

## Iftikhar Ahmad - CV

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NAME: Ahmad, Iftikhar

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POSITION TITLE & INSTITUTION: Assistant Professor, University of South Carolina

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### PROFESSIONAL PREPARATION

INSTITUTION	LOCATION	MAJOR / AREA OF STUDY	DEGREE (if)	YEAR YYYY
Government College Lahore	Lahore, Punjab	Physics (Gold Medalist)	M.Sc.	1996
Texas Tech University	Lubbock, Texas	Applied Physics	MS	2002
Texas Tech University	Lubbock, Texas	Physics (Semiconductor)	PHD	2005

### PROFESSIONAL APPOINTMENTS

2018 - present    Assistant Professor, University of South Carolina, Department of Electrical Engineering, Columbia, SC

2018 - 2020      Consultant, Sensor Electronic Technology, Inc., Columbia, SC

2015 - 2018      Senior Epitaxial Growth Scientist, SET, Inc., Columbia, SC

2014 - 2015      Senior Research Scientist, Nitek, Inc., Columbia, SC

2010 - 2014      Research Scientist, Nitek, Inc., Columbia, SC

2008 - 2010      Research Assistant Professor, University of South Carolina, Department of Electrical Engineering, Columbia, SC

2002 - 2005      Research Assistant, Texas Tech University, Physics Department, Lubbock, TX

1999 - 2000      Teaching Assistant, WIU, Macomb, IL

### PRODUCTS

#### Peer-Reviewed Journal Papers:

1. Surface properties of MOCVD grown  $(Al_{1-x}Ga_x)_2O_3$  thin films on c-plane sapphire via scanning Kelvin probe microscopy, Mohi Uddin Jewel, Scott R. Crittenden, Tahir Hassan, Samiul Hasan, Dongkyu Lee, Nifat Jahan Nipa, Md. Ghulam Zakir, Mohammad Jamal El Loubani, Vitaliy Avrutin, Ümit Özgür, Hadis Morkoç, Iftikhar Ahmad, AIP Advances 14, 125029, <https://doi.org/10.1063/5.0233458> (2024).
2. Reduction in Density of Interface Traps Determined by C-V Analysis in III-nitride Based MOSFET Structure., Samiul Hasan, Mohi Uddin Jewel, Scott R. Crittenden, Md Ghulam Zaki, Nifat Jahan Nipa, Vitaliy Avrutin, Ümit Özgür, Hadis Morkoç, and **Iftikhar Ahmad**, Applied Physics Letters, 124, 112103, <https://doi.org/10.1063/5.0193603> (2024).
3. Alpha Particle Detection Using Highly Rectifying Ni/Ga<sub>2</sub>O<sub>3</sub>/4H-SiC Heteroepitaxial MOS Junction, Sandeep K. Chaudhuri, Ritwik Nag, **Iftikhar Ahmad**, and Krishna C. Mandal, IEEE TRANSACTIONS ON ELECTRON DEVICES, 70 (12), [doi.org/10.1109/TED.2023.3328329](https://doi.org/10.1109/TED.2023.3328329). (2023).
4. Phase Stabilized MOCVD Growth of  $\beta$ -Ga<sub>2</sub>O<sub>3</sub> Using SiO<sub>x</sub> on c-Plane Sapphire and AlN/Sapphire Template, Mohi Uddin Jewel, Samiul Hasan, Scott R. Crittenden, Vitaliy Avrutin, Ümit Özgür, Hadis

Morkoç, **Iftikhar Ahmad**, Phys. Status Solidi A, 220, 2300036, doi.org/10.1002/pssa.202300036. (2023).

