Single Crystals for Remote Phosphor Solid State Light Sources

Sebastian Schwung[a,b,c], Daniel Rytz[b], Rainer Poettgen[c], and Thomas Jüstel[a]

[a] Muenster University of Applied Sciences, Stegerwaldstrasse 39, D-48565 Steinfurt, Germany

[b] Forschungsinstitut für Edelsteine und Edelmetalle (FEE) GmbH, Struthstrasse 2, D-55743 Idar-Oberstein, Germany

[c] WWU Münster, Institut für Anorganische und Analytische Chemie, Corrensstraße 30 D-48149 Münster, Germany

FEE

Fachhochschule Münster University of Applied Sciences

Westfälische Wilhelms-Universität Münster

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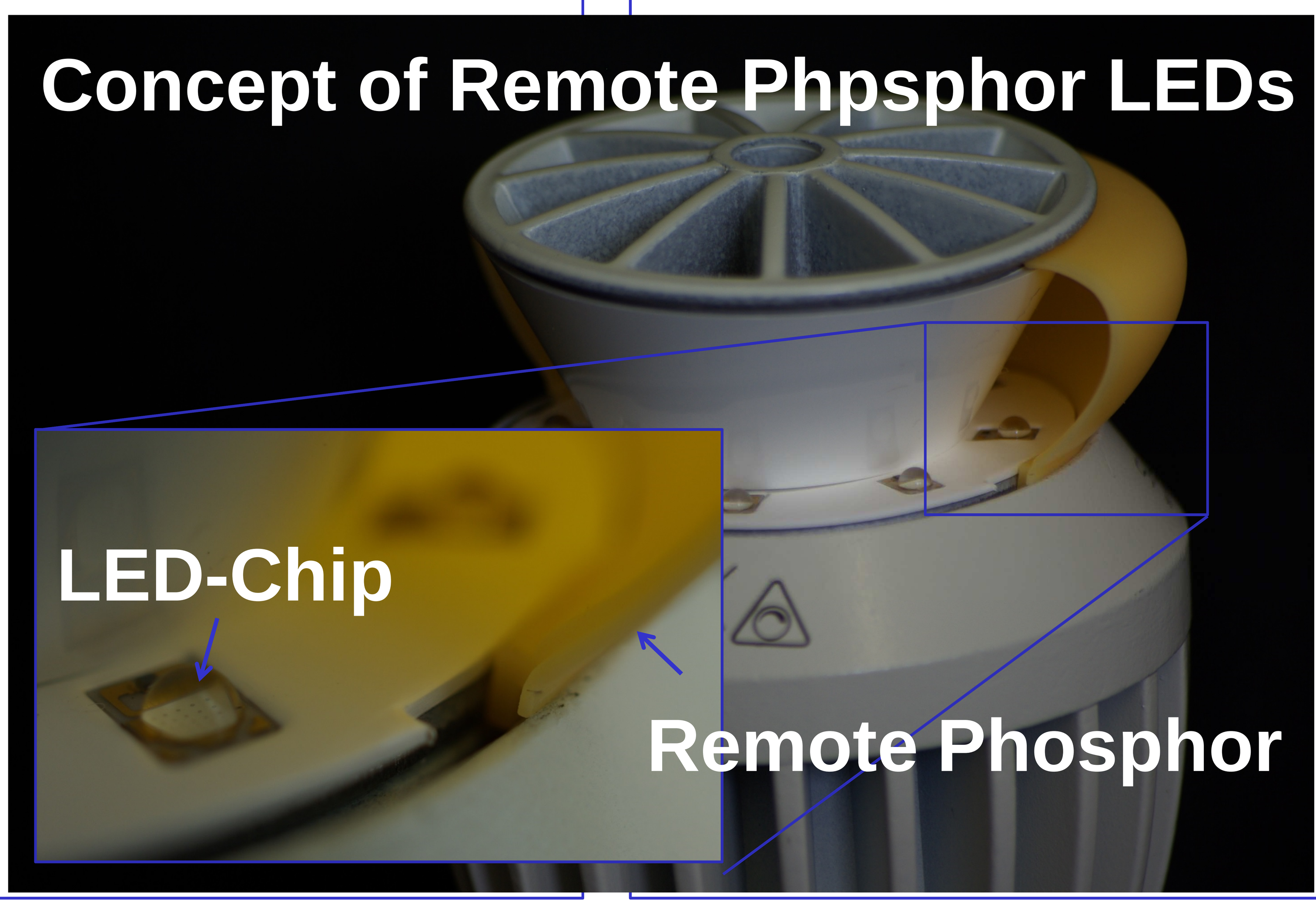
Background

The future of general and special lighting will be dominated by inorganic (and organic) light emitting diodes (LEDs). Nevertheless, phosphor converted (pc) LEDs for general lighting still show some shortcomings: The dissipation of heat and re-absorption limits the efficiency and the color point stability over lifetime of pcLEDs. In order to solve these problems a change of architecture is necessary.

