DR. ANDREW SARANGAN, PROFESSOR

Department of Electro-Optics and Photonics

Andrew Sarangan, professor at the University of Dayton School of Engineering, directs the Nanofabrication and Nanophotonics Cleanroom Laboratory.

Sarangan teaches and conducts research guided by the principles of engineering, i.e., to build innovative things that solve real life problems. He says, "Engineering requires a thorough understanding of mathematics and science. This is the fuel-air mixture. Innovation is the spark that ignites this mixture to do useful things."

In 2006, Sarangan built the Nano-Fab Lab entirely from externally sponsored research funding and has continued to operate and upgrade its capability with support from government and private companies.

Ten years later, the Lab's advanced capabilities include optical thin film deposition, photolithography, deep-UV nano-lithography, semiconductor diffusion and oxidation processes, and a variety of plasma etching capabilities.

Sarangan focuses on two research areas: photonic devices such as photodetectors, waveguides and polarizers, and optical thin film design and synthesis. He endeavors not only to come up with great ideas but also to build and test functional prototypes.

Nanofabrication is the key enabler that makes integrated circuits (electronic chips) possible. It involves synthesizing and depositing novel types of material, patterning these materials, and then removing them (etching) in a systematic manner.

The next-generation of electronic chips will inevitably include some photonic components. This requires the development of nanoscale photonic components that are compatible with electronic integrated circuit manufacturing and assembly processes. This is the overarching vision of Sarangan's research.

Specifically, his research includes developing new nanoscale materials that can emit, detect and manipulate light, and designing new device concepts for boosting their performance.

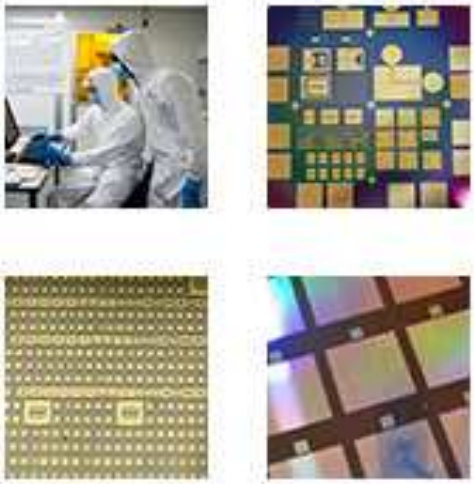
Sarangan uses a novel deposition method for creating nanostructured thin films with optical properties that can be engineered to meet specific characteristics.

He also developed a method to make silicon nanowires that exhibit unusual light absorption because of a quantum mechanical process known as sub-band absorption. He plans to utilize these materials in the next-generation photonic integrated circuits.

Sarangan's current grants include an Air Force funded project on "Interferometric Lithography," two projects funded by the National Science Foundation (NSF) and one funded by the Army Research Office.

One NSF project is a collaboration between Sarangan and Dr. Keigo Hirakawa, associate professor with the Department of Electrical and Computer Engineering. In it, they work to develop an image sensor that can record the full spectrum of color (or wavelengths) instead of the traditional red, green and blue. They plan on extending this concept to the infrared spectrum where the concept of color does not even exist.

In another project, in collaboration with Dr. Joseph Haus, professor with the Department of Electro-Optics and Photonics, and Dr. Imad Agha, assistant professor, Department of Physics and Electro-Optics, Sarangan works to develop a new method for detecting light using a phenomenon known as quantum tunneling through ultra-thin layers.



Nanofabrication and Nanophotonics Cleanroom Laboratory and Thin Films

In the past, Sarangan was principal investigator on an NSF grant to establish a nanotechnology curriculum to undergraduate engineering students. He worked with Sinclair Community College and created an innovative delivery method for enhancing the teaching methods used in nanotechnology education.

New on the horizon, Sarangan plans to build electro-optic chips for biologists, chemists and toxicologists to study how biological cells respond to various environments. Known as "organs on a chip," these are chips, not unlike electronic chips, that mimic the behavior of real organs, so responses to various stimuli and toxins can be studied easily, reliably and safely.

Sarangan's Nano-Fab Lab has the capability to enable conceptualizing and building prototypes of all of the aforementioned. He and his graduate students do everything in the lab to keep it operational, including maintenance and repairs. He insists that his students develop useful, practical skills, and focus on building things that people need. As Sarangan says, he is an "engineer, and engineers build useful things."

Sarangan's courses, labs and research projects appeal to a wide range of students. He came up with the idea of using a live interactive video system for teaching to a classroom directly from his cleanroom laboratory.

The video setup allows for greater accessibility to a larger number of students and saves time because students do not have to "gown-up," to enter the Lab. The system is like a super-broadband Skype with multiple cameras and multiple microphones. Sarangan can see and hear every student in the classroom, and the students can see every detail of the equipment or process that he is teaching.

Hands-on with state-of-the-art labs and mentoring describes Sarangan's teaching style. He teaches and conducts research with undergraduate and graduate students from multi-disciplines: electro-optics, electrical and computer engineering, mechanical engineering and materials engineering. His teaching oeuvre encompasses Nano Fabrication, Integrated Optics, Quantum Electronics, Nano Photonics, Optical Thin Films, and Advanced and Principles of Nanotechnology.

As testimony to his teaching and research efforts, Sarangan has been honored with the *Faculty Excellence in Teaching Award* from the Southwestern Ohio Council for Higher Education and the *Sigma Xi Noland Award for Excellence in Research*.