5. MOCVD-grown  $\beta$ -Ga<sub>2</sub>O<sub>3</sub> as a Gate Dielectric on AlGa<sub>N</sub>/Ga<sub>N</sub>-Based Heterojunction Field Effect Transistor, Samiul Hasan, Mohi Uddin Jewel, Scott R. Crittenden, Dongkyu Lee, Vitaliy Avrutin, Ümit Özgür, Hadis Morkoç, and **Iftikhar Ahmad**, Crystals, 13, 231. doi.org/10.3390/cryst13020231. (2023).
6. A comprehensive study of defects in gallium oxide by density functional theory, Mohi Uddin Jewel, Samiul Hasan, and **Iftikhar Ahmad**, Computational Materials Science 218, 111950, doi.org/10.1016/j.commatsci.2022.111950. (2023).
7. Progress in Hexagonal Boron Nitride (h-BN)-Based Solid-State Neutron Detector, Samiul Hassan, and **Iftikhar Ahmad**, Electron. Mater., 3(3), 235-251, doi.org/10.3390/electronicmat3030020 (2022).
8. Comparative Spectroscopic Study of Aluminum Nitride Grown by MOCVD in H<sub>2</sub> and N<sub>2</sub> Reaction Environment, Samiul Hasan, Mohi Uddin Jewel, Stavros G. Karakalos, Mikhail Gaevski, and Iftikhar Ahmad, MDPI Journal – Special Issue "Thin Films and Nanostructures by MOCVD: Fabrication, Characterization and Applications" Coatings, 2022, 12(7), 924 (2022), doi.org/10.3390/coatings12070924 (2022).
9. Growth evolution of high-quality MOCVD aluminum nitride using nitrogen as carrier gas on the sapphire substrate, Samiul Hasan, Abdullah Mamun, Kamal Hussain, Mikhail Gaevski, **Iftikhar Ahmad** & Asif Khan, Journal of Materials Research, vol. 36, pp. 4360–4369 (2021).
10. Investigation of MOCVD grown crack-free 4  $\mu$ m thick aluminum nitride using nitrogen as a carrier gas, Samiul Hasan, Abdullah Mamun, Kamal Hussain, Dhruvinkumar Patel, Mikhail Gaevski, **Iftikhar Ahmad**\* & Asif Khan, Material Research Society Advances, vol. 6, pp. 456–460 (2021).
11. High-Temperature Operation of Al<sub>x</sub>Ga<sub>1-x</sub>N ( $x > 0.4$ ) Channel Metal Oxide Semiconductor Heterostructure Field Effect Transistors with High-k Atomic Layer Deposited Gate Oxides Shahab Mollah, Kamal Hussain, Richard Floyd, Abdullah Mamun, Mikhail Gaevski, MVS Chandrashekhar, **Iftikhar Ahmad**, Grigory Simin, Virginia Wheeler, Charles Eddy, and Asif Khan, Phy. Stat. Sol. a, 1900802 (2020).
12. Ultra-wide bandgap AlGa<sub>N</sub> metal oxide semiconductor heterostructure field effect transistors with high-k ALD ZrO<sub>2</sub> dielectric, Shahab Mollah, Mikhail Gaevski, MVS Chandrashekhar, Xuhong Hu, Virginia Wheeler, Kamal Hussain, Abdullah Mamun, Richard Floyd, **Iftikhar Ahmad**, Grigory Simin, Charles Eddy, and Asif Khan, Semicond. Sci. Technol. 34, 125001 (2019).

\*\* paper prior to joining USC\*\*

12. Deep ultraviolet photo pumped stimulated emission from partially relaxed AlGa<sub>N</sub> multiple quantum well heterostructures grown on sapphire substrates, Fatima Asif, Mohamed Lachab, Antwon Coleman, **Iftikhar Ahmad**, Bin Zhang, Vinod Adivarahan, Asif Khan, J. Vac. Sci. Technol. B 32, 061204 (2014).
13. Pulsed modulation doping of Al<sub>x</sub>Ga<sub>1-x</sub>N ( $x > 0.6$ ) AlGa<sub>N</sub> epilayers for deep UV optoelectronic devices Hung-Chi Chen, **Iftikhar Ahmad**, Bin Zhang, Antwon Coleman, Mahbuba Sultana, Vinod Adivarahan, Asif Khan, Phys. Status Solidi C, 11, 3–4, 408 (2014).

