MANIPULATION AND DETECTION OF MICRO- AND NANOPARTICLES

ECTS: 5

Course coordinator: Assist. Prof. Dr. Dejan Križaj

Lecturers: Assist. Prof. Dr. Dejan Križaj

No. of hours: 125
Lectures: 10
Seminar: 15
Lab. work: 15
Other: 85

2. Entry requirements:
General conditions for enrolment in doctoral studies.

3. Objectives of the course and intended learning outcomes:
(competences)
Educational aims:
- familiarity with microelectronic technology and the technology of microprocessing silicons, which enables the production of micro-electro-mechanical systems (MEMS). This includes recognising materials, techniques and procedures that enable the production of microstructures.
- understanding physical phenomena that are dealt with, which must be taken into account or enable the use of MEMS structures (electric forces, electrophoresis, dielectrophoresis, electro-osmosis, thermo-electric phenomena, microfluids, optical phenomena etc.).
- familiarity with applications based on the use of MEMS technology, especially those that are of interest in biotechnology and include detection (analysis) with the aid of electrophoresis, dielectrophoresis, impedance methods, amperometric methods, optical perception etc.

Intended learning outcomes:
- familiarity with the basis concepts of microtechnology with a stress on technologies that enable realisation of micro-electro-mechanical systems.
- understanding basic physical phenomena that are important for the operation of micro-electro-mechanical systems.
- recognition of specific MEMS devices that enable micro-total-analysis.
- familiarity with procedures of manipulation of perception of micro- and sub-micro particles used in MEMS devices.

4. Syllabus outline:
Microelectronic technology enables, in addition to the production of electronic chips, also the production of micro-electro-mechanical systems (MEMS). The subject will familiarise students with the basic concepts of microtechnological procedures and microprocessing, which, in addition to standard procedures of diffusion, implantation, oxidation and metalisation, also use procedures of etching and accumulating additional layers. The result is MEMS structures, which embrace integration of mechanical elements, sensors, actuators and electronics in a single element (normally from silicon). One of the fastest advancing fields of use of these structures is biotechnology and biomedicine, since MEMS structures enable manipulation and
detection of micronic and submicronic particles. The advantage of these structures is not just their extremely small size of the sample that we process but also frequently the speed and cheapness of the procedures. Students will be familiarised with physical processes that must be respected or that can be usefully exploited in analysis of the operation of MEMS structures or in planning new structures. Because of the extremely wide range of possibilities that the technology offers, we will examine in more detail technologies and applications that are based on micro-total analysis systems (μTAS) or laboratory-on-a-chip, and especially possibilities that the phenomenon of dielectrophoresis enables for manipulation and detection of micronic and submicronic particles.

5. Literature (in the case of books and monographs, study sources are only selected chapters from them):

6. Teaching methods:
Lectures which will be held in computer classrooms if there are the technical possibilities for this. Within the framework of the subject, students will carry out small projects which, if possible, will be connected with their work to date. They will be carried out concurrently in the form of compulsory homework. They will be completed after the completion of lectures. Individual monitoring and help will be provided in their implementation.

7. Assessment methods:
Completion of the project; the assessment consists of the assessment of homework (50%) and assessment of the project and its defence (50%).

8. References:

Križaj Dejan