

## Luminescence (C003208)

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

**Credits 6.0**

**Study time 180 h**

**Contact hrs**

52.5h

**Course offerings and teaching methods in academic year 2022-2023**

A (semester 2)

English

Gent

guided self-study

12.5h

lecture

30.0h

project

5.0h

**Lecturers in academic year 2022-2023**

Joos, Jonas

WE04

lecturer-in-charge

Poelman, Dirk

WE04

co-lecturer

Smet, Philippe

WE04

co-lecturer

**Offered in the following programmes in 2022-2023**

[Master of Science in Teaching in Science and Technology\(main subject Physics and Astronomy\)](#)

6

A

[Master of Science in Physics and Astronomy](#)

6

A

[Exchange Programme in Physics and Astronomy \(Master's Level\)](#)

6

A

**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 DC 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 Introduction to 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

Guided self-study, Lecture, Project, Seminar: coached exercises

#### Learning materials and price

Course notes, handouts of presentations and scientific articles. Estimated cost: 10EUR.

#### 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 examination, Open book examination, Written examination with open questions

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

Oral examination, Open book examination, Written examination with open questions

#### Examination methods in case of permanent assessment

Report, 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%)