14. Pseudomorphic Al<sub>x</sub>Ga<sub>1-x</sub>N MQW based deep ultraviolet light emitting diodes over sapphire, Fatima Asif , Hung-Chi Chen, Antwon Coleman, **Iftikhar Ahmad**, Bin Zhang, Joe Dion , Ahmad Heidari, Vinod Adivarahan, and Asif Khan, Phys. Status Solidi C, 11, No. 3–4, 798 (2014).
15. Enhancement of light extraction efficiency in sub-300 nm nitride thin-film flip-chip light-emitting diodes, M. Lachab, F. Asif , B. Zhang , **I. Ahmad**, A. Heidari, Q. Fareed, V. Adivarahan, A. Khan, Solid-State Electronics, 89, 156 (2013).
16. Substrate Lifted-off AlGa<sub>N</sub>/AlGa<sub>N</sub> Lateral Conduction Thin-Film Light-Emitting Diodes Operating at 285 nm, Fatima Asif, Hung-Chi Chen, Antwon Coleman, Mohamed Lachab, **Iftikhar Ahmad**, Bin Zhang, Qhalid Fareed, Vinod Adivarahan and Asif Khan, Jpn. J. Appl. Phys. 52, 08JG14, (2013).
17. MOCVD growth of semipolar Al<sub>x</sub>Ga<sub>1-x</sub>N on m-plane sapphire for applications in deep-ultraviolet light emitters, K. Balakrishnan, M. Lachab, H. C. Chen, D. Blom, V. Adivarahan, **I. Ahmad**, Q. Fareed, M. A. Khan, Phys. Status Solidi A 208, No. 12, 2724–2729 (2011).
18. 276 nm Substrate-Free Flip-Chip AlGa<sub>N</sub> Light-Emitting Diodes, Seongmo Hwang, Daniel Morgan, Amanda Kesler, Mohamed Lachab, Bin Zhang, Ahmad Heidari, Haseeb Nazir, **Iftikhar Ahmad**, Joe Dion, Qhalid Fareed, Vinod Adivarahan, Monirul Islam, and Asif Khan, Appl. Phys. Express 4, 032102 (2011).
19. Dislocation reduction in high Al-content AlGa<sub>N</sub> films for deep ultraviolet light emitting diodes, **Iftikhar Ahmad**, Balakrishnan Krishnan, Bin Zhang, Qhalid Fareed, Mohamed Lachab, Joseph Dion, Asif Khan, Phys. Status Solidi A 208, No. 7 (2011).
20. Effect of Temperature on the Growth of InAs/GaAs Quantum Dots Grown on a Strained GaAs Layer, **Ahmad I.**, Avrutin V.; Morkoç H., Moore J. C., Baski, A. A., Journal of Nanoscience and Nanotechnology, Volume 7, Number 8 (2007).
21. Self-heating in a GaN based heterostructure field effect transistor: Ultraviolet and visible Raman measurements and simulations, **I. Ahmad**, V. Kasisomayajula, D. Y. Song, L. Tian, J. M. Berg, M. Holtz, J. Appl. Phys. 100, 113718 (2006).
22. Depth dependence of defect density and stress in GaN grown on SiC, N. Faleev, H. Temkin; **I. Ahmad**, M. Holtz, Yu. Melnik, J. Appl. Phys. 98, 123508 (2005).
23. Self-heating study of an AlGa<sub>N</sub>/Ga<sub>N</sub> based heterostructure field-effect transistor using ultraviolet micro-Raman scattering, **I. Ahmad**, V. Kasisomayajula, and M. Holtz, J. M. Berg, S. R. Kurtz, C. P. Tigges, A. A. Allerman, and A. G. Baca, Appl. Phys. Lett. 86, 173503 (2005).
24. Controlled growth of GaN nanowires by pulsed metalorganic chemical vapor deposition, G. Kipshidze, B. Yavich, A. Chandolu, J. Yun, V. Kuryatkov, **I. Ahmad**, D. Aurongzeb, M. Holtz, and H. Temkin, Appl. Phys. Lett. 86, 033104 (2005).
25. Optical properties of a nanoporous array in silicon, L. Tian, K. Bhargava Ram, **I. Ahmad**, L. Menon, and M. Holtz, J. Appl. Phys. 97, 026101 (2005).
26. Dependence of the stress–temperature coefficient on dislocation density in epitaxial GaN grown on  $\alpha$ -Al<sub>2</sub>O<sub>3</sub> and 6H–SiC substrates, **I. Ahmad** and M. Holtz, N. N. Faleev, and H. Temkin, J. Appl. Phys., 95, 4, (2004).
27. Deep Ultraviolet Light Emitting Diodes Based on Short Period Superlattices of AlN/AlGa(In)N, Sergey A. NIKISHIN, Vladimir V. KURYATKOV, Anilkumar CHANDOLU, Boris A. BORISOV, Gela D.

