GHENT UNIVERSITY

Course Specifications

Valid as from the academic year 2023-2024

Luminescence (C003208)

Course size *(nominal values; actual values may depend on programme)*

Credits 6.0 **Study time 180 h**

Course offerings and teaching methods in academic year 2024-2025

null

Lecturers in academic year 2024-2025

Joos, Jonas	WE04	lecturer-in-charge
Poelman, Dirk	WE04	co-lecturer
Smet, Philippe	WE04	co-lecturer

Offered in the following programmes in 2024-2025	**crdts**	**offering**
null		

Teaching languages

English

Keywords

luminescence, solid state, defects, spectroscopy, display and lighting applications

Position of the course

Luminescent materials can emit light in a non-thermal way, in contrast to a black body radiator. Luminescent materials are ubiquitous, and used in lighting, display and imaging applications. In this course, we first deal with the theoretical background, after which the focus lies on a wide range of applications.

Contents

Theoretical background of luminescence
- Configuration coordinate diagram, selection rules, transition probabilities, energy transfer, decay behaviour, thermal behaviour
- Lanthanide based luminescence (europium, cerium, erbium, terbium,...)
- Transition metal based luminescence (manganese, chromium,...)
- Other luminescent ions (lead, bismuth, antimony,...)
- Luminescence in organic compounds
- Synthesis and characterization of phosphors
- Up-conversion and quantum cutting
- Dopant-host interactions
- Quantum confinement and quantum dots
- Colour perception and eye sensitivity

Types of luminescence
- Photoluminescence (PL)
- Electroluminescence (EL): AC and DX powder electroluminescence, thin film electroluminescence, LEDs
- Cathodoluminescence: principle, usage as analytical technique, in combination with electron microscopy
- Thermoluminescence (TL)
- Persistent luminescence
- Radioluminescence (RL)
- Other forms (mechanoluminescence, triboluminescence, chemiluminescence, bioluminescence, sonoluminescence)

Applications of luminescence
- Historic development of luminescent materials
- Phosphors for cathode ray tubes

- LEDs and phosphors for white LEDs
- OLEDs
- Lasers
- Phosphors for medical imaging and storage phosphors
- Scintillator phosphors and phosphors for radiation detectors
- Afterglow phosphors

Defect characterization of semiconductors

Initial competences

Having successfully followed the courses Material Physics, Quantum Mechanics and Atomic and Molecular Physics, or having gained similar expertise by following other courses.

Final competences

1 Have a thorough knowledge and insight in luminescent processes in condensed matter and the newest scientific developments in this context.
2 Identifying and understanding coherence between luminescence and other relevant science domains, such as atomic and molecular physics, group theory and quantum mechanics.
3 Being able to analyze, critically evaluate and structure information available in scientific literature on luminescence.
4 Communicate on new developments and underlying theories of relevant luminescence processes and applications, with experts and non-experts.

Conditions for credit contract

Access to this course unit via a credit contract is determined after successful competences assessment

Conditions for exam contract

This course unit cannot be taken via an exam contract

Teaching methods

Seminar, Lecture, Independent work

Study material

None

References

G. Blasse, G.C. Grabmeier, Luminescent materials, Springer
C.R. Ronda, Luminescence: from theory to applications, Wiley
W.M. Yen, S. Shionoya, H. Yamamoto, Phosphor Handbook, 2nd Edition, CRC Press
Y.A. Ono, Electroluminescent displays, World Scientific
E.F. Schubert, Light-emitting diodes, Cambridge

Course content-related study coaching

Interactive support via Ufora (forum, e-mail); individual (on appointment)

Assessment moments

end-of-term and continuous assessment

Examination methods in case of periodic assessment during the first examination period

Oral assessment, Written assessment with open-ended questions

Examination methods in case of periodic assessment during the second examination period

Oral assessment, Written assessment with open-ended questions

Examination methods in case of permanent assessment

Participation, Assignment

Possibilities of retake in case of permanent assessment

examination during the second examination period is possible

Extra information on the examination methods

Permanent evaluation: project report and public presentation (powerpoint), participation to online discussion groups and reading assignments. Periodic evaluation: written exam, open book, limited to questions testing insight

Calculation of the examination mark

Report, presentation and reading assignments (50%) + Exam (50%)