

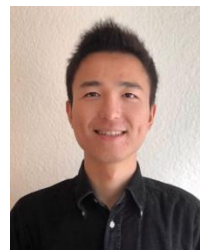
Advanced additive manufacturing technologies

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 11 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 session
10	24.04.	---	Easter break	---	---
11	01.05.	Prof. Paul Dalton, University of Oregon	tbd	---	TP SLA printing session and imaging session per group
12	08.05.	Dr. Gari Arutinov, Holst Center	An Overview of Solutions for the Mass Transfer of Microcomponents	---	TP SLA printing session and imaging session 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

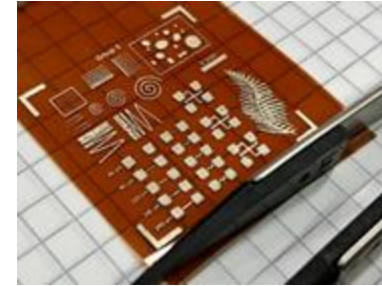
Design



Print



Thermal processing



Characterize

Geometrical



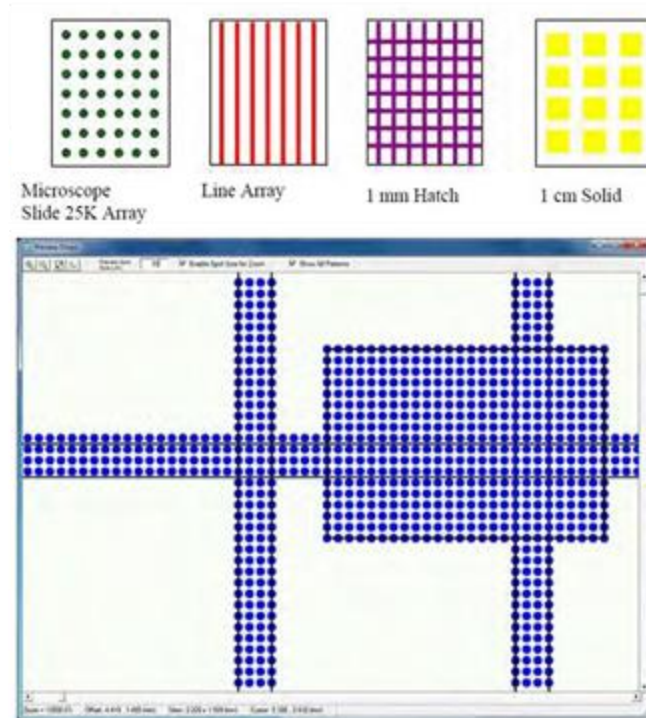
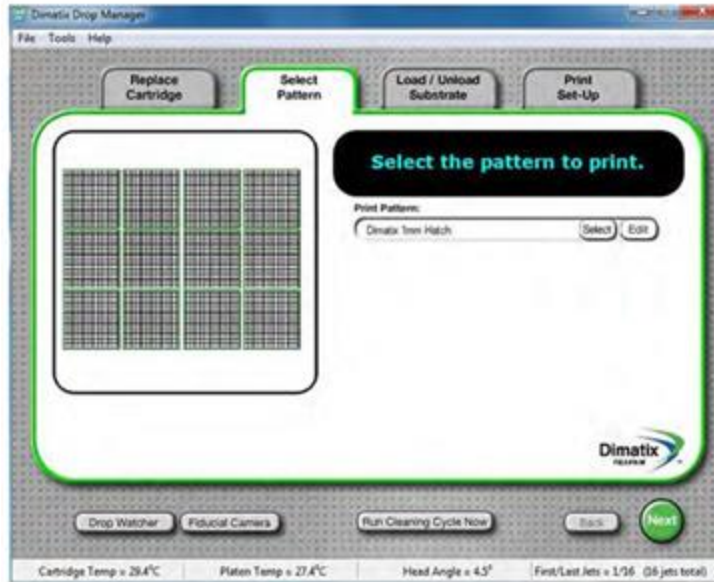
Electrical