KIPSHIDZE, **Iftikhar AHMAD**, Mark HOLTZ, and Henryk TEMKIN, Jpn. J. Appl. Phys., 42, L 1362–L 1365 (2003).

28. Microfabrication and Characterization of Teflon AF-Coated Liquid Core Waveguide Channels in Silicon, Arindom Datta, In-Yong Eom, Achintya Dhar, Petr Kuban, Rosalynn Manor, **Iftikhar Ahmad**, Shubhra Gangopadhyay, Tim Dallas, Mark Holtz, Henryk Temkin, IEEE SENSORS JOURNAL, 3, 6, (2003).

#### Referred Conference articles:

1. Demonstration of thick phase-pure  $\beta$ -Ga<sub>2</sub>O<sub>3</sub> on a c-plane sapphire substrate using MOCVD, Proc. SPIE 12422, Oxide-based Materials and Devices, Mohi Uddin Jewel, Samiul Hasan, Scott R. Crittenden, Vitaliy Avrutin, Ümit Özgür, Hadis Morkoç, **Iftikhar Ahmad**, Proc. SPIE 12421, Proc. SPIE 12421, Gallium Nitride Materials and Devices XIV, 1242204, doi.org/10.1117/12.2661097 (2023).
2. Gate leakage current and threshold voltage characteristics of  $\beta$ -Ga<sub>2</sub>O<sub>3</sub> passivated AlGaIn/GaN based heterojunction field effect transistor, Samiul Hasan, Mohi Uddin Jewel, Scott R. Crittenden, Dongkyu Lee, Vitaliy S. Avrutin, Ümit Özgür, Hadis Morkoç, and **Iftikhar Ahmad**. Proc. SPIE 12421, Gallium Nitride Materials and Devices XVIII, 124210A, doi.org/10.1117/12.2668236 (2023).

#### Grants and Contracts

Project Title	Role	Sponsor	Total Amount and Share of Funding	Start Year	End Year
High-Power Electronic Chip Devices Using Novel Materials and Innovative Strategies	PI	NSF	\$549,989 (100%)	2023	2025
SCEEE Supplemental Grant: Research Experiences for Undergraduates (REU)	PI	SCEEE	\$5,000 (100%)	2021	2022
High Efficiency UV-LEDs Based on Hybrid 2D/3D Materials.	PI	NSF	\$375,501 (100%)	2021	2024
Achieving High Efficiency in Deep Ultraviolet Light Emitters Using Boron Nitride	PI	SCEEE	\$27,987 (100%)	2021	2022
Proposal for MOCVD Equipment for Ultra-wide Bandgap Research at the University of South Carolina.	PI	SETI	\$500,000 (100%)	2020	2022
Aspire 1: Low Cost Neutron Detector using Thick BN layers on Sapphire	PI	USC	\$15,000 (100%)	2019	2020

#### Patents:

1. Gallium Oxide based High-power vertical Micro-pixel Flip-chip Field Effect Transistors, Iftikhar Ahmad, *Samiul Hasan\**, US Patent Application No. 63.651,567; Filed on 05/24/2024.
2. IN-SITU DEPOSITION OF OXIDE PASSIVATION LAYER ON III-NITRIDE BASED HEMT, Iftikhar Ahmad, *Samiul Hasan\**, U.S. Appl. No. 18/520,979, Filing Date 11/28/2023.

