

# Investigation of Luminescence Properties of $\text{KEu}(\text{WO}_4)_2$ Single Crystals

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## Background

- $\text{KY}(\text{WO}_4)_2$  samples doped by rare earth ions, including  $\text{KY}(\text{WO}_4)_2:\text{Eu}^{3+}$ , have been investigated in various studies.
- The present investigation was focused on the growth and characterization of  $\text{KEu}(\text{WO}_4)_2$  single crystals.

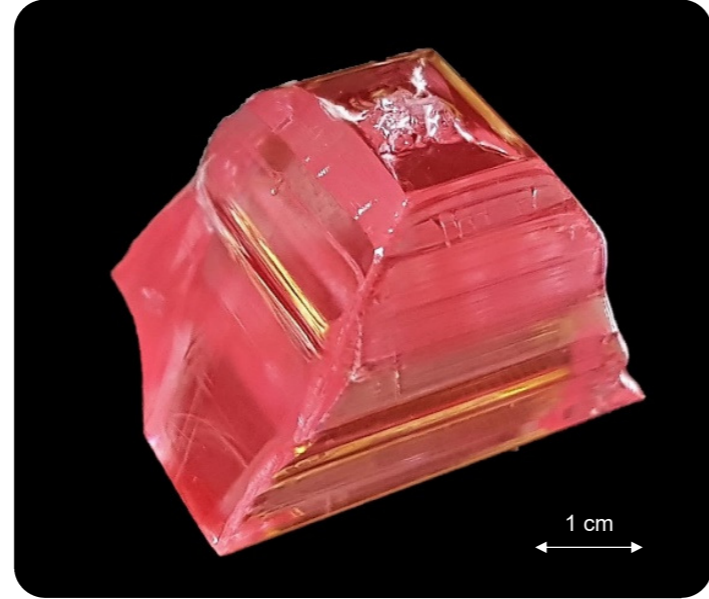


Fig. 1: Image of a  $\text{KEu}(\text{WO}_4)_2$  single crystal

## Experimental Section

- Bulk single crystals of  $\text{KEu}(\text{WO}_4)_2$  have been grown by the TSSG method. (Top Seeded Solution Growth)
- $\text{K}_2\text{W}_2\text{O}_7$  as high temperature solvent was used.
- The crystal growth took round about 2 weeks per crystal.
- Optical properties were investigated by recording photoluminescence spectra as well as by fluorescent lifetime measurements, X-ray excitation, and polarized transmission measurements.

