

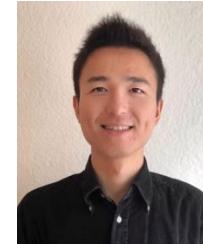
# Advanced additive manufacturing technologies

MICRO-413

Spring semester 2025

# Teaching team

- Jürgen Brugger
- Christophe Moser
- Guest lectures
  - External industry speakers
- TA's
  - Jongeon Park, Sönke Menke, Tao Zhang, Maria Isabel Alvarez Castaño



# Calendar

- Week 1 (all)
  - Intro lecture topics, practicals, seminars and workshop, Lecture start (JB)
- Week 2-4 (J. Brugger)
  - Inkjet and other digital/on-demand printing
- Week 5-8 (Ch. Moser)
  - In-depth Light-based photopolymerization technologies
- Week 10-15
  - Guest lectures with experts from Industry and Academia
  - Workshop
- Lectures (2h) and TP/exercises (2h)

Week	Date	Lecturer	Topics	In class exercise	TP
1	20.02.	all	Intro to course, TP's, form groups start lecture on DOD (JB)	---	---
2	27.02.	JB	Drop on demand printing (DOD), aka inkjet printing, drop generation, drop surface interaction	Exercise 1 (1h) drop formation	---
3	06.03.	JB	Other material printing techniques, laser induced forward transfer (LIFT), nanoscale methods, transfer printing	Exercise 2 (1h) drop/substrate interaction	TP IJP (3h printing session, 2h characterization)
4	13.03.	JB, BT	Other advanced printing techniques, Melt Electro Writing (MEW)	Exercise 3 (1h) LIFT	TP IJP (3h printing session, 2h characterization)
5	20.03.	Ye. Pu	Photo induced radical polymerization - chemical components in DLP resins - role of oxygen – CLIP method -	---	TP IJP (3h printing session, 2h characterization)
6	27.03.	CM	In-depth VAT 3D printer – resolution vs build volume-	Exercise 4 (1h) photochemistry	TP IJP (3h printing session, 2h characterization)
7	03.04.	CM	Volumetric printing by tomographic back projection. Principle of two photon absorption – peak power required in practice	Exercise 5 (1h) photochemistry	TP SLA training 1/ group
8	10.04.	CM	Two photon polymerization and applications	Exercise 6 (1h) volumetric printing	TP SLA last group 1h per group/ First printing session
9	17.04.	CM	Two photon polymerization and applications	Exercise 7 (1h) volumetric printing	TP SLA printing se
10	24.04.	---	Easter break	---	---
11	01.05.	Prof. Paul Dalton, University of Oregon	tbd	---	TP SLA printing se and imaging sess per group
12	08.05.	Dr. Gari Arutinov, Holst Center	An Overview of Solutions for the Mass Transfer of Microcomponents	---	TP SLA printing se and imaging sess per group
13	15.05.	Seminar 3	tbd	---	---
14	22.05.	Seminar 4	tbd	---	---
15	29.05.	---	Ascension	---	---

# Examination

- Oral ( $\frac{1}{2}$  final grade)
  - List of (30-40) questions as study basis
  - 15 min prep
  - 15 min oral exam
- 2 quizzes during the semester ( $\frac{1}{6}$  final grade)
- TP report(s) ( $\frac{1}{3}$  final grade)

# Class information/handouts

- All material on Moodle
  - Slides
  - Exercises
  - TP related information
  - Q&A discussion on EDstem

Additional videos from past year(s)/ intro to AM by E. Boillat

# TP organization

- Inkjet printing TP (Jongeon, Sönke, Tao)
- Stereolithography printing TP (Maria)

You will get hands-on training !!