3. PHASE STABILIZED GROWTH OF MONOCLINIC-GALLIUM OXIDE ON THERMALLY CONDUCTING MATERIALS, Iftikhar Ahmad, *Mohi Uddin Jewel\**, U.S. Appl. No. 63/479,384; Filing Date 01/11/2023.
4. Semiconductor and template for growing semiconductors, Vinod Adivarahan, Asif Khan, Iftikhar Ahmad, Bin Zhang, Alexander Lunev, Awarded Patent # 9859457 (2018). [Prior to joining USC].

### Number of Ph.D. Graduated

Dr. Iftikhar Ahmad has successfully supervised and graduated two (2) Ph.D. students who are making impactful contributions in their respective fields of semiconductor technology development. One of his students works at Intel Corporation, and the other is at Samsung Electronics. Both of his students are positively contributing to the field of semiconductors, earning respect for themselves and the University of South Carolina.

### Established a new lab at USC

1. Installed two Metal Organic Chemical Vapor Deposition (MOCVD) systems at USC.
2. Created material characterization facilities including UV-visible spectroscope, C-V measurements, Hall measurements, Atomic Force Microscopy, and semiconductor parameter analyzer.

The lab is worth more than \$1.5 M, which he uses for his research and teaching. The lab also facilitates other researchers at Molinaroli College of Engineering and other colleges in the university. The established lab also enables him to collaborate with different groups within and outside the university.

### Contribution in Presentation

1. Electrical properties of AlGaN/GaN based heterojunction field effect transistor structures with a  $\beta$ -Ga<sub>2</sub>O<sub>3</sub> gate dielectric grown by MOCVD, *Samiul Hasan\**, *Mohi Uddin Jewel\**, Scott R. Crittenden, Vitaliy Avrutin, Ümit Özgür, Hadis Morkoç, and **Iftikhar Ahmad** Photonics West, January 2023.
2. Phase Stabilized MOCVD Growth of Phase-Pure  $\beta$ -Ga<sub>2</sub>O<sub>3</sub> on c-Plane Sapphire, *Mohi Uddin Jewel\**, *Samiul Hasan\**, Scott R. Crittenden, Vitaliy Avrutin, Ümit Özgür, Hadis Morkoç, and **Iftikhar Ahmad**, SPIE Photonics West, January 2023.
3. Comparative Spectroscopic Study of AlN Grown by MOCVD in H<sub>2</sub> and N<sub>2</sub> Reaction Environment, *Samiul Hasan\**, *Mohi Uddin Jewel\**, Stavros Karakolos, Mikhael Gaevski, and **Iftikhar Ahmad**, Control ID 3676535, MRS 2022 – Online oral presentation.
4. Ultraviolet Light Emitting Diodes (U-LEDs), *Samiul Hassan\**, *Jewel Mohiuddin\** – Mentored by **Iftikhar Ahmad** – Discover UofSC, April 2022.
5. Native Point Defects in Gallium Oxide Material - *Jewel Mohiddin\**, *Samiul Hassan\**, Mentored by Iftikhar Ahmad– Discover UofSC, April 2022.
6. Comparative spectroscopic study of Aluminum Nitride grown by MOCVD in Hydrogen and Nitrogen reaction environment, *Samiul Hasan\**, *Jewel Mohiuddin\**, Stavros G. Karakalos, Mikhail Gaevski, and **Iftikhar Ahmad**, 22 MRS spring meeting 2022.

