

Fabrication of nanostructures and nanoscale devices

Prof Galina Tsirlina

1. Optical and Electronic Lithography
 - 1.1. Polymer and inorganic resists (composition, solubility, microstructure)
 - 1.2. Spin-coating, adhesion, roughness
 - 1.3. Light and beam interactions with positive and negative resists; amplification
 - 1.4. Post-exposure procedures (developers, thermal effects, wetting)
 - 1.5. Maskless lithography
2. Fabrication of Thin Films
 - 2.1. Supports (etching, polishing, termination)
 - 2.2. Physical vapor deposition (thermal, laser, magnetron; growth control and monitoring)
 - 2.3. Chemical vapor deposition (CVD) (precursors, reactors, plasma assisted modes)
 - 2.4. Exfoliation of vdW thin films
 - 2.5. Epitaxial films (MBE, ALD)
 - 2.6. Wet deposition (electroless, electrochemical)
3. Local Fabrication Techniques
 - 3.1. Focused ion beam (imaging, milling, implantation, deposition)
 - 3.2. Probe microscopes as fabrication tools (printing, grafting, deposition)
 - 3.3. Mechanical manipulation
 - 3.4. Light-assisted technologies
4. Fabrication of 1D objects
 - 4.1. Carbon nanotubes (free-standing, SW, MW)
 - 4.2. Ordered templates for fabrication of nanowires (track membranes, AAO)
 - 4.3. Templated fabrication of nanowires (filling under pressure, electrodeposition)
 - 4.4. Isolation of single nanowires and nanotubes
5. Fabrication of 0D objects
 - 5.1. Colloidal metals
 - 5.2. Semiconductor quantum dots
 - 5.3. Characterization (UV-vis spectra, dynamic light scattering)
6. Assembling of low-dimensional objects
 - 6.1. Dry transfer methods
 - 6.2. Wet transfer methods
 - 6.3. Fabrication of junctions and contacts
 - 6.4. Fabrication of nm-size gaps
7. Nanometrology
 - 7.1. Characterization of single objects (TEM, SEM, probe techniques; image distortions)
 - 7.2. Compositional analysis (EDX, vibration spectroscopy, X-ray scattering)
8. Fabrication of superconducting circuits <presented by Prof Vladimir Manucharyan (EPFL, Lausanne) <https://people.epfl.ch/vladimir.manucharyan/?lang=en>
9. Laboratory training (individual assignments, to be started in 2024)