## Results and Discussion

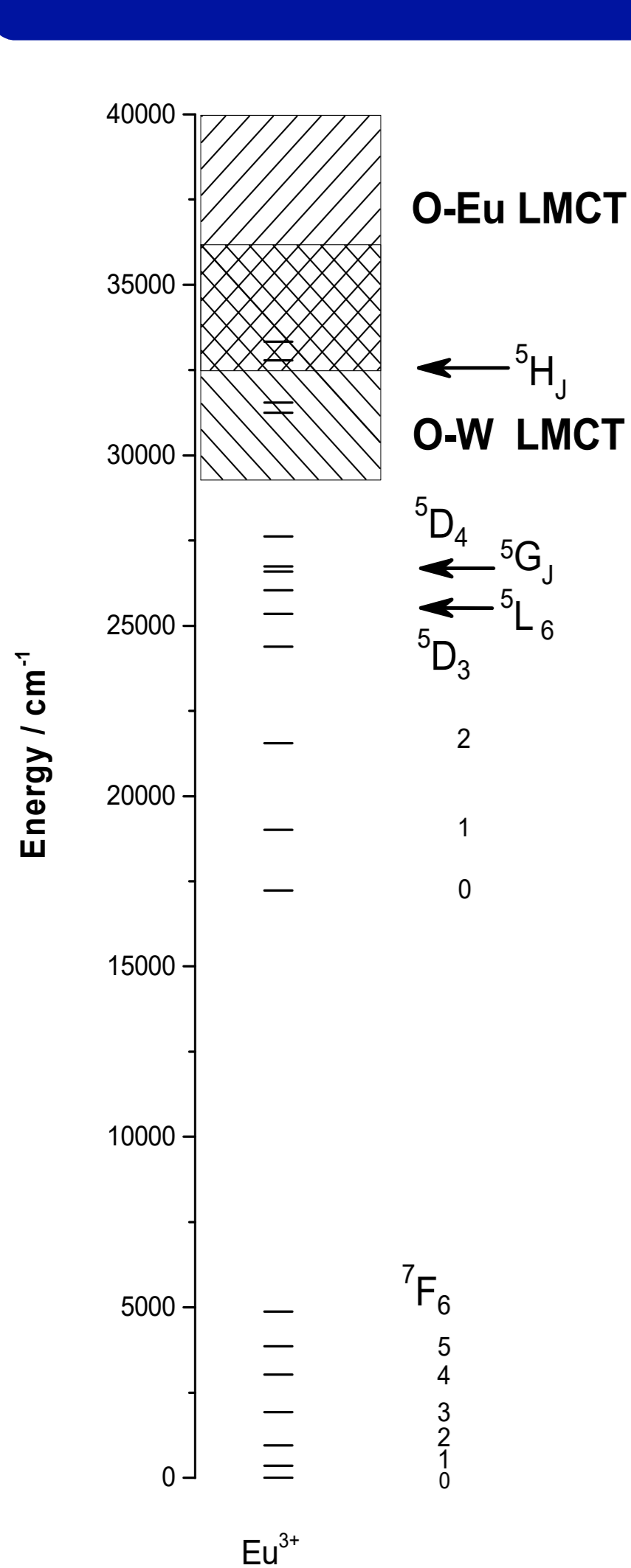


Fig. 4: Energy level diagram of  $\text{Eu}^{3+}$  in  $\text{KEu}(\text{WO}_4)_2$ .

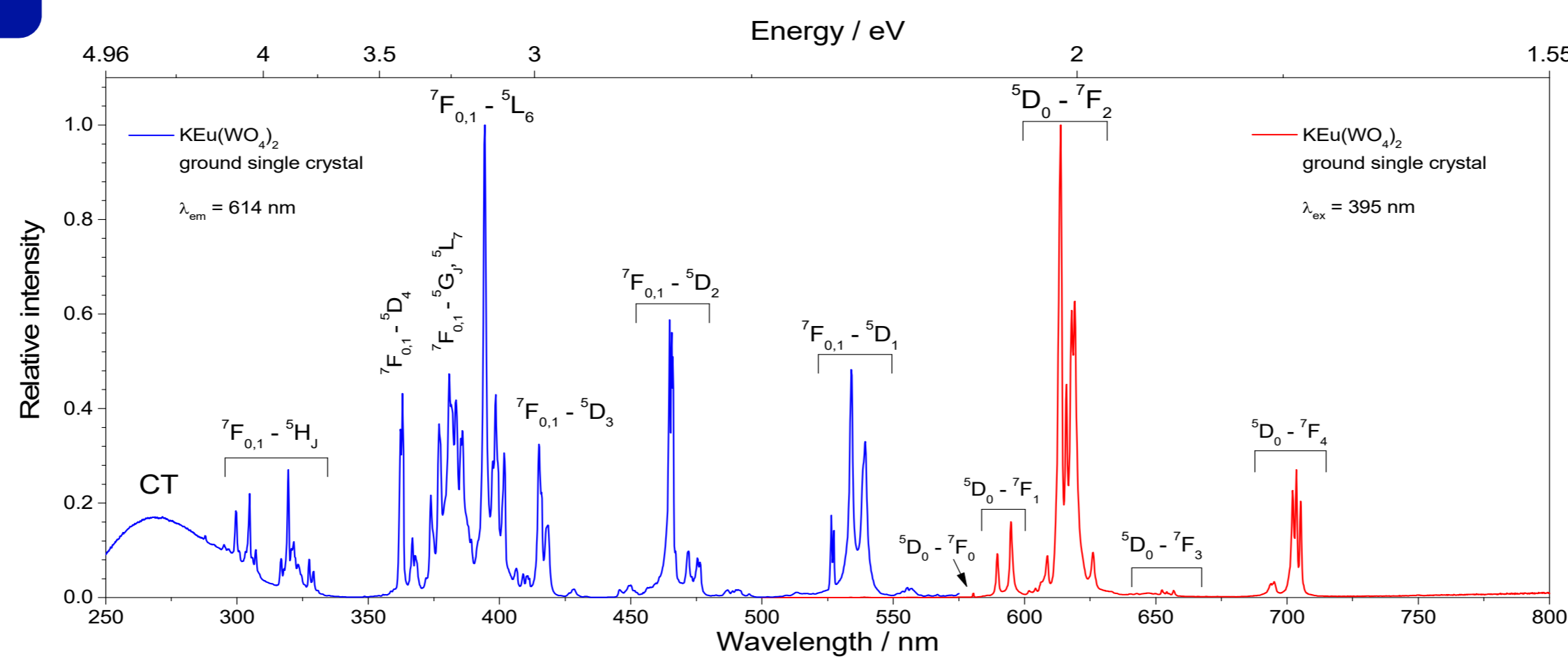


Fig. 2: Excitation and emission spectra of  $\text{KEu}(\text{WO}_4)_2$  powder from a ground  $\text{KEu}(\text{WO}_4)_2$  single crystal, normalized to highest intensities.

