Nanofabrication Technologies for Optoelectronics, Imaging, Sensing, and Displays

Professor Jay Guo’s group is conducting research in nano and microphotonic devices and developing nanofabrication technologies. They have exploited light confinement and enhancement effect of plasmonic nanoantennas for applications in organic solar cells, nanolasers, flexible displays, optical and electronic metamaterial structures, photoacoustic imaging, and biochemical sensors. They have also developed a polymer microresonator as a novel platform for ultrasound detection with high sensitivity and broadband response. In addition, his group has been working on understanding the unique one-step direct transfer technique for fabricating pristine nanomaterial with exceptional electrical, mechanical, and optical properties. They have developed novel 3D reversible nanoimprint and dry etching technology for high performance sensors and single molecule microfluidic systems.

Carbon Nanotubes

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High-efficiency, high-resolution light-confinement plasmonic color filters using nanostructured metallic dielectric metal stacks (left). Nanopatters on a flexible substrate fabricated by high-speed and continuous roll-to-roll nanoimprint process.

A Snapshot of Current Research by Associated Faculty Members

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Faculty in Electrical and Computer Engineering at Michigan have the expertise to conduct CNPS-related research in the specialty areas of photonics, optics and optoelectronics, spintronics, and microelectronics. This research impacts the application areas of quantum information processing, secure communication, quantum optics, spin-based nanoelectronics, and ultimately devices for the diverse applications listed above. An introduction to the research conducted by faculty in the division of Electrical and Computer Engineering in the area of nanoscale photonics and spintronics is provided in this brochure.

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For more information, contact:
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### Center Associated Faculty Members

**Pallab Bhattacharya**
Charles M. Vest Distinguished University Professor and James R. Mellor Professor of Engineering
Research Interests: Molecular beam epitaxy, low-dimensional quantum confined systems, quantum dot lasers and detectors, nanowire devices, optoelectronic integrated circuits, spintronic devices

**Stephen R. Forrest**
Vice President for Research, William Gould Dow Professor of Electrical Engineering
Research Interests: Organic electronics, photonic integrated circuits, photonic materials

**Lingjie (Jay) Guo**
Associate Professor
Research Interests: Nanofabrication technology and applications, photonic microresonator sensors, organic photovoltaic, nanophotonics, and nanoelectronics

**Pei-Cheng (P. C.) Ku**
Assistant Professor
Research Interests: Optoelectronic devices and materials

**Wei Lu**
Assistant Professor
Research Interests: Nanoelectronics, growth of nanoscale semiconductor heterostructures, novel electronic device structures and device physics, solid-state based spintronics, nanoelectromechanical systems

**Stella W. Pang**
Professor
Research Interests: Nanofabrication technology, dry etching, dry deposition, microelectronic, optical, micromechanical and biomedical devices

**Jamie D. Phillips**
Associate Professor
Research Interests: Compound semiconductor and oxide materials for electronic and optoelectronic devices

**Zhaoxue Zhong**
Assistant Professor
Research Interests: Nanoelectronics and nanophotonics, microwave and terahertz frequency nanoelectronics, solar cell technology, chemical and biological sensing, nanomaterial synthesis

### Resources

**Solid-State Electronics Laboratory (SSEL)**
The SSEL is home for 27 faculty members and 127 graduate students conducting research in microelectronic, optoelectronic and spintronic devices, materials growth and characterization, micro-and nanofabrication, and micromachined devices, circuits, and microsystems (MEMS). Faculty members in SSEL offer a variety of undergraduate and graduate courses in these areas. The Lurie Nanofabrication Facility (LNF), a state-of-the-art materials processing and device and circuits fabrication facility, is an integral part of SSEL and a national resource.

**National Nanotechnology Infrastructure Network (NNIN)**
The National Nanotechnology Infrastructure Network (NNIN) is an integrated networked partnership of 13 user facilities, supported by the National Science Foundation since March 1, 2004. The NNIN provides users across the nation open access to leading-edge tools and capabilities to help enable their individual research projects. The NNIN also has extensive education, training, and outreach activities, as well as programs on societal and ethical issues involving nanotechnology.

**Facilities, Equipment, and Laboratories**
The SSEL and LNF provide among the most extensive facilities in the nation for research in nanoscale photonics, electronics, spintronics, and in the other diverse areas listed above (including solid-state circuits, MEMS, displays). Highlights are:
- Over 11,000 sq. ft. class 1000/100/10 cleanrooms
- Dedicated areas for:
  - Silicon processing
  - Compound semiconductor devices
  - Thin films deposition
  - Wet and dry etching
  - Electron beam lithography
  - Metrology
- III-V materials growth by MBE and MOCVD
- Organic semiconductor growth and device fabrication
- Synthesis and processing of carbon nanotubes and spintronics materials
- Laboratories for packaging and testing
- Laboratories for optical, electrical, and magnetic measurements on materials and devices including nanoscale structures and devices
- Laboratories for time-resolved optical measurements in the visible and near-infrared wavelength ranges
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