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On the VUV luminescence and degradation of UV-C emitting phosphors

Mike Broxtermann[1] and **Thomas Justel**[2]
[1,2]Munster University of Applied Sciences, Germany

Xenon comprising excimer discharge lamps represent themselves as an efficient source of vacuum ultraviolet radiation, which may find an application, e.g. for disinfection purposes by the use of suitable photoluminescent conversion materials. [1,2] Among these conversion phosphors there are some doped yttrium ortho-phosphates, as well as respective lutetium or lanthanum containing derivatives, exhibiting promising properties. [3,4] A common design for phosphor converted Xe excimer lamps consists of a discharge vessel made from quartz glass, which is coated with a thin layer of phosphor particles (around 10 - 50 µm) on the inner side. Experimental results demonstrate that all of the above mentioned PO_4-based phosphor materials exhibit a distinct degradation resulting in a mayor loss of lamp UV radiation output over just a few days of operation time. Recovery of aged phosphor material enabled the investigation of that performance loss which could be traced back to a strong new absorption in the UV range. This is accompanied by well fitting excitation bands spreading over the UV spectral range as well as a corresponding broad band emission peaking in the deep red. Immersing analysis of the undoped phosphate compounds YPO_4, $LuPO_4$ and $LaPO_4$ evidenced, that these aging effects find their origin within the phosphate host material itself being directly exposed to the plasma discharge, most probably to the existence of phosphorous III in $[Ne]3s^2$ electron configuration. Further work is thus conducted on the understanding as well as on the obviation of phosphor aging throughout the application of protective particle coatings.

1 U. Kogelschatz, Dielectric-barrier Discharges: Their History, Discharge Physics, and Industrial Applications, *Plasma Chem. Plasma Process*. 2003, 23, p. 1

2 Patent US 6398970 B1

3 T. JUstel, P. Huppert, W. Mayr, D.U. Wiechert, Temperature-dependent spectra of YPO4:Me (Me = Ce, Pr, Nd, Bi), *J. Lumin*. 2004, 106, p. 225

4 Patent US20140099798 A1

Biography

Mike Broxtermann has completed his bachelor and master studies at the Ruhr-University Bochum, Germany. Afterwards he has started his PhD studies on the analysis and improvement of UV emitting phosphor converted Xe-excimer lamps at the MUnster University of Applied Sciences. The respective research project "Hg free UV Radiation Sources for Energy Efficient Water Treatment" is supported by the German federal ministry of education and research (BMBF). Mike Broxtermann himself is an awardee of the German foundation economics (sdw).

mike.b@fh-muenster.de

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