A remote conversion screen is regarded as a solution towards LED driven light sources with an ultimate lifetime. This concept paves the way for the entry of thick ceramic bodies or single crystalline phosphors into solid state lighting.



(Li,K)*RE*(Mo,W)$_2$O$_8$ single crystals

Fig. 1. LEM crystal fragments of violet LEM (left) and shiny LEM (right) at ambient light (top) and upon excitation at 365 nm (bottom).

Fig. 2. KYW:Eu polished crystal at ambient light (left) and upon excitation at 410 nm (right).

Bulk single crystals of $KYW_2O_8:Eu^{3+}$ and $LiEuMo_2O_8$ (**Fig. 1 & 2**) have been grown by the top-seeded solution growth method[1].

Particularly, $LiEuMo_2O_8$ shows a strong influence of the molybdenum valence state on the optical properties of the crystals[2].

Spectroscopic Properties

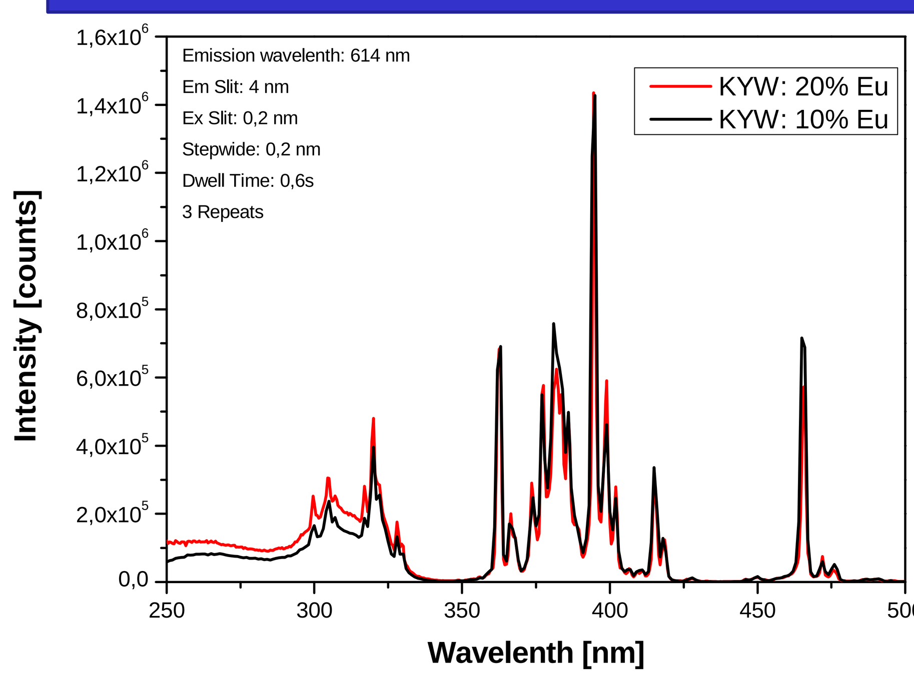


Fig. 3. Excitation spectra of 10 and 20 % Eu doped KYW

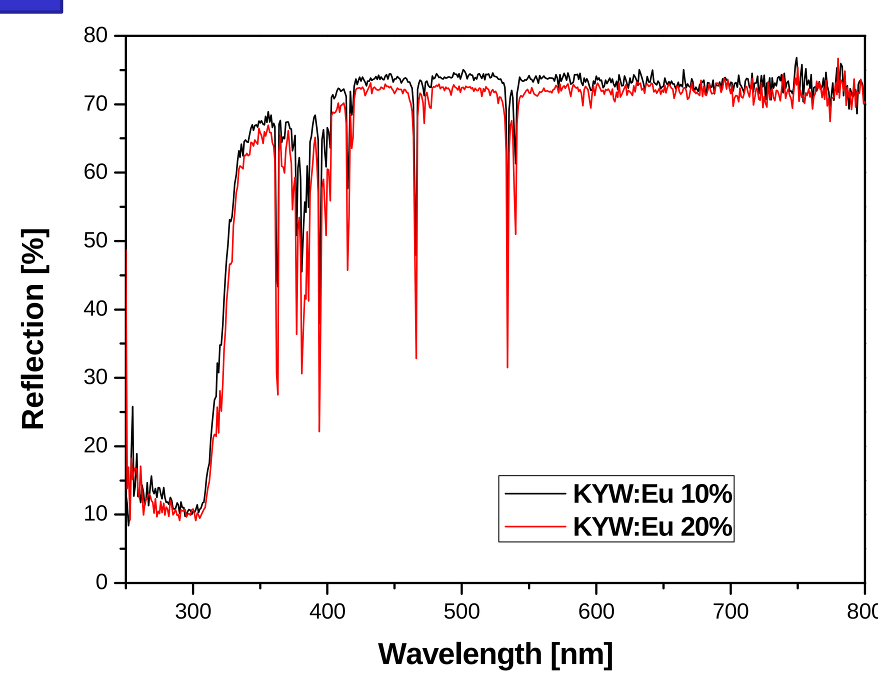


Fig. 5. Reflection spectra of 10 and 20 % Eu doped KYW crystals

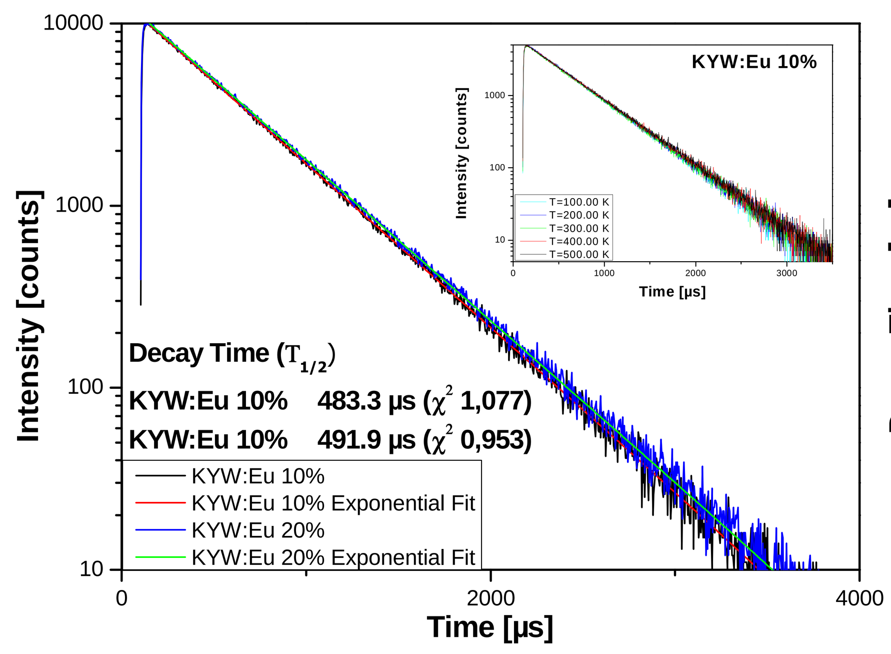


Fig. 6. Decay Time of 10 and 20 % Eu doped KYW

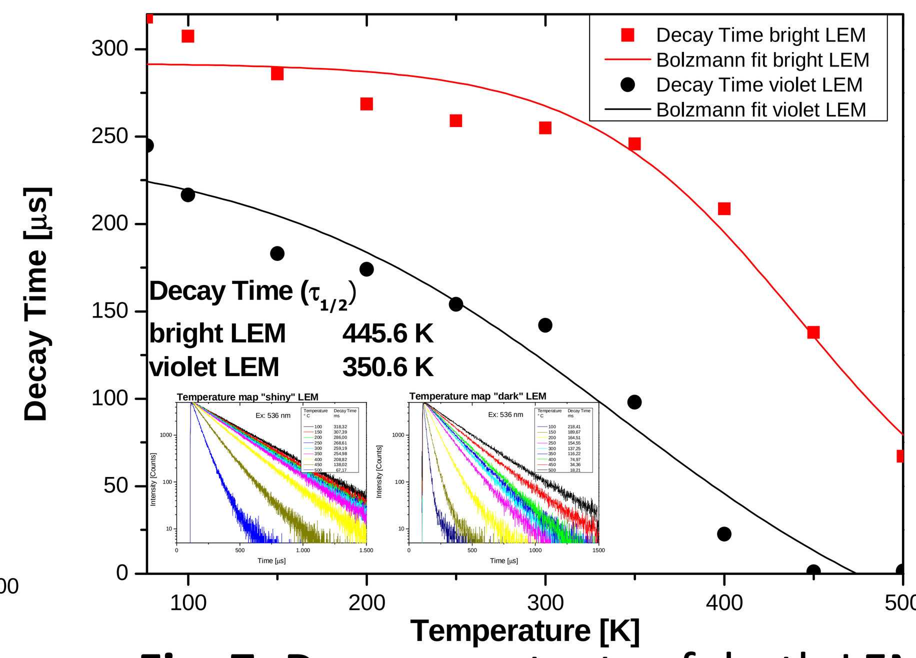


Fig. 7. Decay constants of both LEM phases as function of temperature

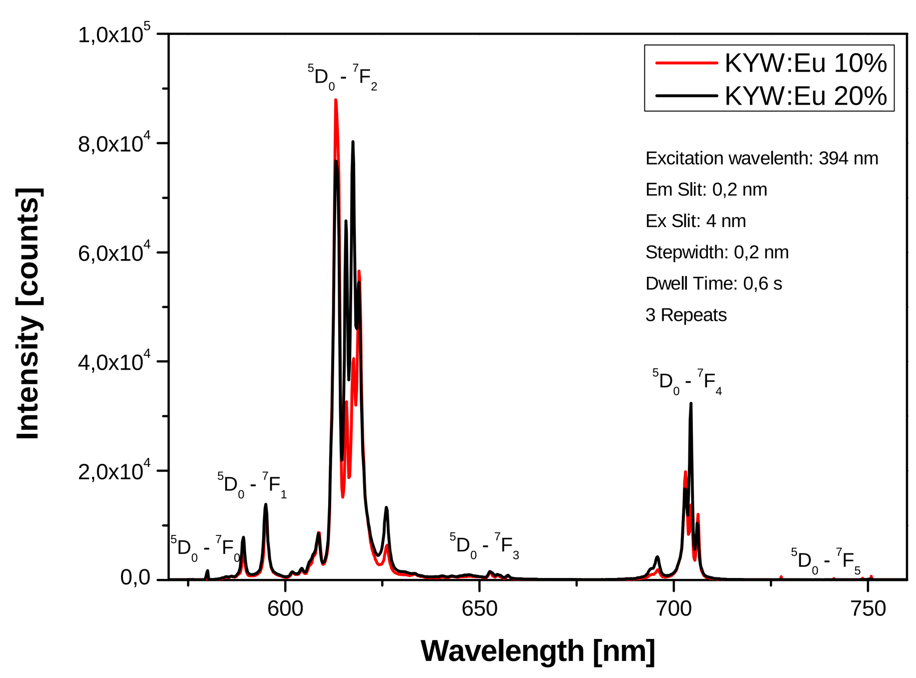


