

MSE-619

**Nanofabrication with focused electron and ion beams**

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| Cursus                            | Sem. | Type |
|-----------------------------------|------|------|
| Advanced Manufacturing            |      | Opt. |
| Materials Science and Engineering |      | Opt. |

|                            |                   |
|----------------------------|-------------------|
| Language of teaching       | English           |
| Credits                    | 2                 |
| Session                    |                   |
| Exam                       | Oral presentation |
| Workload                   | 60h               |
| <b>Hours</b>               | <b>28</b>         |
| Lecture                    | 12                |
| Exercises                  | 8                 |
| Practical work             | 8                 |
| <b>Number of positions</b> | <b>20</b>         |

**Frequency**

Every 2 years

**Summary**

Nanofabrication with focused charged particle beams (SEM, FIB) and their applications such as lithography, gas assisted deposition / etching, and milling are discussed and the limitations of these processes are developed based on the acquired understanding of the interactions.

**Content**

- Introduction to Scanning Electron / Ion Microscopes: SEM, Ga-FIB, He-FIB, AuSi-FIB
- Electron / Ion interaction with solids: concepts and simulations
- Analysis with focused electron and ion beams: EDX, EBIC, EBSD, tomography
- Nanofabrication with FIB and FEB: milling, deposition, etching, lithography
- Novel Add-Ons for Nanomanipulation and Nanoanalysis inside electron microscopes: 4-point electrical measurements, positioning systems for nanostructures, magnetic bead detection, mechanical measurements: tensile, bending, and compressive loading of nanostructures, 3D topography with in-situ atomic force microscopy, chemical depth profiling by combined FIB-mass spectroscopy. Live demonstrations: Add-ons, SEM, Dual Beam.

**Keywords**

FIB, FEB, nanofabrication, integrated setups for in-situ measurements (chemical, mechanical, structural, electrical) of nanostructures and their in-situ synthesis (gas injection)

**Learning Prerequisites****Recommended courses**

Physics and Chemistry at university level, general concepts of NanoSciences and Fabrication

**Assessment methods**

Exposé