Master Physique fondamentale et applications
Optical components

Informations

Composante : Faculté des Sciences

Responsables

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Langue(s) d'enseignement

Anglais

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The students from different backgrounds elaborate their knowledge on the physical principles of optoelectronic devices. Applications in sensing, lightning, nanotechnology, energy harvesting.

The teaching unit is composed of 3 completely independent parts: Optoelectronics, crystal based components, thin film optical coatings.

Part 1: Crystal based optical components
Anisotropic optics in biaxial crystal, finding the linearly polarized waves that can propagate in a given arbitrary direction (index and polarization direction) Applications is polarizers, waveplates, pockels cells and other optical components

Part 2: Semiconductor based optical components
- Electronic band theory of semi-conductors : mono-dimensional toy model, electronic band structure, effective mass : origin of holes, extension in 3D and application to common semi-conductors, transitions in direct and indirect bandgap semi-conductors
- Light Emitting Diodes : From the Electronic band structure to the space band diagram, Classical homojunction, heterojunction
- Devices : Structure of a LED, fabrication, extraction and light management, efficiencies, emission spectrum, applications

Part 3: Thin film optical coatings
– Thin film theory (propagation and interferences inside a multilayer structure; Calculation techniques for the reflectance and transmittance factors of a coating;
– Thin film design (classical multilayer stuctures used for dielectric mirrors, antireflection coatings, edge filters, bandpass filters);
– Manufacturing and characterization of thin film filters (theoretical elements and experimental demonstration).

Compétences à acquérir

The students know

- how what represents an bandstructure and how it can be obtained
- what is a direct / indirect bandgap materials
- understand the applications of each
- what an LED and a CMOS sensor are and how they are build
- what the efficiency of a LED and a sensor is
- how to determine the refractive index and the polarization of the linearly polarized eigenmodes propagating in a crystal
- the different types of polarizers
- how waveplates, electro-optic modulators (pockels cells), liquid-crystal light modulators, acousto-optic modulators work.
- what happens inside a multilayer structure.
- how to design a thin film stack to obtain a given reflectance or transmittance spectral profile.
- how thin film filters are manufactured.

Modalités d'organisation

Final written examination consisting of several problems and knowledge/comprehension questions on the course content

Bibliographie, lectures recommandées

Pierret, Advanced semiconductor fundamentals, 1987
Parker, Physics of optoelectronics, CRC Press, 2005
Chuang, Physics of optoelectronic devices, 1995

Pré-requis obligatoires

Basic knowledge on electrodynamics and solid state physics

VOLUME HORAIRE

- Volume total: 32 heures
- Cours magistraux: 32 heures

Codes Apogée

- SPFCU46J [ELP]

Pour plus d'informations

Aller sur le site de l'offre de formation...

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