Fig. 4. Emission spectra of 10 and 20 % Eu-doped KYW

Some spectroscopic properties of KYW_2O_8 (KYW) are shown in (**Fig 3 - 5**). The Quantum efficacy increases from 39% in $KYW:Eu^{3+}$ (10%) to 47% for the 20% Eu^{3+} doped crystal. Furthermore, $KYW:Eu^{3+}$ shows in contrast to $LiEuMo_2O_8$ (LEM, **Fig 8**) no temperature influence of the decay time (**Fig 6 & 7**).

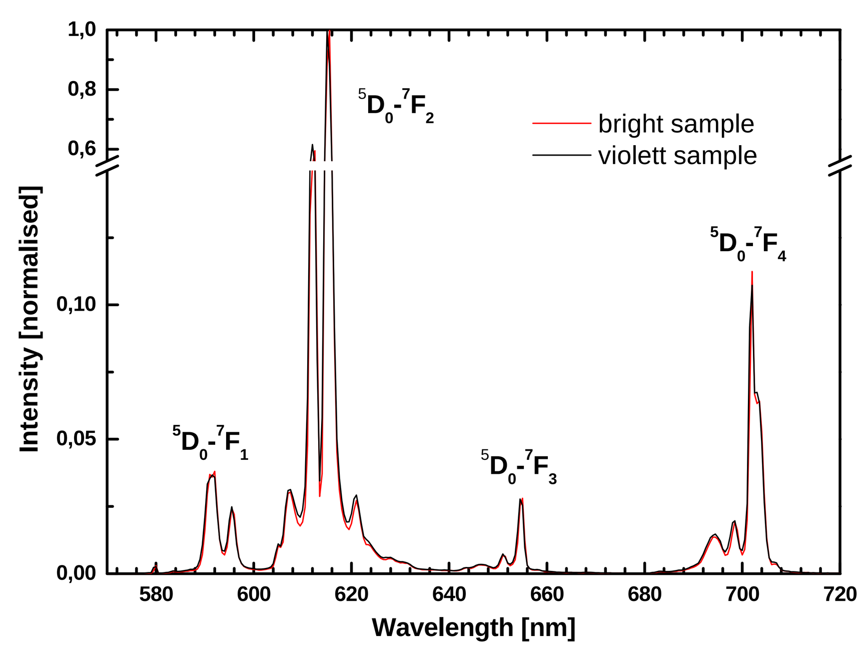


Fig. 8. Normalized emission spectra of both LEM phases

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Sebastian Schwung, sebastian.schwung@fh-muenster.de http://www.fh-muenster.de