Examination

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

Date: September 10th, 2013 **Max. 25 Points**

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

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

Task 1) (4 Points)

Quantities and Terms

Please explain the following expressions! (1 Point each)

a) Radiometric quantities

b) Photometric quantities

c) Lumen equivalent

d) Quantum efficiency

Task 2) **(6 Points)**

Luminescence spectroscopy

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

b) Describe the way to record an emission spectrum of a luminescent material, e.g. of Y_2O_3:Eu^{3+} powder, that shows a charge-transfer transition at 230 nm! (1 Point)

c) Describe the way to record an excitation spectrum of a luminescent material, e.g. of Y_2O_3:Eu^{3+} powder, that shows an emission line at 611 nm! (1 Point)

d) Why is it commonly necessary to correct excitation spectra? Please also describe the process of the correction! (1 Point)

Task 3) **(6 Points)**

Reflection spectroscopy

a) Sketch the build-up of a typical reflection spectrometer and assign all required optical components! (3 Points)

b) What is the function of the Ulbricht sphere? (1 Point)

c) Please explain by taking the Kubelka-Munk-Function ($R\infty$ = reflectance, A = absorption coefficient und S = scattering coefficient) into account, why perfectly black or white substances do not exist! (2 Points)

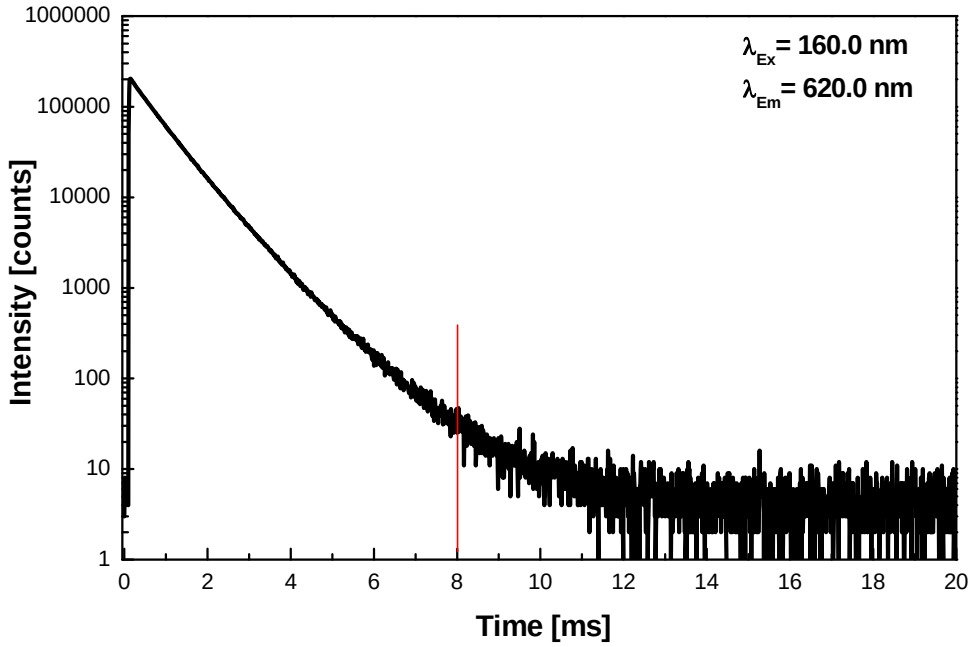
Kubelka-Munk-Function: $$F(R_\infty) = \frac{A}{S} = \frac{(1-R_\infty)^2}{2 \cdot R_\infty}$$

Task 4) **(4 Points)**

Time resolved spectroscopy

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

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



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)

Task 5) (5 Points)

Temperature resolved spectroscopy

a) Describe the way to record a glow curve of a luminescent material! (2 Points)

b) Which information can be withdrawn from the glow curves (3 Points)