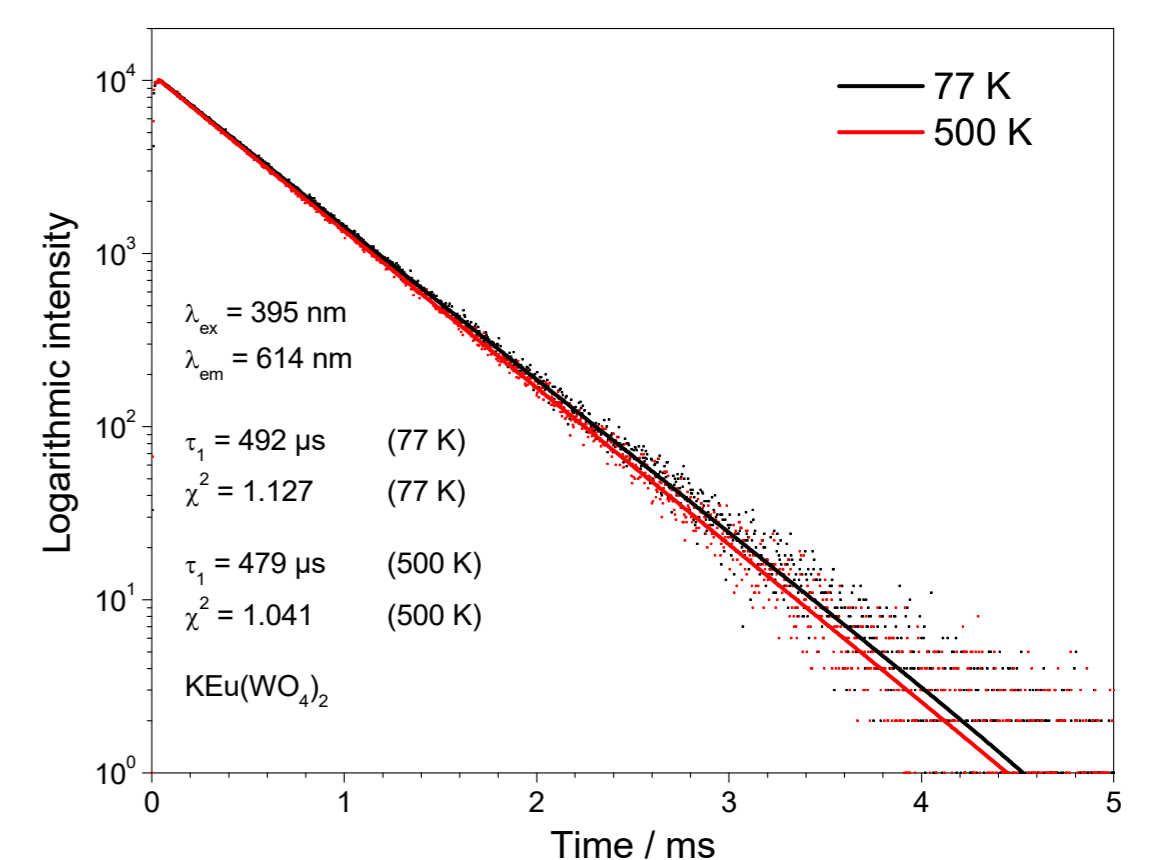


Fig. 3: Fluorescence lifetime of the  $\text{Eu}^{3+}$  emission decreases slightly with increasing temperature.

