NANOTECHNOLOGY FOR NANOPHOSPHORS

Development of recovery processes for recycling of valuable components from FPDs (In, Y, Nd) for the production of high added value NPs

Grant agreement: 310312

WHY NANOPHOSPHORS?

In recent years, nanophosphor materials have been of interest in many different fields. This is because of the **large surface-to-volume ratio** of the nanoparticles, which makes them very interesting due to:

- the quantum effect,
- their improved and unique properties such as high luminescent efficiency,
- and the higher doping concentration without concentration quenching

With these unique properties, nanophosphor materials can be employed in a wide range of applications such as optical, electrical, medical and biological technologies.

SYNTHESIS OF NANOPARTICLES BY FLAME SPRAY PYROLYSIS

With Flame Spray Pyrolysis (FSP) we are able to produce a multitude of single and mixed metallic oxide nanoparticles which can be used as nanophosphors

Indeed, actually, TECNAN, partner of the project owns the biggest production capacity of nanoparticles by FSP in Europe.

FSP Nanopowder production 2 Tn/year

Biggest LF-FSP in the world, with a productive capacity of 10 Tn/year of nanoparticles

SYNTHESIS OF NANOPARTICLES BY FLAME SPRAY PYROLYSIS

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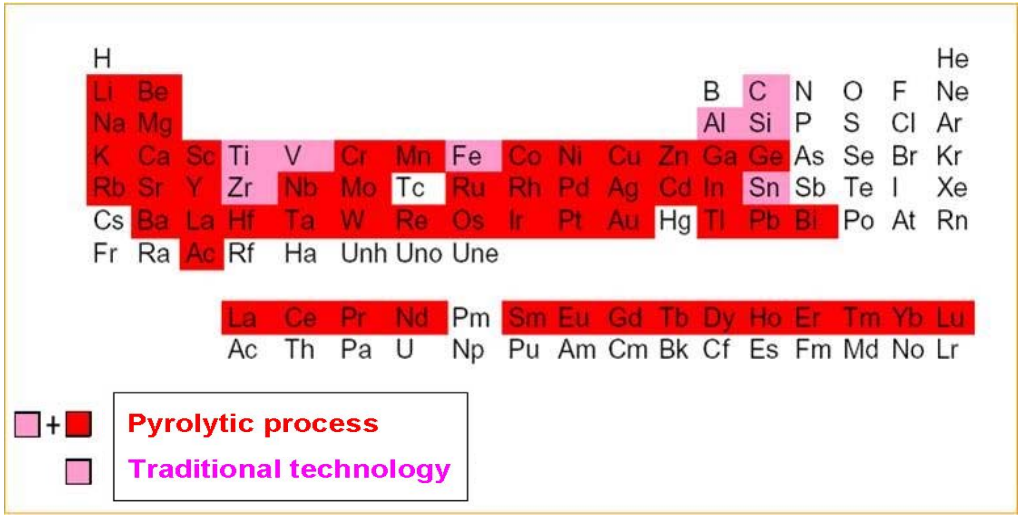
- Low sizes (7-25 nm) ⟶ high SSA ⟶ high efficiency
- High purity
- Narrow size distribution
- High chemical & thermal stability
- High dispersion capacity
- Low Agglomeration
- Wide variety ⟶ Different sectors

