Nanoscale UV-B Emitting Scintillator – $LuPO_4:Pr^{3+},Gd^{3+}$

Jan Kappelhoff and Thomas Jüstel

Münster University of Applied Sciences, Department of Chemical Engineering, Stegerwaldstr. 39, D-48565 Steinfurt
jan-Kappelhoff@fh-muenster.de, tj@fh-muenster.de

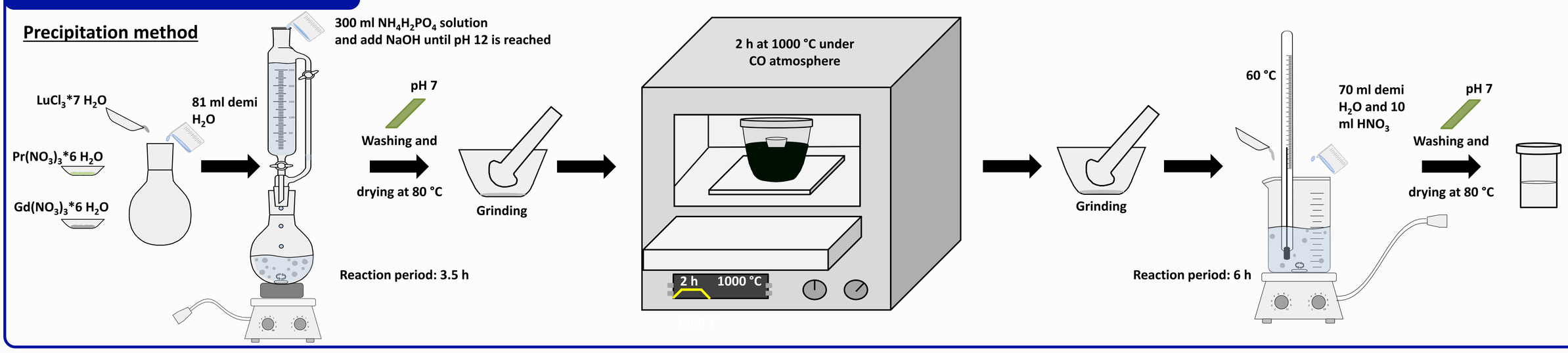
22nd JCF Frühjahrssymposium 2020, March 25-28, Cologne, Germany

Background

Ultraviolet radiation is well known to be an important environmental hazard acting onto human skin. Nevertheless, phototherapy based on UV-B radiation is applied for the treatment of skin diseases like Psoriasis or Vitiligo for quite some time already. Broadband UV-B radiation has been used for the treatment since the mid of the 20th century. Since the most efficient wavelength range is located between 305 and 315 nm [1], the narrow UV emission from Gd^{3+} at 312 nm is very efficient for the application in UV-B based phototherapy.

This work deals with nanoscale samples of $LuPO_4$ doped with 1% Pr^{3+} because of its high quantum yield [2], and the co-doping with different concentration of Gd^{3+} (0.1 - 5%). The resulting energy transfer from Pr^{3+} to Gd^{3+} has been studied. In addition, reflectance and X-ray excited emission spectra were recorded.