Analyze the data and report

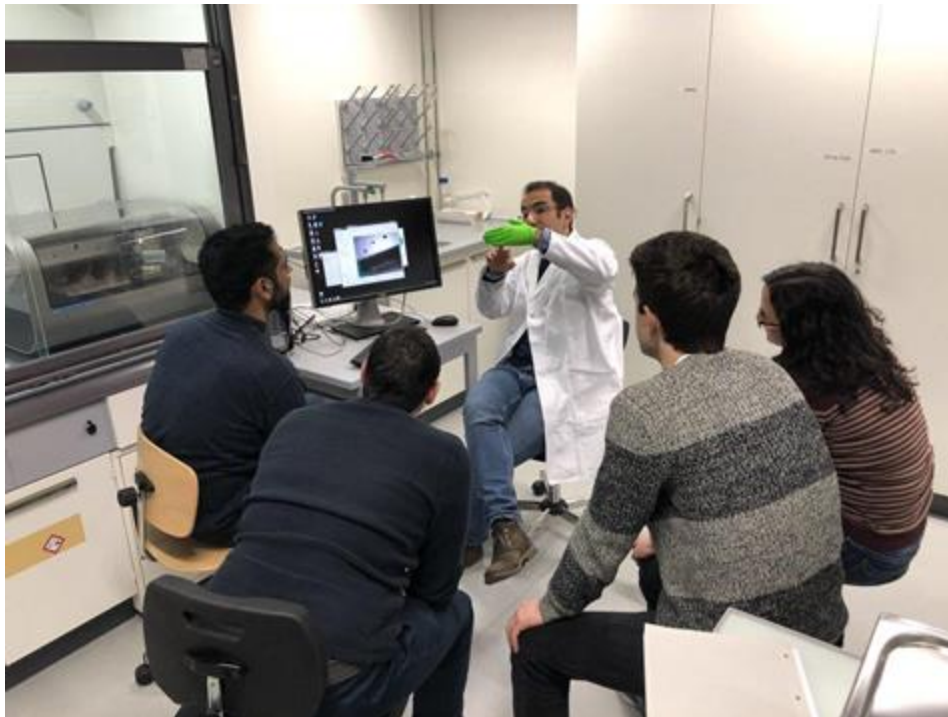


Design with the Dimatix drop manager



BM 3213

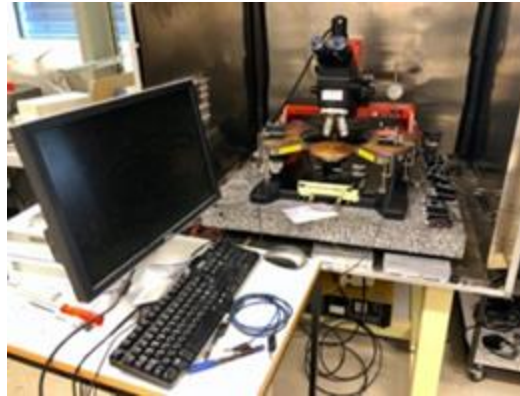
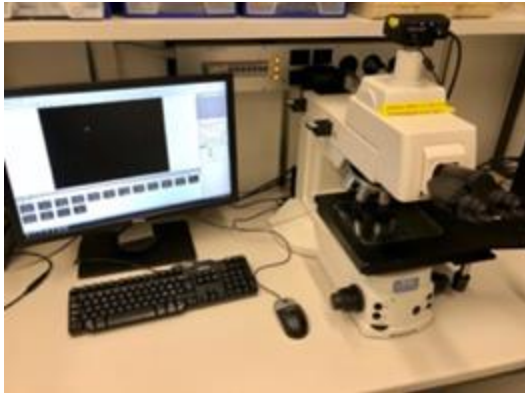
TP IJP Fabrication



- 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	7th March	11th March	11th March	12th March	12th March	13th March	18th March	18th March	19th March	19th 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)



