

## Tuning the $4f^15d-4f^2$ UV Emission of $Pr^{3+}$

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The emission spectra of phosphors based on  $Pr^{3+}$  exhibit a strong dependence on the host lattice, i.e. on the site symmetry and crystal field strength.

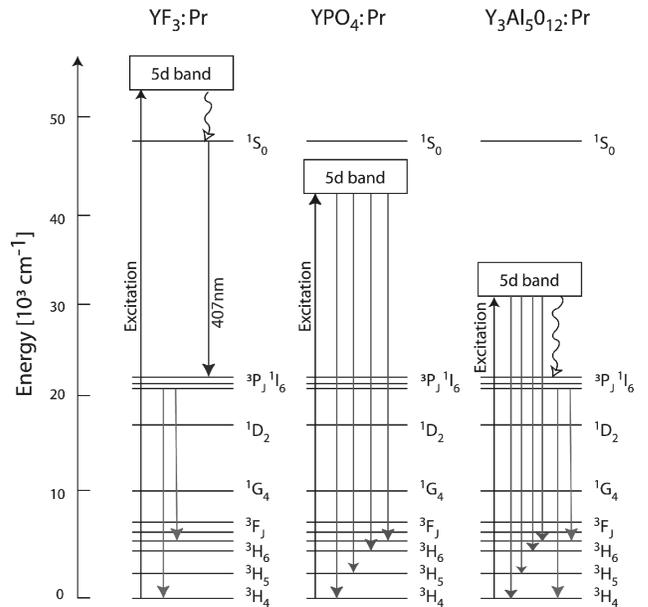
If  $Pr^{3+}$  is doped into a host lattice that exerts a weak crystal field, e.g. in  $YF_3$ , the lowest crystal field component of the  $4f^15d$  configuration is energetically located above the  $4f$ -state  $^1S_0$  (fig. 1). After VUV excitation the dominant relaxation path yields the population of the  $^1S_0$  level. This results in photon-cascade emission and thus quantum efficiencies higher than 100 % are observed [1].

$Pr^{3+}$  shows broad emission in the UV spectral range [2], if it is doped into host lattices, in which the crystal field on the activator sites is strong enough that the lowest crystal field component of the  $4f^15d$  configuration is located below the  $^1S_0$  state. The observed five transitions between the  $4f^15d$  configuration and the levels  $^3H_4$ ,  $^3H_5$ ,  $^3H_6$ ,  $^3F_2$  and  $^3F_3$  of the  $4f^2$  configuration are located in the UV-C and UV-B range (fig. 2). The spectral position of the observed bands is governed by the energetic position of the lowest crystal field component of the  $4f^15d$  configuration and thus shifts to lower energy by increasing the crystal field strength. A host lattice with a very strong crystal field is YAG and thus the  $4f^15d-4f^2$  transitions are located in the UV-A range. In this host lattice the lowest crystal field component of the  $4f^15d$  configuration is located closely enough to the  $^3P_1$  levels, which results in the population of the  $4f$  states. Consequently, transitions from the  $^3P_0$  levels to the  $^3H_J$  and  $^3F_J$  states of  $Pr^{3+}$  are also present as lines in the visible range of the emission spectrum (fig. 3).

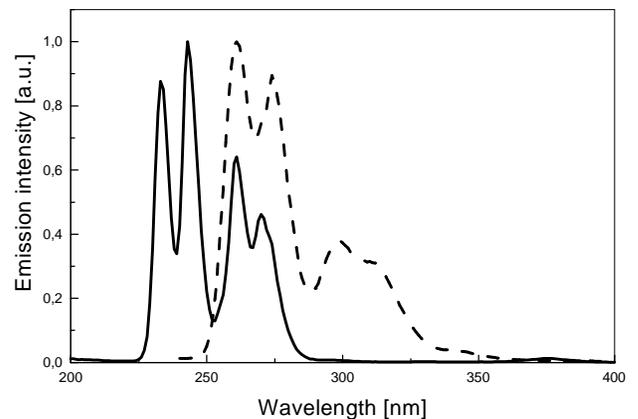
In this presentation, we will discuss a series of  $Pr^{3+}$ -based UV-Phosphors. The influence of the chemical environment on the position and splitting of the  $4f^15d$  configuration will be elucidated.

### References

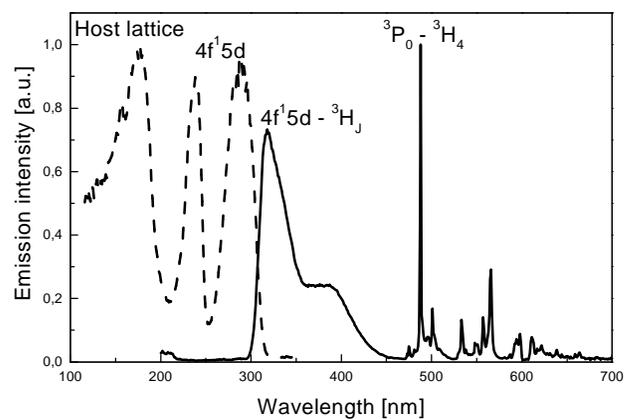
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b) W.W. Piper, J.A. deLuca, F.S. Ham, J. Luminescence 8 (1974) 344.
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**Fig. 1:** Energy level scheme of  $Pr^{3+}$ .



**Fig. 2:** Emission spectra of  $YPO_4:Pr$  (solid line) and  $YBO_3:Pr$  (dashed line).



**Fig. 3:** Excitation (dashed line) and emission (solid line) spectrum of  $Y_3Al_5O_{12}:Pr$  (YAG:Pr).