Synthesis Procedure



Characterization

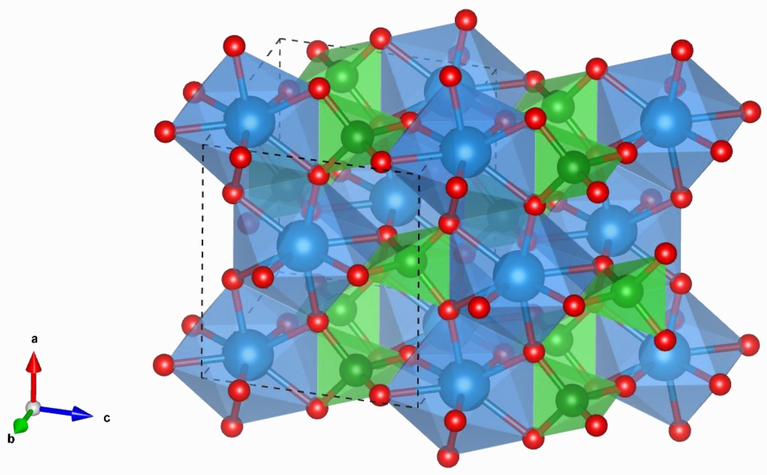


Fig. 1: Section of the tetragonal crystal structure of $LuPO_4$

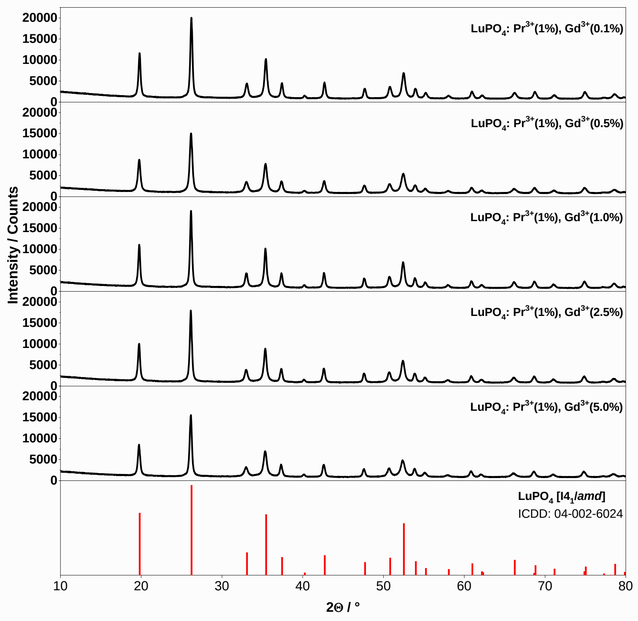


Fig. 2: The X-ray powder diffraction pattern of tetragonal $LuPO_4$ with varying Gd^{3+} concentrations

