

The Importance of PML

Why should semiconductor technology be important to you?

First, it's important because it enables technology that has transformed the way we live—your computer, your cell phone, and your DVD player are every day products based on semiconductor technology.

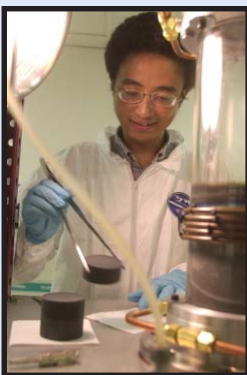
A second and even more important reason is the development of solid-state white and multi-color lighting which will result in a paradigm shift for the current indoor and outdoor lighting and display technology. PML's low voltage light sources currently under development will allow a tremendous savings of energy.

Third, PML researchers are developing deep ultraviolet light-emitters which have a major impact on our homeland defense, public health, medicine, and advanced high tech manufacturing. These devices are key to developing miniature systems for anthrax detection, water purification, and solid-state white lighting. Stopping a biological attack requires the fast detection of pathogens, and ultraviolet laser-induced auto-fluorescence of biological material markers provides a real-time technique for detecting airborne pathogens such as aerosolized bacterial spores and viruses. Additionally, semiconductor UV optical sources offer the potential of low cost, small size, low power, and high reliability in contrast to conventional mercury lamps.

PML is focused on the future of discovering and developing new techniques to revolutionize this industry and solve the problems of tomorrow.



MOCVD reactor



Preparation for growth of semiconductor



Photonics & Microelectronics Lab



Innovative Technology for Tomorrow's World

Dr. M. Asif Khan
Founding Director

301 South Main Street
Columbia, SC 29208



PML Training and Facilities

... outstanding in every way

The Photonics and Microelectronics Laboratory located at the USC Columbia campus serves as a hub for leading edge research, development, and education in the areas of photonics and microelectronics with a strong emphasis towards wide bandgap GaN and SiC materials and devices. It provides the skilled manpower required for local high-tech businesses and strongly supports South Carolina Department of Commerce's mission of attracting semiconductor businesses to the state.

The goals set for the Photonics and Microelectronics Laboratory are:

- Establish vertically integrated capabilities for materials and device fabrication, packaging, and testing.
- Establish an interdisciplinary photonics-microelectronics education program in the College of Engineering.
- Strengthen USC's position in photonics by hiring recognized leaders in the core technology disciplines.
- Transition technology from R&D to industrial applications via small business incubation.
- Establish active research and product development programs with industrial sponsors.

Located in the College of Engineering and Information Technology at USC, the lab has dedicated 20,000 sq. ft. clean-room lab facilities and office spaces for activities in the opto-electronic materials and devices and systems disciplines. These labs are capable of research and development in fabrication and testing of active and passive photonics devices, fiber-optical components, and opto-mechanical packaging. The laboratory personnel have multi-

disciplinary skills from Electrical, Computer, Mechanical, Optical and Chemical Engineering, Physics, and Chemistry.

The infrastructure for the laboratory was put into place using federal research and development grants. Presently it has about 18 Ph.D. scientists and about 20 graduate students. Several innovative technologies have already resulted from the research. The lab now enjoys support from Northrop Grumman, Triquent, Lockheed Martin, GE, and Raytheon. In addition, several DOD agencies such as the Missile Defense Agency, DARPA, Navy, and Army funding also support the PML Lab.

The research program is closely coupled to a related education program which has both an undergraduate and graduate component. Both of these educational programs will be carried out with an accompanying photonics-microelectronics lab. The students from these programs will graduate and be fully capable of supporting and enhancing the South Carolina-based high-tech industries.

The Photonics and Microelectronics Laboratory facilities are at present producing photonic devices such as lasers, LEDs, and detectors. They are also being used to fabricate high frequency high power transistors for military radar systems. These facilities contain MOCVD epitaxial layer deposition systems that can be used to grow multi-layer hetero-junction devices. The PML has accompanying material characterization facilities including those for photoluminescence, scanning electron microscopy and hall and CV, IV, Electron Microscopy, X-ray, SEM and TEM. The device fabrication facilities are comprised of photolithography, metallization, reactive-ion etching, contacts annealing and rf-sputtering. In addition, there are device DC, rf, noise and power measurement systems capable of operation up to 50 GHz.

Dr. M. Asif Khan

Founding Director, PML
Chair, Electrical Engineering Department
Carolina Distinguished Professor
Distinguished Professor of Engineering



Dr. Khan joined the University of South Carolina's EE Department in 1997 as a Professor, and in June 2001 he became the Chair of the Department of Electrical Engineering. Dr. Khan earned a Ph.D. from the Massachusetts Institute of Technology, Cambridge, in 1979. Under his tenure the department successfully

completed its ABET accreditation. He also was instrumental in hiring four new faculty, two of whom have already secured the National Science Foundation CAREER Award, a highly prestigious award which recognizes and supports the early career development activities of those faculty scholars who are deemed most promising to become leaders in academia in the 21st century.

The Electrical Engineering Department is a high profile member of the university's research community, having departmental research expenditures in the top 20 percent on the NSF ERC survey. The EE Photonics and Microelectronics Lab which Dr. Khan established in 1997 is a 15,000 square foot Class 1000 clean room facility which is designed to have full MOCVD growth, photolithography, material and device fabrication, packaging, and characterization capabilities. The initial focus is on the fabrication of AlGaIn and SiC-based high power microwave transistors for high temperature operations and deep UV light emitters.

Dr. Khan brings a solid research and business background to the educational arena as he worked in industry prior to coming to USC. He was the Vice President of Optoelectronics Products at APA Optics where his research group did pioneering work in the development of GaN-AlGaIn materials and devices. He was a

Technical Marketing and Product Manager in the Optical Disc Development project at 3M Company and a senior principal research scientist with Honeywell's Corporate Research Center. He has extensive experience in originating leading edge research in the III-V semiconductor technology area. In the past five years his own research funding has averaged around \$3 million per year, and he has received over 70 grants and contracts over the years totaling more than \$30 million from the Office of Naval Research (ONR), Defense Advanced Research Projects Agency (DARPA), Missile Defense Agency (MDA), AFOSR, Wright-Patterson Airforce Base, Rockwell, Northrop Grumman, Triquint, SET, Inc., and General Electric. Dr. Khan has authored over 250 refereed papers, several book chapters, and over 60 invited papers. He has been granted ten patents.



Cutting edge research and education continue on a daily basis while Dr. Khan is preparing for a Site Visit in late October from the National Science Foundation who will be reviewing his proposal for funding an NSF Science and Technology Center (STC).



A Glimpse into the Photonics and Microelectronic Laboratory



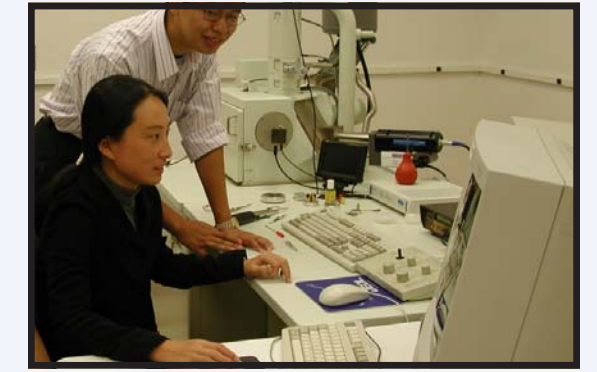
MOCVD Aixtron multi-wafer growth



Etching and Metallization



Growth Laboratory



Scanning Electron Microscope



Photolithography



Device Characterization

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