGa <sub>N</sub> LED over Silicon	APL, 1999
First Quaternary Barrier InGa <sub>N</sub> LEDs	APL, 2000
First Ga <sub>N</sub> -AlN SIS Junction Detectors	APL, 1995
First High Temperature Vertical Cavity Lasing	Elect. Lett., 1995
First Voltage Controlled Photoconductive Detectors	Elect. Lett., 1995
First Ga <sub>N</sub> High Temp. High Frequency Transistors	APL, 1995
First Ga <sub>N</sub> -AlGa <sub>N</sub> Memory Elements	Elect. Lett., 1995

First GaN pn-Junction Detector	Elect. Lett., 1995
First InGaN Vertical Cavity Stimulated Emission	APL, Aug. 1994
First GaN-AlGaN Sub-micron Gate Transistor	APL, Nov. 1994
First GaN-AlGaN HEMT Transistor	APL, Aug. 1993
First GaN MESFET Transistor	APL, Apr. 1993
First p-GaN Photo voltaic Detector	APL, May 1993
First GaN-AlGaN 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 2010**

“A Hybrid Micro-Pixel Based Deep Ultraviolet Light Emitting Diode Lamp” Seongmo Hwang, Monirul Islam, Bin Zhang, Mohamed Lachab, Joe Dion, Ahmad Heidari, Haseeb Nazir, Vinod Adivarahan and Asif Khan, Accepted for publication in Applied Physics Express, November 2010.

[“First Demonstration of Semipolar Deep Ultraviolet Light Emitting Diode on m-Plane Sapphire with AlGaN Multiple Quantum Wells,”](#) Krishnan Balakrishnan, Vinod Adivarahan, Qhalid Fareed, Mohamed Lachab, Bin Zhang, and Asif Khan, Japanese Journal of Applied Physics 49 (2010) 040206 (3 pages).

[“Lamps boost output in the deep ultraviolet,”](#) Asif Khan, Qhalid Fareed and Vinod Adivarahan, Compound semiconductor magazine, June 29, 2010.

High Voltage Operation of Field Plated AlInN HEMTs.  
Qhalid Fareed, Ahmad Tarakji, Joseph Dion, Monirul Islam, Vinod Adivarahan and Asif Khan;  
Physica Status solidi (Submitted)

Defect Reduction in High Al-content AlGaN Films for Deep Ultraviolet Light Emitting Diodes.  
Iftikhar Ahmad, Balakrishnan Krishnan, Bin Zhang, Qhalid Fareed, Mohamad Lachab and Asif Khan, Physica Status solidi (Submitted)

➤ **Publications 2009**

354. [“Vertical architecture cranks up UV output,”](#) Asif Khan, Compound Semiconductor Magazine, October 16, 2009.
353. “Ohmic Contact to High-Aluminum-Content AlGaN Epilayers”, Surendra Srivastava, Seong Mo Hwang, Md. Islam, K. Balakrishnan, Vinod Adivarahan and Asif Khan Journal of Electronic Materials (v.38, #11) (pp. 2348-2352).
352. “Vertical Injection Thin Film Deep Ultraviolet Light Emitting Diodes with AlGaN Multiple-Quantum Wells Active Region”, Adivarahan Vinod; Heidari Ahmad; Zhang Bin; Fareed Qhalid; Islam Monirul; Hwang Seongmo; Balakrishnan Krishnan; Khan Asif Applied Physics Express 2009;2(9):092102-092102-3.
351. “280 nm Deep Ultraviolet Light Emitting Diode Lamp with an AlGaN Multiple Quantum Well Active Region”, Adivarahan Vinod; Zhang Bin; Fareed Qhalid; Heidari Ahmad; Hwang Seongmo; Islam Monirul; Khan Asif; Applied Physics Express 2009; 2(10):102101-102101-2
350. “Semiconductor photonics: Laser diodes go green,” Asif Khan; Nature Photonics 3, 432 - 434 (2009).