# TP Inkjet Printing

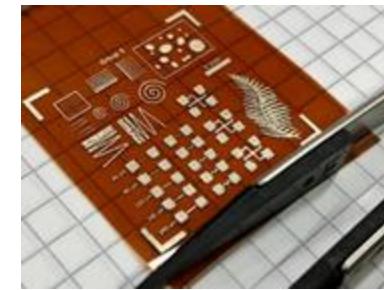
Design



Print



Thermal processing



Characterize

Geometrical



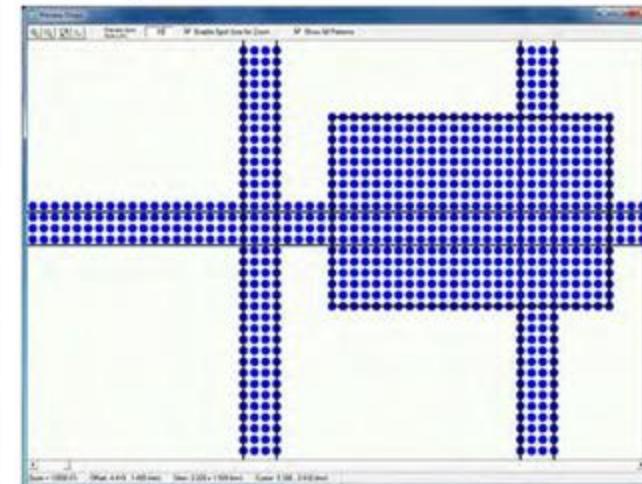
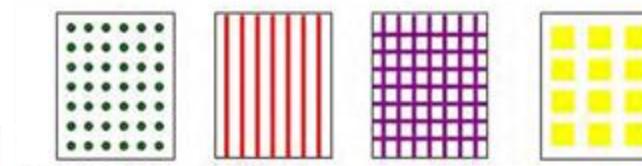
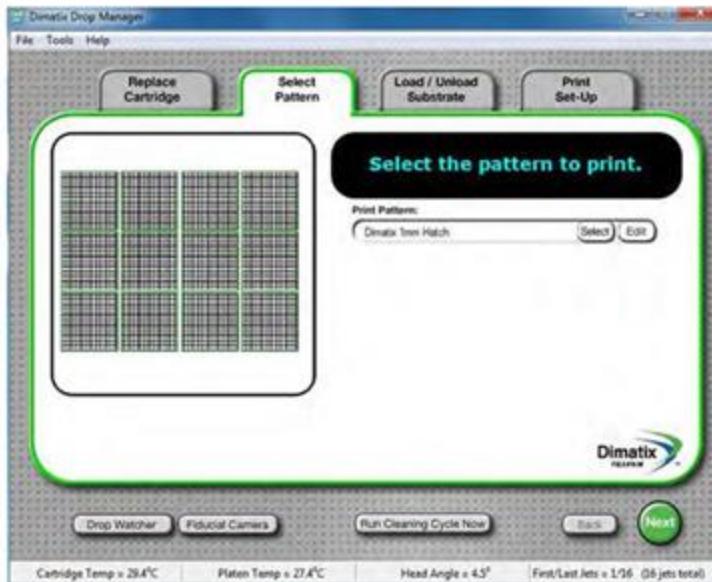
Electrical



