EDMI MICRO-724 (2025)

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

J. Brugger, F. Perez-Murano, K. Böhringer, M. Mastrangeli

PhD course MICRO-724

Teachers

Schedule

Group formation

Mini-project preparation

All relevant class material is provided via the MOODLE

PhD course MICRO-724

Teachers:

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

Workflow

Aug_15	Deadline for registration	~25 students max
Aug_17	PhD students upload info on their background and PhD study/status.	gdrive link
Aug_20	Review papers will be assigned for reading	Get an overview of the field
Aug_29	Form groups of PhD students	
Sep_01	Time for literature reading, group discussion, review paper summary, in groups	upload documents to moodle; ensure you are prepared to benefit from detailed discussions
Sep_02	AM: lecture JB, PM: lecture KB	room AAC 006
Sep_03	AM: lecture FPM, AM: lecture MM	room AAC 006
Sep_04	Time for groups to prepare material for workshop presentation	upload documents to Moodle
Sep_05	Group present their mini-project; discussion and feedback	All students and professors; room AAC 014

Week schedule

Schedule for lessons (in-class on EPFL-Lausanne Campus)					
	Mon 1 Sep Campus/HO	Tue 2 Sep AAC 0 06	Wed 3 Sep AAC 0 06	Thu 4 Sep Campus/HO	Fri 5 Sep AAC 0 14
09:15-12h	self study	JB	FPM	workshop prep	workshop
15:15-18h	self study	KB	MM	workshop prep	-

Participants

- Profile of all participants is on Moodle
- Background, interest, PhD topic, etc are listed
- Groups of 5 have been formed
  1. FACS
  2. Smallest Transistor
  3. Device/systems of own choice
  4. microLED

Participants in groups

Smallest transistor	microLED	FACS	Device of your choice	No group
Morteza Dadashi Jordehe	Ehsan Ansari	Chih-Ying Chang	Yagmur Ceren Alatas	
Lotte Franciska N De Schrijver	Francesco Bertot	Suraj Kumar Maurya	Alexandre Germain Philippe Domenech	
Ivan Krsic	Sandra Hernández Escobar	Rahim Vesal	Suraj Bhimrao Gaikwad	
Luca Mazzone	Léo Mutschler	Tao Zhang	Giada Romano	
Ketong Yang	Shulang Shen	Karim Kouny	Prabhleen Singh	

Lectures

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:
- Vazquez-Mena et al. Nanostencil review
- Howel et al. t-SPL review

Lectures

KB	Intro lesson:
	• Self-assembling microsystems: motivation and history
	• Taxonomy: serial vs. parallel, deterministic vs. stochastic; capillary-driven, lock-and-key, templated, fluidic)
	
	Advanced lessons:
	• Micro-scale self-assembly techniques
	  • Shape-matching
	  • Palletizing on templates
	  • The uniqueness challenge
	  • Surface tension driven self-assembly
	  • Assembly in bulk liquids
	  • Assembly at the air water interface
	  • Models for self-assembly by surface tension
	• Computational aspects
	  • Chemical reaction kinetics
	  • Self-assembly and computation

Lectures

FPM	Intro lesson:
	• Recap on main top down lithography methods
	  • Figures of merit for lithography
	  • Optical lithography state of the art
	  • Electron and ion beam lithography
	• Directed self-assembly (DSA)
	  • Bottom-up vs top down fabrication
	  • Principles of DSA of block co-polymers
	
	Advanced lesson:
	• Advanced DSA aspects

Lectures

MM	Intro lesson: •Top-down meets bottom up •Particle diffusion and entrapment •Directed NP assembly: optical, magnetic, electric, capillary Advanced lesson: •Advances in flow coating •Advances in capillary nanoparticle assembly

Workshop schedule

09:15 - 09:45 Group #

09:45 - 10:15 Group #

10:15 - 10:30 Break

10:30 - 11:00 Group #

11:00 - 11:30 Group #

11:30 - 12:00 General discussion and feedback

Each group 30 min in total (20 min presentation + 10 min discussion)

Each group member presents an average of 4 min

Guideline for workshop

- Balanced presentation among group members
- Balanced content for experts and novices
- You may use following structure and adapt it to your group topic:
  - Overview of device/systems relevance in current applications
  - Historical facts and developments
  - Who are key players in the field (academics, industry)
  - Advanced specifications achieved and aimed at in the future
  - Manufacturing techniques used, process flow challenges, breakthroughs, etc.
  - Possible future scenario using topics covered in the course
  - Any other interesting observation you may want to share