➤ **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 SiO<sub>2</sub>/AlGa<sub>N</sub>/Ga<sub>N</sub> 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<sub>N</sub>/InGa<sub>N</sub>/Ga<sub>N</sub> 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<sub>N</sub>/Ga<sub>N</sub> 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 AlGa<sub>1</sub>N 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, Qualid 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 AlGaIn/InGaIn/GaN MOSDHfet"](#), V. Adivarahan, M. Gaevski, A. Koudymov, J. Yang, G. Simin, M. A. Khan, *IEEE Electron Device Letters* 28 (3), 192-194, March 2007.
335. ["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.
334. ["Non-catalyst growth and characterization of a-plane AlGaIn 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.
333. ["AlGaIn 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.
332. ["The 1.6 kV AlGaIn/GaN 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.
331. ["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.
330. ["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.
329. ["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.
328. ["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.

327. ["Digital oxide deposition of SiO<sub>2</sub> 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.
326. ["Low Threshold AlGaN/ 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.
325. ["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.
324. ["Role of Alloy Fluctuations in Photoluminescence Dynamics of AlGaN Epilayers"](#), E. Kuokstis, W. Sun, M. Shatalov, J. Yang, M. Asif Khan, *Applied Physics Letters*, vol. 88 (26), 261905, June 27, 2006.
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12. "Non-resonant and Bandgap Resonant OPC in Hg<sub>0.784</sub>Cd<sub>0.216</sub>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<sub>1-x</sub>Cd<sub>x</sub>Te at 10.6 micron." Optics Letters, 6,560 (1981) (with R.L.H. Bennet, P.W. Kruse).
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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

- |   |                        |      |
|---|------------------------|------|
| • IWN   | Tampa, FL              | 2010 |
| • Lester Eastman Conference on High Power Devices   | Troy, NY               | 2010 |
| • CLEO 2010   | San Joes, CA           | 2010 |
| • ACCGE-17  | Lake Geneva, WI        | 2009 |
| • ICAM 2009   | Rio De Janeiro, Brazil | 2009 |
| • ICNS 2009   | Jeju, Korea            | 2009 |
| • China Intl Forum on Solid State Lighting  | Shenzhen, China        | 2009 |
| • Indo-US Workshop on Visible and Ultraviolet Sources for Solid State Lighting and Water Purificaiton | Chennai, India         | 2009 |

### ➤ Past Invited Presentations

- |  |                       |      |
|--|-----------------------|------|
| • 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 |
| • Intl LED Expo 2006                                 | Korea                 | 2006 |
| • 2006 ECS   | Denver, CO            | 2006 |
| • 2006 MRS Spring Meeting                            | San Francisco         | 2006 |
| • Intl Wrkshp on Nanocience/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 <sup>th</sup> Intl Conf on Adv Materials/Devices | Jeju Is., Korea       | 2005 |
| • IEDM   | Washington, DC        | 2005 |
| • 4th Intl Workshp Indus Tech Opt. Semi.             | Gwangju., Korea       | 2005 |
| • 5 <sup>th</sup> 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 <sup>th</sup> Intl Conf Nitride Semic (Plenary)	Bremen, Germany	2005
• Plenary Speaker, IEEE PESC	Recife, Brazil	2005
• 16 <sup>th</sup> ACCGE	Big Sky, Montana	2005
• WOCSEMAAD	Miami	2005
• AFOSR Nitride Workshop	Anchorage, Alaska	2004
• 27 <sup>th</sup> Intl Conf. Physics Semiconductors	Flagstaff, AZ	2004
• 2004 Intl Workshp Nitride Semiconductors	Pittsburgh, PA	2004
• 12 <sup>th</sup> 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 <sup>th</sup> 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 <sup>th</sup> Wide Bandgap III Nitride Wkshop	Richmond, VA	2000
• 42 <sup>nd</sup> 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	Banglore, India	1994
• International OE Workshop	Mexico City, Mexico	1994
• Tropical OE Workshop	California	1994

#### Conference Presentations – 2004 - 2005

95. "AlGaIn multiple quantum well based deep UV LEDs and their applications," Invited Speaker, 6<sup>th</sup> International Conference on Nitride Semiconductors, Bremen, Germany, August 28 – September 2, 2005.
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***Additionally, about seventy oral presentations prior to 1999 at various technical meetings. This includes presentations at EMC, DRC, CLEO, MRS, Int'l SiC workshop, Int'l GaN workshop, Gordon research conference, Optical Society of the U.S., and SPIE Meetings.***