Analyze the data and report

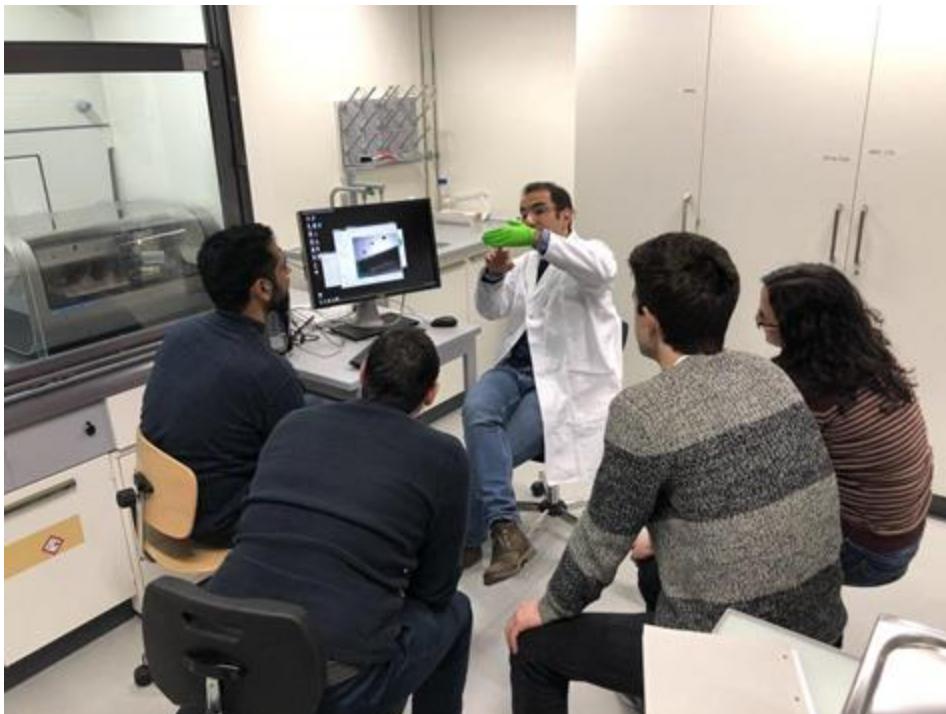


# Design with the Dimatix drop manager



BM 3213

# TP IJP Fabrication



- Get introduced to the Dimatix DoD inkjet printer
- Investigate printability of silver ink
- Print silver on a glass slide
- Thermal treatment (sintering) of the printed features (will be done by the TA's)

# TP IJP Characterization

BM 3229



- Week 5 and 6
- Investigate the print quality using an optical microscope
- Characterize electrical properties

# TP IJP Schedule

	4th March	4th March	5th March	5th March	6th March	6th March	7th March	7th March	11th March	11th March	12th March	12th March	13th March	13th March	18th March	18th March	19th March	19th March	20th March	20th March	25th March	25th March	26th March	26th March	27th March
P1	Week 3					Week 4																			
	Tue		Wed		Th	Fri	Tue		Wed		Th														
	AM	PM	AM	PM	AM	AM	AM	PM	AM	PM	AM														

P2											Week 5					Week 6				
											Tue	Wed	Th	Tue	Wed	Th				
											AM	PM	AM	AM	AM	AM	PM	AM	PM	AM

