MICRO-407

Materials design for vat photopolymerization

Yee Daryl

Cursus	Sem.	Type
Materials Science and Engineering	MA1, MA3	Opt.
Microtechnics	MA1, MA3	Opt.

Language of teaching	English
Credits	3
Withdrawal	Unauthorized
Session	Winter
Semester	Fall
Exam	During the semester
Workload	90h
Weeks	14
Hours	**3 weekly**
Courses	2 weekly
TP	1 weekly
Number of positions	**15**

It is not allowed to withdraw from this subject after the registration deadline.

Summary

This course is focused on designing materials for vat photopolymerization 3D printing technologies. The course combines theoretical description with practical lab work where students will design, formulate, and print their own materials.

Content

Important course information: This course will be a mixture of lectures, exercises, and practical lab sessions. The first half of the semester will focus more heavily on lectures/exercises (1 hour of lab session per week on average, with the other 2 hours dedicated to lectures and exercises), while the second half of the semester will focus more on the lab sessions (2 hour of lab sessions on average, 1 hour of lectures/exercise).

The practical lab sessions will involve working in a chemistry lab. All registered students must participate in the lab practical sessions.

The exercise sessions will range from literature discussion to solving problem sets.

For Fall 2026, only a maximum of 15 students can be registered in the course.
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The course will cover the following:
1) Introduction to vat photopolymerization (VP) additive manufacturing technologies
2) Fundamentals of photopolymerization as applied to VP
3) Resin design for polymer printing
4) Chemical safety in the lab
5) Practical considerations for polymer printing and processing
6) Structure-processing-property relationships in 3D printed polymer parts

Keywords

- Polymers
- Vat photopolymerization
- 3D printing
- Photopolymerization
- Mechanical properties
- Processing

- Synthesis

Learning Prerequisites

Required courses

SMT: MSE-214 and MICRO-413
SMX: MSE-360

Important concepts to start the course

- Understand the basics of free-radical polymerization
- Understand the differences between a thermoplastic and thermoset
- Understand how the glass transition temperature impacts polymer properties
- Understand that a polymer can have a variety of network structures

Learning Outcomes

By the end of the course, the student must be able to:

- Explain the working principles of each type of VP technology
- Develop photoresins that can achieve a particular polymer property
- Design their own resins and analyse the properties of the printed polymer
- Analyze the mechanical properties of polymers
- Manipulate VP printers
- Analyze relevant polymer printing literature

Transversal skills

- Access and evaluate appropriate sources of information.
- Collect data.
- Make an oral presentation.
- Continue to work through difficulties or initial failure to find optimal solutions.
- Take responsibility for health and safety of self and others in a working context.
- Identify the different roles that are involved in well-functioning teams and assume different roles, including leadership roles.
- Negotiate effectively within the group.
- Demonstrate a capacity for creativity.

Teaching methods

Classroom lectures, exercises, practical lab sessions, and project work.

The classroom lectures will cover the theoretical parts of the course, including safety aspects of working in a lab.

The exercises will cover a range of activities, including discussion on selected literature, group presentations, and problem sets.

The lab sessions will include resin formulation, printing, and material testing.

There will be a 7 week long project that will require the students to obtain printed polymers with defined properties.

Expected student activities

Short assignments
Hands-on lab project, in groups
Presentation of articles from the scientific literaure

Assessment methods

- Group project; presentation within the last 2 weeks of the semester (75% of the grade)
- Individual oral examination between week 6 and 7 of the semester (25% of the grade)

Supervision

Office hours	No
Assistant.e.s	Yes
Forum	No
Others	Prof. Yee will be present during the execise and lab sessions to answer questions.

Resources

Virtual desktop infrastructure (VDI)

No

Bibliography

G. Odian, Principles of polymerization, John Wiley & Sons, Inc., 2024

Kitos Vasconcelos, Ana Paula, et al. "Light-based 3D printing of polymeric materials." *Annual Review of Materials Research* 55.1 (2025): 491-521.

Ligon, Samuel Clark, et al. "Polymers for 3D printing and customized additive manufacturing." *Chemical reviews* 117.15 (2017): 10212-10290.

Notes/Handbook

Slides and notes of the course will be available on Moodle.

Moodle Link

- https://go.epfl.ch/MICRO-407