Examination

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

Date: February 01st, 2016 **Max. 25 Points**

Name, Given name: **Enrolment number:**

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

Task 1) (4 Points)

Basics of Optical Spectroscopy

Sketch the arrangement of the basic components of a spectrometer set-up for the following purposes! Give also for each component an example for a widely applied device! (Each 2 Points)

a) Luminescence Spectroscopy

b) Reflection Spectroscopy

Task 2) (6 Points)

Radiation Sources for Optical Spectroscopy

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

a) Absorption spectrum between 400 and 3000 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

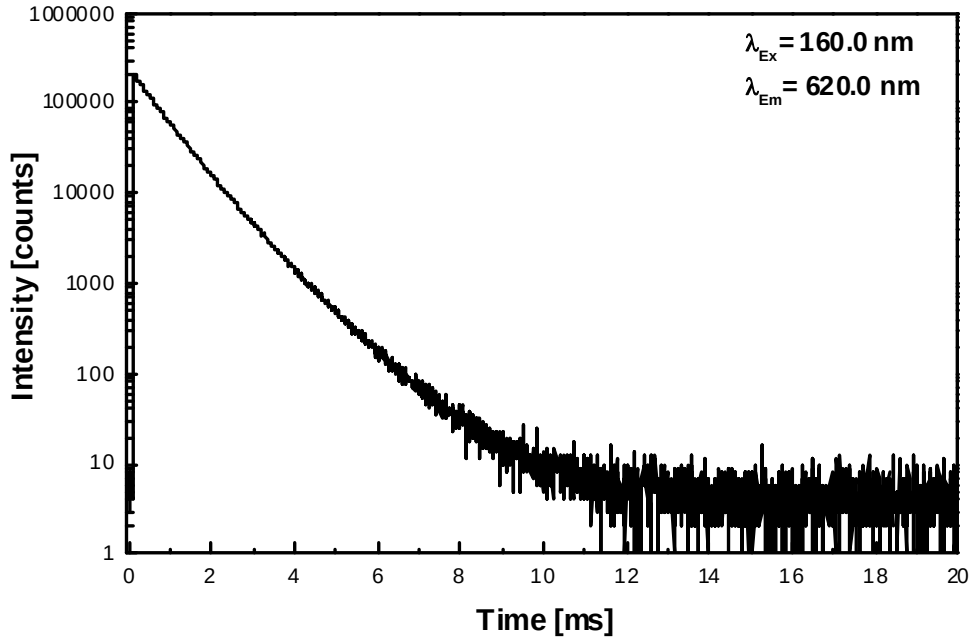
f) Decay curve under 172 nm excitation

Task 3) **(5 Points)**

Time resolved spectroscopy

a) Describe the procedure to record a decay curve of an arbitrary luminescent material! (2 Points)

b) The figure below displays the decay curve of $YVO_4:Eu^{3+}$, which is applied in high-pressure Hg discharge lamps and plasma displays. Please determine the decay constants $\tau_{1/e}$ and $\tau_{1/10}$ from the following graph! (1 Point)



c) Please name a potential cause for the deviation of the curve from linearity for the above given log(Intensity) over time t plot about 5 ms after the excitation source has been switched off! (1 Point)

d) Select a function for the fitting of the decay curve shown above and explain your choice! (1 Point)

$I(t) = A_0 - B_1 * t/\tau_1$

$I(t) = A_0 + B_1 * \exp(-t/\tau_1)$

$I(t) = A_0 + B_1 * \exp(-t/\tau_1) + B_2 * \exp(-t/\tau_2)$

Task 4) (5 Points)

Temperature resolved spectroscopy - Thermoluminescence

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

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

Task 5) **(5 Points)**

Temperature resolved spectroscopy - Thermal quenching

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)

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

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