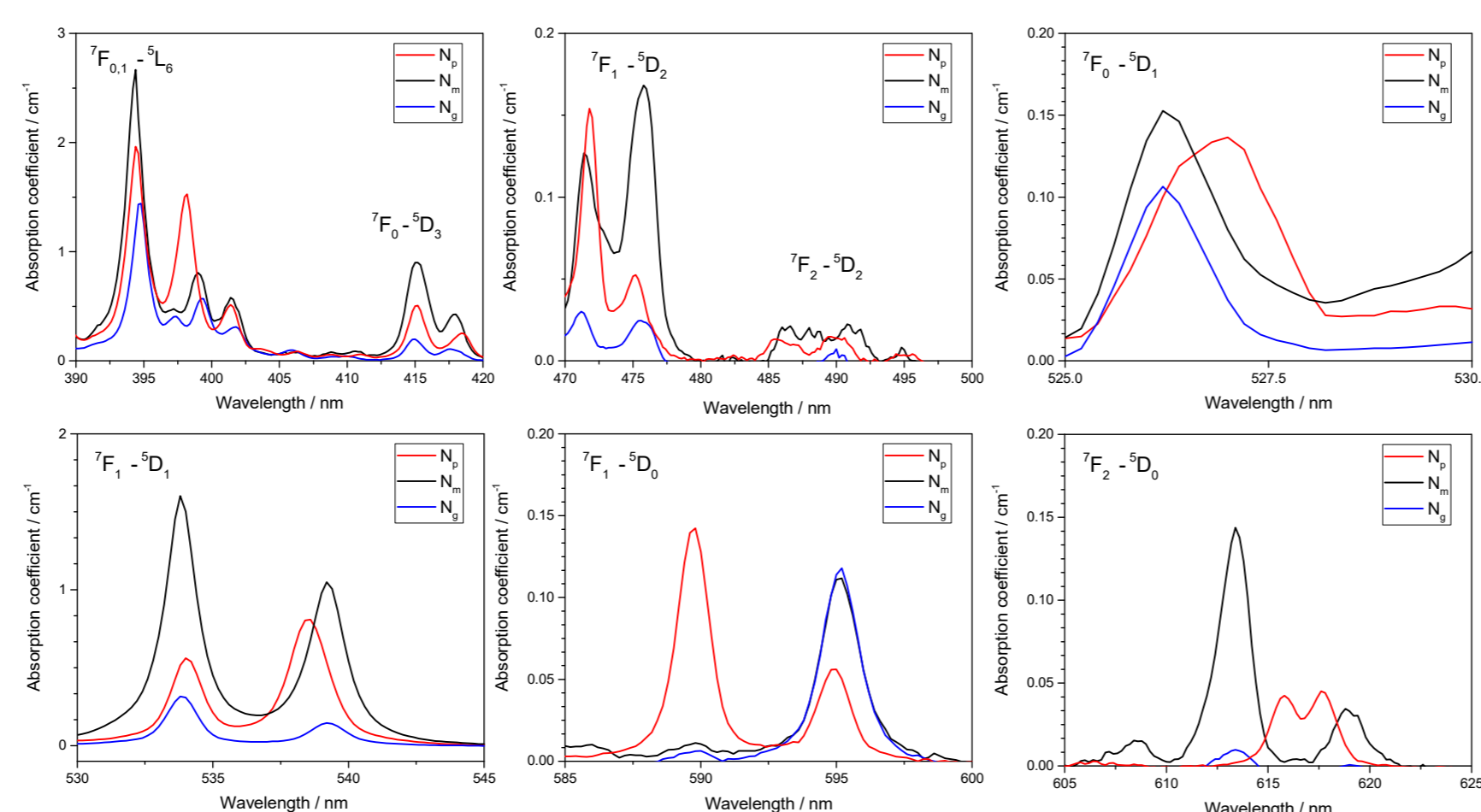


Fig. 5: Polarized transmission measurements, showing the anisotropic absorption behavior of  $\text{KEu}(\text{WO}_4)_2$ .

