

Examination

“Material Characterisation – Optical Spectroscopy (Prof. Dr. Jüstel)”

Date: March 20th, 2014

Max. 25 Points

Name, Given name:

Enrolment number:

Please only use these sheets (you might also use the reverse)!

Task 1)

(5 Points)

Fundamentals of Spectroscopy

- a) Which kind of macroscopic interactions between light and matter are known to you? (2 Points)

- b) Please explain the terms “radiometric quantities” and “photometric quantities”! (2 Points)

- c) Explain the term time-resolved spectroscopy! (1 Point)

Task 2)

(5 Points)

Luminescence spectroscopy

a) Sketch the build-up of a typical fluorescence spectrometer and give examples of all required optical components! (3 Points)

b) Describe the way to record an emission spectrum of a luminescent material, e.g. of $\text{Y}_3\text{Al}_5\text{O}_{12}:\text{Ce}^{3+}$ powder that shows a 4f5d-transition at 460 nm! (1 Point)

c) Describe the way to record an excitation spectrum of a luminescent material, e.g. of $\text{Y}_3\text{Al}_5\text{O}_{12}:\text{Ce}^{3+}$ powder that shows a broad emission band at 540 nm! (1 Point)

Task 3)**(5 Points)****Radiation Sources for Optical Spectroscopy**

What kind of radiation sources can be used for the following measurement purposes?
Explain your choice! (1 Point each)

- a) Absorption spectrum between 300 and 1000 nm
- b) Emission spectrum between 500 and 800 nm under 450 nm excitation
- c) Excitation spectrum between 250 and 500 nm
- d) Excitation spectrum between 100 and 300 nm
- e) Decay curve under 395 nm excitation

Task 4)

(5 Points)

Thermoluminescence

- a) Describe the procedure to record a glow curve of a luminescent material! (3 Points)

- b) Which information can be derived from a glow curve? (2 Points)

Task 5)**(5 Points)****Temperature resolved spectroscopy**

a) Describe the way to record a thermal quenching curve and to fit the experimental data by the so-called Struck-Fonger equation! (3 Points)

$$I(T) = A_0 + I_0 / (1 + B \exp(-\Delta E/kT)) \quad \text{„Struck-Fonger-Equation“}$$

b) Draw the shape of a typical thermal quenching curve in a respective intensity-temperature diagram and assign the $T_{1/2}$ value! (2 Points)