

## 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

Type: Syllabus

Name: Luminescence  
 Indicative price: Free or paid by faculty  
 Optional: no  
 Language : English  
 Number of Pages : 45  
 Available on Ufora : Yes  
 Online Available : No  
 Available in the Library : No  
 Available through Student Association : No

Type: Slides

Name: Luminescence  
 Indicative price: Free or paid by faculty  
 Optional: no  
 Language : English  
 Available on Ufora : Yes  
 Online Available : No  
 Available in the Library : No  
 Available through Student Association : No

Type: Project

Name: Project  
 Indicative price: Free or paid by faculty  
 Optional: no

Type: Other

Name: Articles  
 Indicative price: Free or paid by faculty  
 Optional: no  
 Language : English  
 Available on Ufora : Yes  
 Online Available : No

Available in the Library : No  
Available through Student Association : No

### **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%)