



EDMI MICRO-724 (2022)

Advanced micro and nanomanufacturing: top-down meets bottom-up

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Teachers

Schedule

Group formation

Mini-project preparation

All relevant class material is provided via the MOODLE

Teachers:

- Francesc Murano-Perez (CNM Barcelona)
- Karl Bohringer (U-Washington, Seattle)
- Massimo Mastrangeli (TU-Delft)
- Juergen Brugger (EPFL)



Date	Activity	Comment
Aug 15	Deadline for registration	20 students max
Aug 16	PhD students upload info on their background and PhD study/status.	template will be provided
Aug 22-26	Introduction lectures by 4 Professors	Online for the all lectures teachers; schedule see below https://epfl.zoom.us/j/61857650676
Aug 26	Form n groups of m PhD students	
Aug 26	Define concept mini-project per group	
Aug 26- Sep 26	Time for literature reading, self-study, group discussion, project brainstorming, report writing	
Sep 16	Progress feedback	
Sep 26	Hand-in mini-report and draft slides	
Sep 27	Advanced lectures	In-person for all professors; detailed schedule below
Sep 30	Group presenting their mini-project; discussion and feedback	All students and professors; detailed schedule below

Part I: introduction lectures online

Schedule for introduction lessons (online):				
	Tue 23 Aug	Wed 24 Aug	Thu 25 Aug	Fri 26 Aug
09h15 - 11h	JB	-	-	-
10h15 - 12h	-	FPM	-	MM
16h15 - 18h	-	-	KB	

Part II: advanced lectures (in person)

Schedule for advanced lessons (in-class on EPFL-Lausanne Campus):				
	Tue 27 Sep	Wed 28 Sep	Thu 29 Sep	Fri 30 Sep
09:15-12h	KB	JB	MM	Students' presentations
15:15-18h	-	-	FPM	-

JB

Intro lesson:

- Recap of (top-down) lithography
- Basics in Nanostencil lithography
- Basics in t-SPL

Advanced lesson:

- Advances in Nanostencil lithography
- Advances in t-SPL

2 Review papers and ~ 1-2 recent scientific paper will be provided for your study

FPM

Intro lesson:

- Recap on electron and ion beam lithography
 - Principles and limitations
 - Relevant examples of ion beam patterning
- Directed self-assembly (DSA)
 - Bottom-up vs top down fabrication
 - DSA for high volume manufacturing
 - Principles of DSA of block co-polymers

Advanced lesson:

- Ion beam patterning for the fabrication of Nanoelectronic and nanomechanical devices
- Advanced DSA aspects:
 - Methods for creating guiding patterns
 - Applications

KB

Intro lesson:

- Self-assembling microsystems: motivation and history
- Taxonomy: serial vs. parallel, deterministic vs. stochastic; capillary-driven, lock-and-key, templated, fluidic)

Advanced lesson:

- Self-assembly by shape-matching
 - Palletizing on templates
- Surface tension driven self-assembly
 - Assembly in bulk liquids
 - Assembly at the air water interface
 - Models for self-assembly by surface tension
- Computational aspects
 - Self-assembly and chemical reaction kinetics
 - Self-assembly and computation
 - Wang tiles and Sierpinski triangles

MM

Intro lesson:

- Particle diffusion and entrapment
- Coffee stain effect
- Wetting and topography: Modes of flow coating
- Capillarity-assisted single nanoparticle printing

Advanced lesson:

- Advances in flow coating
- Advances in CAPA

Mini-projects

(to define by early next week)

Teacher's topics examples

- How to create a guiding pattern with alternative top-down method for self-assembly
- How to create a grayscale pattern using alternative top-down methods.
- How to engineer a self-assembly system to avoid ambiguity.
- How to assemble LEDs in large scale manufacturing.
- How to fabricate large-scale substrates for single nanoparticle printing without lithography
- ...

Student's topics

- ... tbd

Summary of workflow

- Intro lesson on alternative top-down and bottom-up micro/nano fabrication
- Review papers to get overview of state of the art
- Recent research papers to learn about latest trends/interest
- Define research topic mini-project → apply alternative methods for a device of interest, close to your thesis topic
- Work in a group to share mutual knowledge
- Present mini-report and presentation to class and teachers