MSE-611

Piezoelectric materials, properties and devices

Damjanovic Dragan

Cursus	Sem.	Type
Materials Science and Engineering		Opt.

Language of teaching	English
Credits	1
Session	
Exam	Written
Workload	30h
Hours	**14**
Courses	10
TP	4
Number of positions	**30**

Frequency

Every 2 years

Remark

Schedule : 2020, November 23rd to 27th from 9:00 to 12:00

Summary

The students acquire knowledge on structure-property relations of piezoelectric and related materials (ferroelectrics, relaxors). Different material classes (ceramics, crystals, composites, polymers) are discussed in view of applications in sensors, actuators, high frequency transducers and others.

Content

Since the backround and interest of the attendeeds varies from year to year, the lectures' content is adapted each time to the partcipants as much as this is possible. The discussed topics may include but are not limited to:
1. Piezoelectric effect. Thermodynamic relations. Electromechanical coupling coefficients. Constitutive equations. Boundary conditions.
2. Piezoelectric materials: single crystals, ceramics, polymers and composites. New piezoelectric materials.
3. Piezoelectric anisotropy. Symmetry and piezoelectricity.
4. Concept of morphotropic phase boundary. Soft and hard piezoelectrics.
5. Piezoelectric resonance.
6. Equivalent circuits.
7. Physical phenomena that can contribute to the piezoelectric effect. Piezoelectric hysteresis, nonlinearity, creep and relaxation.
8. Piezoelectric actuators and motors.
9. Piezoelectric sensors. Quasistatic and resonance mode of operation.
10. High frequency piezoelectric transducers for medical imaging. Concept of matching layers. Ultrasonic arrays. Doppler probes.
11. Surface acoustic wave effect and devices.
12. Other types of electro-mechanical and magneto-electro-mechanical coupling (electrostriction, flexoelectricity, strain mediated magneto-electric effect)

Keywords

Piezoelectric effect, piezoelectric materials, actuators, sensors, crystals, ceramics, transducers power transducers, surface acoustic wave effect

Learning Prerequisites

Recommended courses

physics and mathematics on the bachelor level of EPFL, basic materials science

Resources

Websites

- lc.epfl.ch/ddamjanovic.html