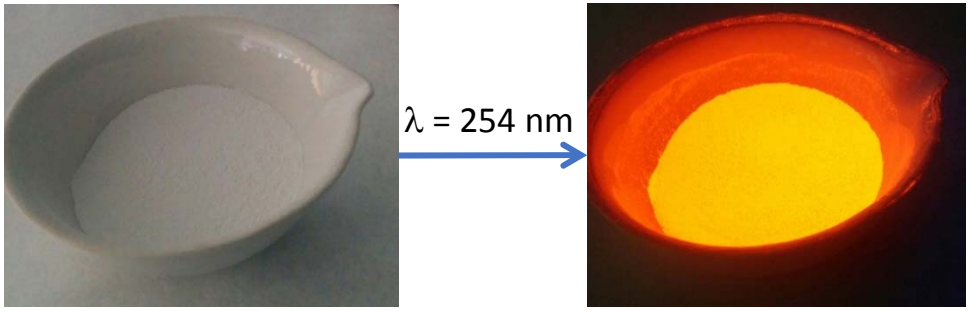


SIMPLE	COMPLEX
Nano-Al_2O_3	Nano-ZrO_2/CeO_2
Nano-CeO_2	Nano-lantanide oxides
Nano-Fe_2O_3	Doped TiO_2
Nano-TiO_2	ZnO Core-Shell
Nano-ZnO	Nano-Y_2O_3/Eu^{3+}
Nano-ZrO_2	Doped-Y_2O_3/Eu^{3+}
Nano-SiO_2	$CaZrO_3$
Nano-HfO_2	$Y_2Al_5O_{12}$
Nano-Ta_2O_5	Doped ZnO
Nano-$Ca_3(PO_4)_2$	Nano-CuO/ZnO
Nano-$CaSO_4$	etc…

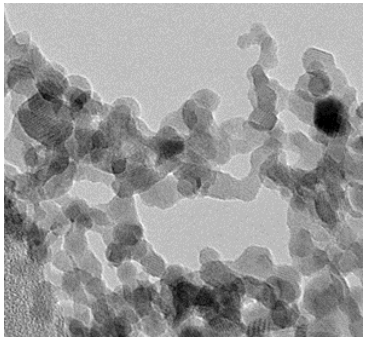
CHARACTERIZATION OF $Y_2O_3:Eu^{3+}$ NANOPHOSPHOR

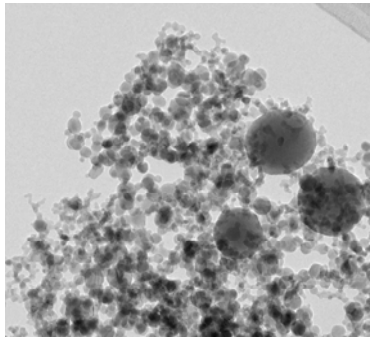
With FSP technology, the partners of the project, Lurederra and TECNAN has carried out the production process of $Y_2O_3:Eu^{3+}$ nanophosphor. Its characterization reveals:

- A white powder that emits red light under UV light (254 nm) excitation.

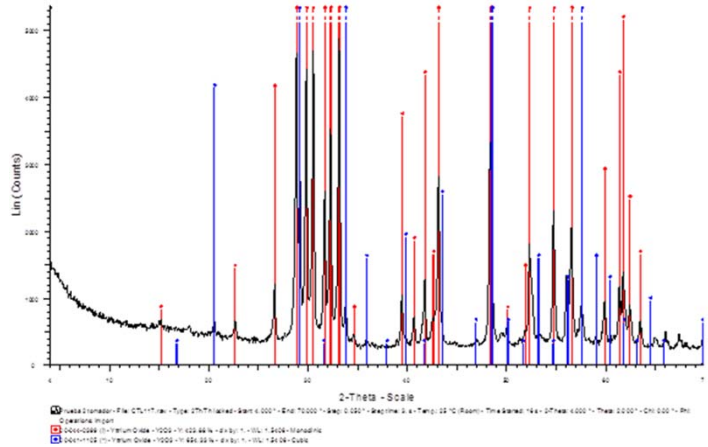


- Specific Surface Area of 29,7 m^2/g.





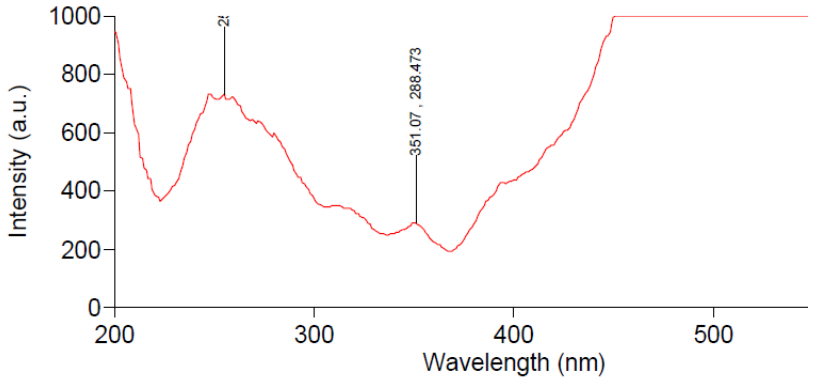
- Cubic phase predominant.