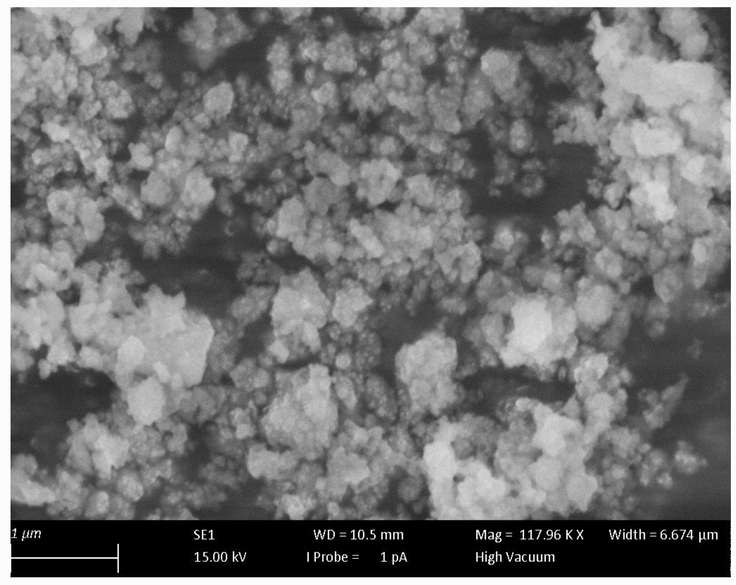


Fig. 3: SEM image of a nanoscale particle sample of $LuPO_4$

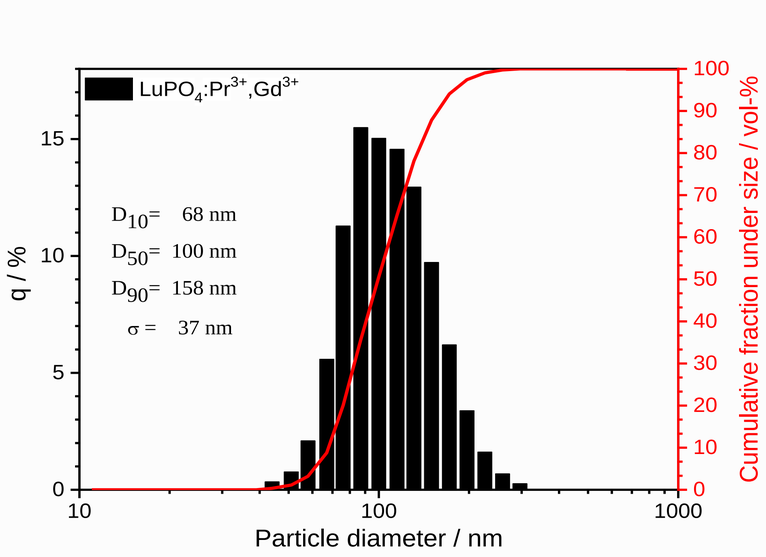


Fig. 4: Particle size distribution of the synthesized $LuPO_4:Pr^{3+},Gd^{3+}$

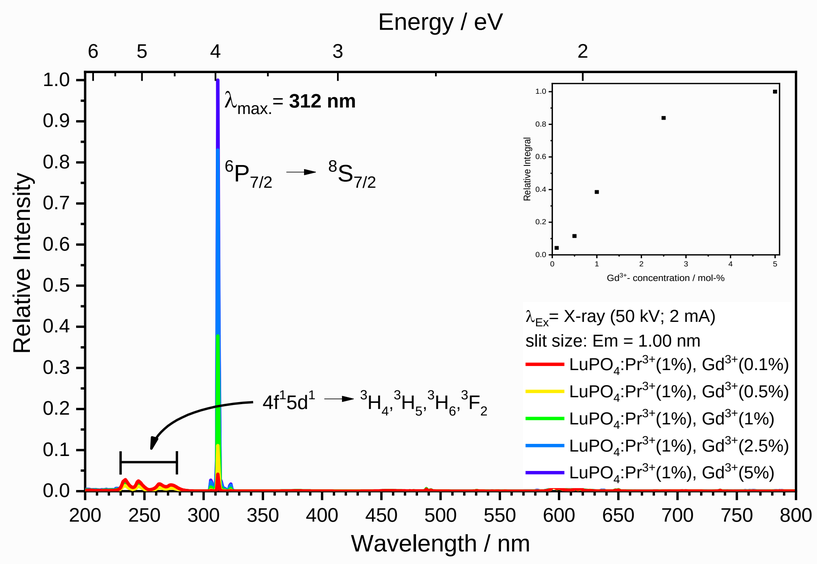


Fig. 5: X-ray excited luminescence spectra and relative integrals

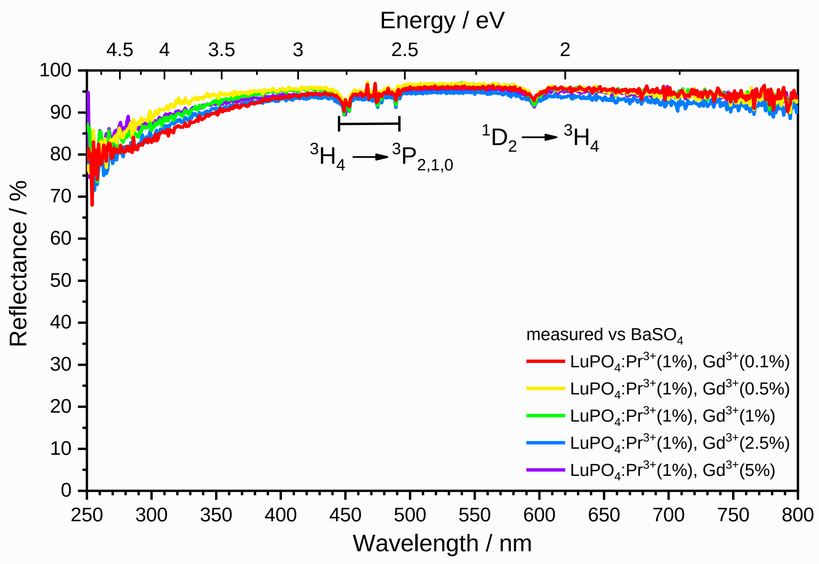


Fig. 6: Diffuse reflection spectra of $LuPO_4:Pr^{3+},Gd^{3+}$

References

[1] M. Weichenthal, T. Schwarz, *Photodermatology, Photoimmunology & Photomedicine,* 21, **2005**, 260
[2] S. Epinoza, M.-F. Volhard, H. Kätker, H. Jenneboer, A. Uckelmann, M. Haase, M. Müller, M. Purschke, T. Jüstel, *Part. Part. Syst. Charact.* , **2018**, 1800282

Acknowledgement

The authors are grateful to the research group "Tailored Optical Materials" and the Department of Chemical Engineering

EUROPÄISCHE UNION
Investition in unsere Zukunft
Europäischer Fonds für regionale Entwicklung

EFRE.NRW
Investitionen in Wachstum und Beschäftigung

TOM Tailored Optical Materials

FH MÜNSTER
University of Applied Sciences

RG Tailored Optical Materials – http://www.fh-muenster.de/juestel