7. Growth of High Quality MOCVD Aluminum Nitride Using N<sub>2</sub> as Carrier Gas, **Samiul Hasan\***, Abdullah Mamun, Kamal Hussain, Dhruvinkumar Patel, Mikhail Gaevski, **Iftikhar Ahmad** and Asif Khan, presented at the Virtual Material Research Society Spring Meeting & Exhibit, (2021).
8. Thick AlN Templates By MOCVD for the Thermal Management of III-N Electronics A. Mamun, K. Hussain, M. U. Jewel, S. Mollah, K. Huynh, M. E. Liao, T. Bai, Y. R. Koh, Z. Cheng, M. S. B. Hoque, L. Yates, J. Gaskins, J. Tomko, **I. Ahmad**, M. Gaevski, M. Chandrashekhar, G. Simin, M. S. Goorsky, S. Graham, P. Hopkins, and A. Khan, 239th ECS meeting (May 30-June 3, 2021)
9. Crack and Strain Free 16 μm thick AlN on Sapphire templates, M. Mamun, Kamal Hussain, **A. Iftikhar**, M. Gaevski, MVS. Chandrashekhar, Kenny Huynh, Michael Liao, Tingyu Bai, M. Goorsky, G. Simin and Asif Khan, 13th International Conference on Nitride Semiconductor 2019 (ICNS-13), Bellevue, WA, July 07-12, 2019.
10. Recent advances in III-Nitride devices using ultrawide bandgap Al<sub>x</sub>Ga<sub>1-x</sub>N Active layers Mikhail Gaevski, Shahab Mollah, Kamal Hussain, Richard Floyd, Abdullah Mamun, MVS Chandrashekhar, Iftikhar Ahmad, Grigory Simin, Virginia Wheeler, Charles Eddy, and Asif Khan, 236th ECS Meeting, October 13-17, 2019, | Atlanta, GA (INVITED).
11. Mikhail Gaevski, Shahab Mollah, Kamal Hussain, Richard Floyd, Abdullah Mamun, MVS Chandrashekhar, Iftikhar Ahmad, Grigory Simin, Virginia Wheeler, Charles Eddy and Asif Khan, "Dynamic Performance of AlGaN MOSHFETs with high-k ALD oxides", 13th International Conference on Nitride Semiconductor 2019 (ICNS-13), Bellevue, WA, July 07-12, 2019.
12. Al<sub>x</sub>Ga<sub>1-x</sub>N (x>0.4) Channel MOSHFETs with high-k ALD gate-oxides, Shahab Mollah, Kamal Hussain, Richard Floyd, Abdullah Mamun, Mikhail Gaevski, MVS Chandrashekhar, Iftikhar Ahmad, Grigory Simin, Virginia Wheeler, Charles Eddy and Asif Khan, 13th International Conference on Nitride Semiconductor 2019 (ICNS-13), Bellevue, WA, July 07-12, 2019.
13. Solar Blind High-k ZrO<sub>2</sub>- Gate AlGaN MOSHFET Photodetector, Mohi Uddin Jewel, Md. Didarul Alam, Shahab Mollah, Richard Floyd, Kamal Hussain, Mikhail Gaevski, **Iftikhar Ahmad**, Grigory Simin, Asif Khan, and MVS Chandrashekhar, 13th International Conference on Nitride Semiconductor 2019 (ICNS-13), Bellevue, WA, July 07-12, 2019.
14. AlGaN MOSHFETs with high-k ALD oxides, Shahab Mollah, Richard Floyd, Kamal Hussain, Mikhail Gaevski, **Iftikhar Ahmad**, MVS Chandrashekhar, Grigory Simin, Virginia Wheeler, Charles Eddy and Asif Khan, 61st Electronic Materials Conference (EMC) 2019, Ann Arbor, MI, June 26-28, 2019.

#### **Awards and Honors**

1. "Outstanding PhD Student" by Texas Tech University Department of Physics –
2. April 2004.
3. "Peter J. Seibt Graduate Scholarship in Physics" by Texas Tech University Department of Physics. (Excellence in Experimental Physics) - April 2004
4. "Peter J. Seibt Graduate Scholarship in Physics" by Texas Tech University Department of Physics. (Excellence in Experimental Physics) - April 2003
5. Nominated for Nanotechnology Foundation of Texas (NFT) fellowship - 2003
6. "Outstanding MSI Student" in applied physics graduate program by Texas Tech University Department of Physics – April 2002.

7. Awarded "University Gold Medal" by PU, Pakistan, M.Sc. Degree – Ist in University of the Punjab (PU), Pakistan.
8. Awarded "Phillips Electrical Company of Pakistan Gold Medal" for M.Sc. - Ist Position in Physics from Govt. College Lahore, Pakistan.
9. Merit Certificate, University of the Punjab (UP), Pakistan.
10. Certificate of Merit (Academic), Govt. Collage Lahore, Pakistan.