

## NSE-845 Nanolithography and Device Fabrication

**Prerequisite:** Nil

**Category:** Elective Course

Existing Course Contents	Proposed Changes
<ul style="list-style-type: none"> <li>• Nanofabrication by Scanning Probes, Exposure of Resist by STM</li> <li>• Exposure of Resist by NSOM, Local Oxidation Lithography</li> <li>• Additive Nanofabrication, Field-Induced Deposition, Dip-Pen Nanolithography</li> <li>• Subtractive Nanofabrication, Electrochemical Etching</li> <li>• Field-induced Decomposition, Thermomechanical Indentation</li> <li>• Mechanical Scratching, High-Throughput SPL</li> <li>• Nanofabrication by Replication, Thermal Press Nanoimprint</li> <li>• Nanoimprint Stamps, Nanoimprint Polymers, Demolding, Alignment</li> <li>• Room Temperature Nanoimprint, UV-Cured Nanoimprint</li> <li>• Transparent Stamps, UV Curable Polymers</li> <li>• Soft Lithography; Soft Stamps, Micro-contact Printing</li> <li>• Replication by Capillary Force Nanoscale Pattern Transfer</li> <li>• Additive Pattern Transfer; Thin Film Deposition, Pattern Transfer by Lift-Off</li> <li>• Pattern Transfer by Plating, Damascene Process</li> <li>• Pattern Transfer by Stencil Mask, Subtractive Pattern Transfer</li> <li>• Isotropic Wet Etching, Anisotropic Wet Etching Reactive-Ion Etching (RIE)</li> <li>• Process Control in Nanoscale RIE</li> <li>• RIE by Inductively Coupled Plasma Critical Issues in RIE</li> <li>• Ion Milling Indirect Nanofabrication Sidewall Lithography</li> <li>• Dimensional Subtraction and Addition; Lateral Subtraction</li> <li>• Lateral Addition, Vertical Subtraction, Nanosphere Lithography</li> <li>• Multistep Processing , Super Resolution Patterning</li> </ul>	<ul style="list-style-type: none"> <li>• Introduction               <ul style="list-style-type: none"> <li>• Introduction and Classification of Lithographic Techniques</li> <li>• The Role of Lithography in Microfabrication and Nanofabrication</li> <li>• Introduction to Device Fabrication Process Flows</li> </ul> </li> <li>• Charged Particle Lithography               <ul style="list-style-type: none"> <li>• Electron Beam Lithography (EBL)</li> <li>• Ion Beam Lithography (IBL)</li> </ul> </li> <li>• Optical Lithography or Photolithography               <ul style="list-style-type: none"> <li>• Ultra-Violet Lithography (UVL)</li> <li>• Deep Ultra-Violet Lithography (DUVL)</li> </ul> </li> <li>• Mechanical and Chemo-Mechanical Lithography Techniques               <ul style="list-style-type: none"> <li>• Microcontact Printing (<math>\mu</math>CP) and Nanoimprint Lithography (NIL)</li> <li>• Scanning Probe Lithography (SPL) and Dip-Pen Nanolithography (DPN)</li> </ul> </li> <li>• Lesser Known Lithography Techniques               <ul style="list-style-type: none"> <li>• Two-Photon Stereolithography; Holographic Lithography; Local Oxidation Lithography; Nanosphere Lithography</li> <li>• Block-Copolymer Directed Self Assembly (BCP-DSA)</li> </ul> </li> <li>• Device Fabrication               <ul style="list-style-type: none"> <li>• Examples of devices and device fabrication process flows will be provided after the end of each lithography section listed above. Pattern transfer categories:                   <ul style="list-style-type: none"> <li>• Metallization + Lift-off (Additive)</li> <li>• Etching + Resist removal (Subtractive)</li> </ul> </li> </ul> </li> </ul>

<ul style="list-style-type: none"> <li>• Nanofabrication by Self-Assembly, Self-Assembly Processes</li> <li>• Guided Self-Assembly, Building Blocks of Future Nanosystems</li> <li>• DNA Scaffold, Carbon Nanotubes, Block Copolymers, Porous Alumina</li> </ul>	
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### Proposed Weekly Plan for the Concerned Faculty

Week /Lecture	Topic
1-3	Introduction <ul style="list-style-type: none"> <li>• Introduction and Classification of Lithographic Techniques</li> <li>• The Role of Lithography in Microfabrication and Nanofabrication</li> <li>• Introduction to Device Fabrication Process Flows</li> </ul>
4-6	Charged Particle Lithography <ul style="list-style-type: none"> <li>• Electron Beam Lithography (EBL)</li> <li>• Ion Beam Lithography (IBL)</li> </ul>
7-9	Optical Lithography or Photolithography <ul style="list-style-type: none"> <li>• Ultra-Violet Lithography (UVL)</li> <li>• Deep Ultra-Violet Lithography (DUVL)</li> </ul>
10-12	Mechanical and Chemo-Mechanical Lithography Techniques <ul style="list-style-type: none"> <li>• Microcontact Printing (<math>\mu</math>CP) and Nanoimprint Lithography (NIL)</li> <li>• Scanning Probe Lithography (SPL) and Dip-Pen Nanolithography (DPN)</li> </ul>
13-15	Lesser Known Lithography Techniques <ul style="list-style-type: none"> <li>• Two-Photon Stereolithography; Holographic Lithography; Local Oxidation Lithography; Nanosphere Lithography</li> <li>• Block-Copolymer Directed Self Assembly (BCP-DSA)</li> </ul>
15-17	Device Fabrication <ul style="list-style-type: none"> <li>• Examples of devices and device fabrication process flows will be provided after the end of each lithography section listed above. Pattern transfer categories:</li> <li>• Metallization + Lift-off (Additive)</li> <li>• Etching + Resist removal (Subtractive)</li> </ul>