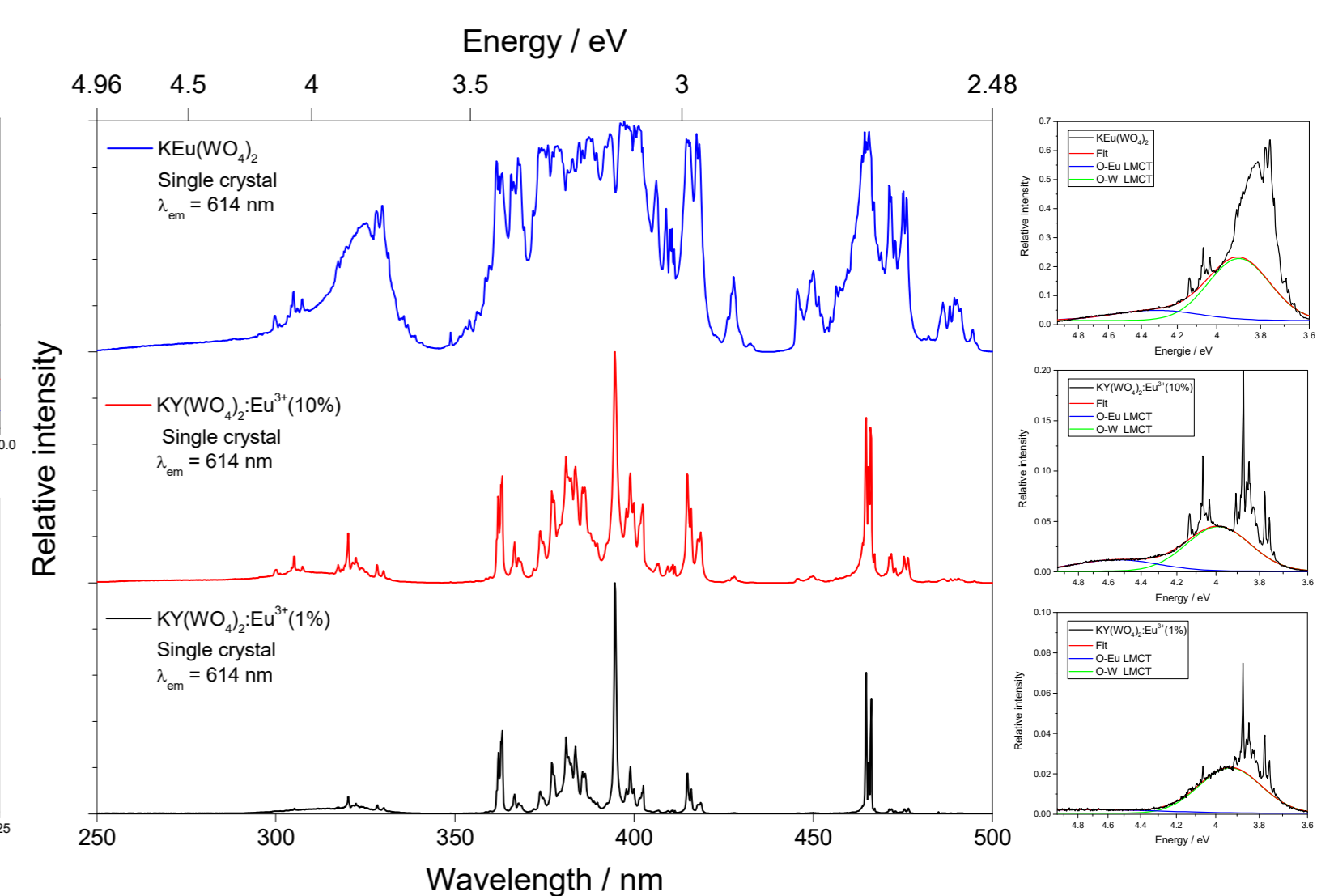


Fig. 6: Excitation spectra of  $\text{KY}_{0.99}\text{Eu}_{0.01}(\text{WO}_4)_2$ ,  $\text{KY}_{0.9}\text{Eu}_{0.1}(\text{WO}_4)_2$  and  $\text{KEu}(\text{WO}_4)_2$  single crystals, normalized to highest emission intensity. The observable increase of the  $\text{Eu}^{3+}$  absorption is caused by the increasing  $\text{Eu}^{3+}$  concentration. The broadening of the absorption bands is caused by the light guiding within the crystal.