**Form a group of 4 or 5, Link in Moodle**

3 hr for the IJP session

2 hr for the characterization

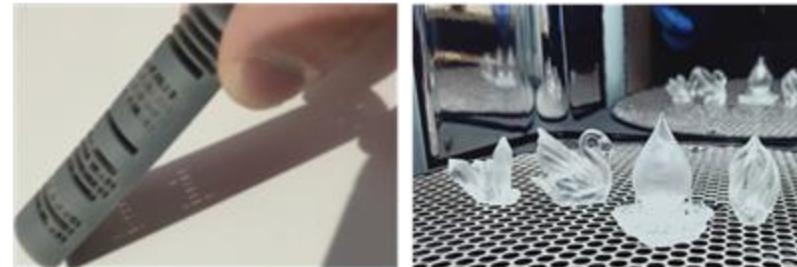
# TP SLA - Printing

**Form 3 (Formlabs)**



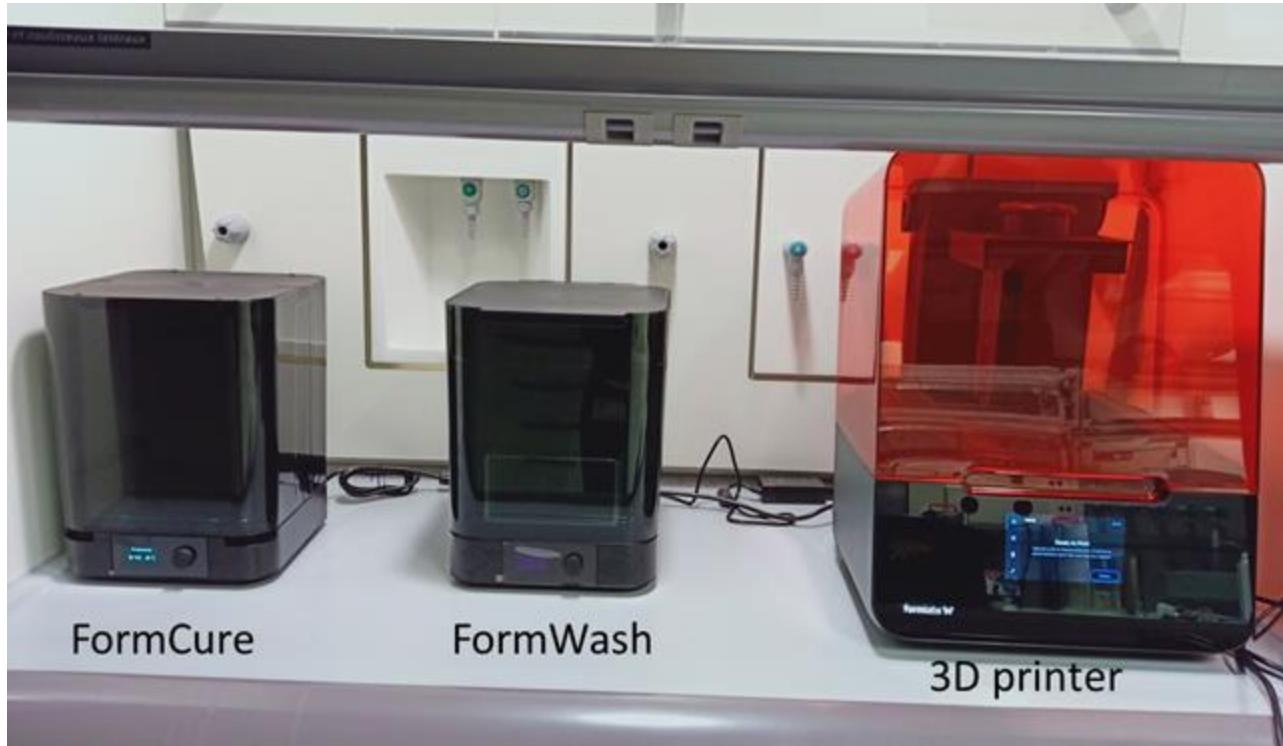
Building volume:  $14.5 \times 14.5 \times 18.5 \text{ cm}^3$   
Printing resolution: up to  $25 \mu\text{m}$  in all direction  
Printing resin: Grey, Clear

**Examples from last year**



# TP SLA - Printing

MED 3 1119



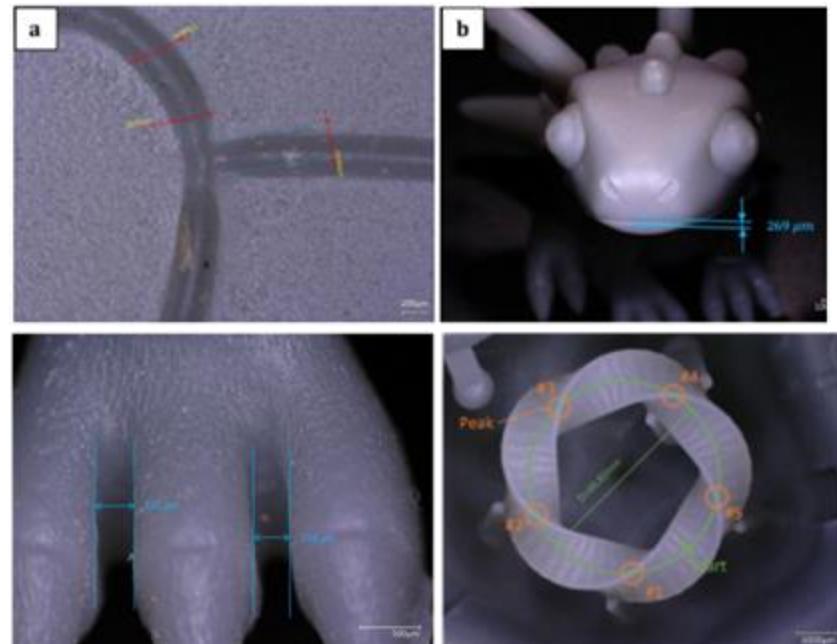
MED 3 1219

# TP SLA - Imaging

**Keyence microscope**



**Examples from last year**



# TP SLA - Schedule

MED 3 1219

TR: training session (1.5h). All the group members must be present.

PR: printing session (4-9 h). Start the printing (0.5 h). Do the post-processing and clean (1 h).

IM: imaging session (1.5 h). All are suggested to come.

# Tentative TP Calendar

# Will be confirmed by next week

## P1: Inkjet printing of Ag ink (3h)

## P2: characterizing printed features (2h)

## TR: Training session for TP SLA (1.5h)

## PR: print own designs (1.5h)

## IM: Print characterization with Keyence (1.5h)