UV emitting luminescent materials are of strong interest for UV emitting fluorescent lamps driven by a Hg low-pressure or a by Xe excimer discharge. Pr³⁺ doped host lattices exhibit efficient UV emission upon deep UV excitation, if the site of the host lattice, where Pr³⁺ is located, is suitable for this purpose.

Rare earth doped yttrium comprising compounds found many application areas, e.g. as scintillators, as crystals for solid state LASER, and as visible or UV emitting luminescent powders for fluorescent lamps. Pr³⁺ activated luminescent materials show UV, visible or IR emission, which is a sensitive function of the crystal field strength and covalent character of the environment of the lattice position, where Pr³⁺ is located.

This work deals with Pr³⁺ activated VUV ceramic luminophores, i.e. materials, which show efficient luminescence upon 160 nm excitation. As host lattices for the potentially UV emitting Pr³⁺ ion aluminates and silicates have been studied. All samples were prepared by conventional mix and fire synthesis techniques with metal oxides as starting materials. Firstly, powder samples were annealed between 1000 and 1700°C and secondly, ceramic samples were repeatedly thermally treated at similar temperatures after pressing. We have demonstrated that translucent ceramics show mainly UV luminescence upon deep UV excitation, while excitation by a blue 450 nm LED results in green to red luminescence with a similar decay time as observed for single crystals.

Conclusions

The observed five transitions between the [Xe]⁴f¹⁵d¹ configuration and the levels ⁴H₁₅, ⁴H₁₃, ⁴H₁₁, ⁴F₂ and ⁴F₃ of the [Xe]⁴f⁴ configuration of Pr³⁺ are located in the UV-C or UV-B range. The spectral position of the observed bands is governed by the energetic position of the lowest crystal field component of the [Xe]⁴f¹⁵d¹ configuration and thus shifts to lower energy by increasing the crystal field strength.

In host lattices with a very strong crystal field, e.g. YAG:Pr³⁺, the [Xe]⁴f⁵d⁴-4F transitions are located in the UV-A range. Consequently, transitions from the ⁴P₀ levels to the ⁴H₂ and ⁴F₂, states of Pr³⁺ are also present and become dominant by further increasing the crystal field strength. LuAG:Pr³⁺ ceramic show mainly UV luminescence upon deep UV excitation, while excitation by a blue 450 nm LED results in green to red luminescence. The decay time of our LuAG:Pr³⁺ ceramics upon 160 nm excitation is 22 ns, which is perfectly in line with the decay time of LuAG:Pr³⁺ single crystals.