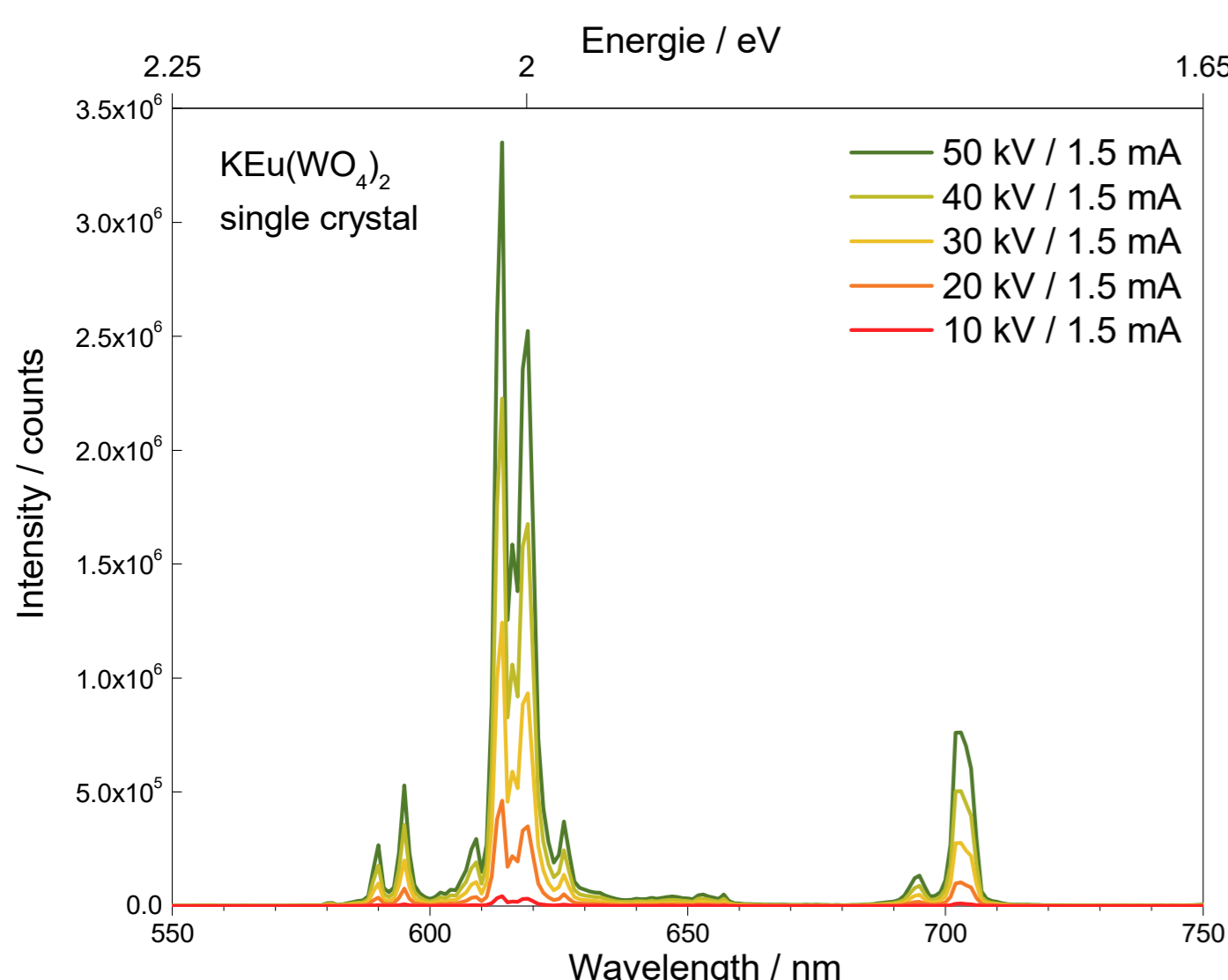


Fig. 7: X-ray excitation spectra of  $\text{KEu}(\text{WO}_4)_2$  at different excitation voltages showing the characteristic  $\text{Eu}^{3+}$  emission in the red spectral region.

## Conclusion

- To our knowledge, large, crack-free  $\text{KEu}(\text{WO}_4)_2$  single crystals have been grown by TSSG method for the first time.
- It was possible to construct an energy level diagram for  $\text{Eu}^{3+}$  in  $\text{KEu}(\text{WO}_4)_2$ , which shows the  $7F_j$  and  $5D_j$  Levels as well as the O-W and O-Eu LMCT.
- $\text{KEu}(\text{WO}_4)_2$  single crystals showed, as expected, an optically anisotropic absorption behavior. Furthermore,  $\text{KEu}(\text{WO}_4)_2$  can be stimulated with X-rays which may be suitable for use as a scintillator.
- $\text{KEu}(\text{WO}_4)_2$  single crystals showed the characteristic excitation and emission behavior of  $\text{Eu}^{3+}$ . In addition single crystal  $\text{KEu}(\text{WO}_4)_2$  also showed a broadening of the excitation bands, presumably due to the light guiding within the crystal.
- Single-crystalline  $\text{KEu}(\text{WO}_4)_2$  may be an interesting material for the use as a frequency converter for the red spectral range.