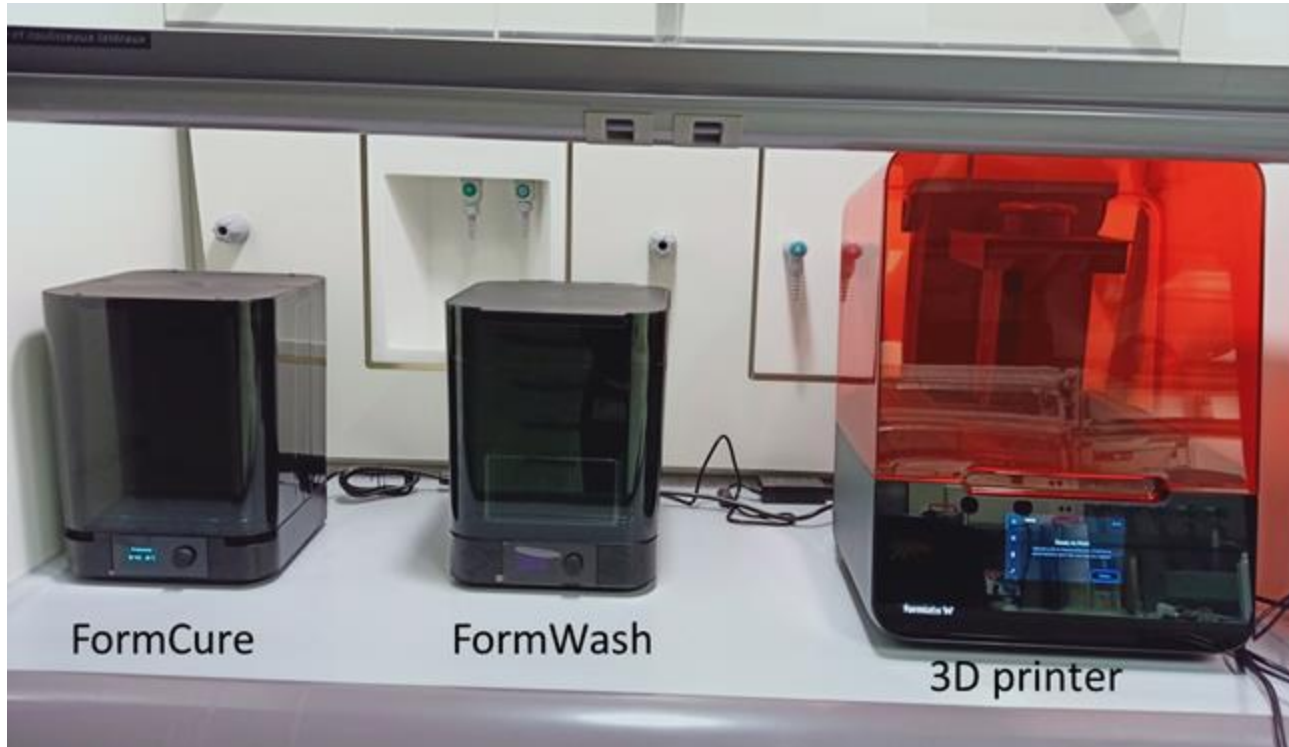
Building volume: $14.5 \times 14.5 \times 18.5 \text{ cm}^3$
Printing resolution: up to $25 \mu\text{m}$ in all direction
Printing resin: Grey, Clear

Examples from last year



TP SLA - Printing

MED 3 1119



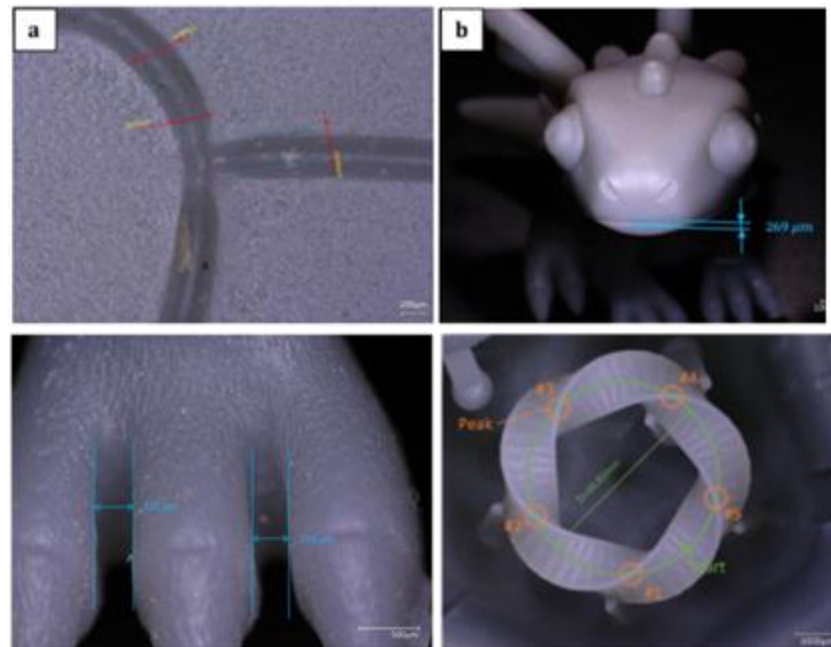
TP SLA - Imaging

MED 3 1219

Keyence microscope



Examples from last year



TP SLA - Schedule

MED 3 1219

Group	Week 7				Week 8 (Easter)				Week 9				Week 10				Week 11				Week 12			
	Wed.		Thu		Wed		Thu		Wed		Thu		Wed		Thu		Wed		Thu		Wed		Thu	
	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
G6																								
Will be annouced next week																								
G7																								
G8																								
G9																								
G10																								

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

day	Week 3					Week 4					Week 5					Week 6					Week 7					Week 8 (Easter)					Week 9					Week 10					Week 11					Week 12				
	Tue		Wed		Th	Tue		Wed		Th	Tue		Wed		Th	Tue		Wed		Th	Wed.		Thu		Wed		Thu		Wed		Thu		Wed		Thu		Wed		Thu		Wed		Thu							
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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)