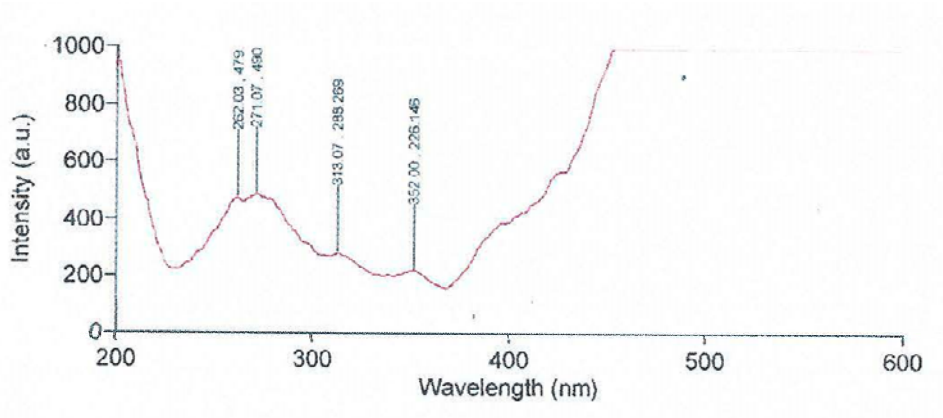
CHARACTERIZATION OF $Y_2O_3:Eu^{3+}$ NANOPHOSPHOR

- Characterization of the excitation spectra revealed that **the intensity** of the interaction of the nanophosphor with UV light **is around 60 % higher** when it is compared with commercial $Y_2O_3:Eu^{3+}$ microphosphor <u>even at ten times lower concentrations.</u>

Nanometric particles (0.03 mg/mL)



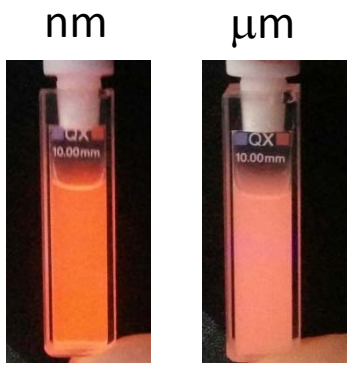
Micrometric particles (0.33 mg/mL)

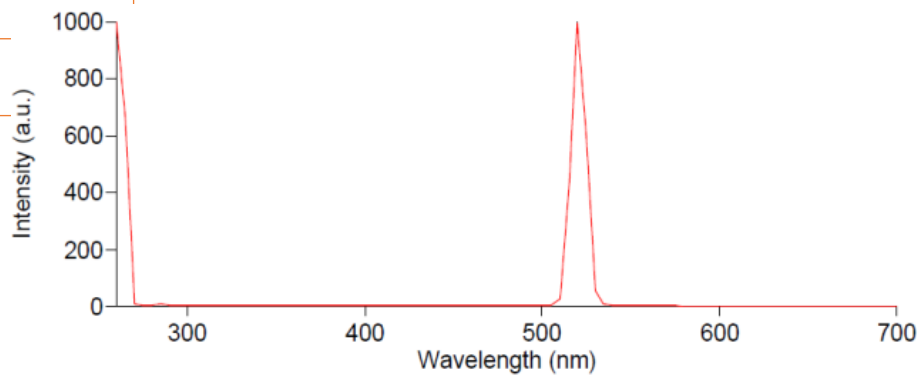


CHARACTERIZATION OF $Y_2O_3:Eu^{3+}$ NANOPHOSPHOR

- By its part, characterization of the emission spectra also revealed that the percentage of light conversion is higher when the nanophosphor is irradiated with light of different wavelength from 260 to 310 nm. Reaching up around a 65 % of higher conversion when the nanophosphor is irradiated with a wavelength of 260 nm and up to 130% higher when irradiated at 310 nm.

λ_{ex} (nm)	λ_{em} (nm)	$\%_{conv}$ nanometric particles	$\%_{conv}$ micrometric particles
260	520	100	61,34
270	540	100	89,7
280	560	100	60,5
300	600	93,6	52,91
310	620	97,6	42,1



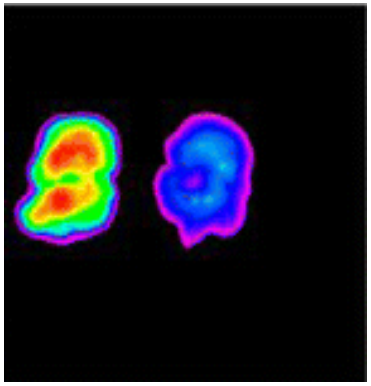


POTENTIAL APPLICATIONS OF NANOPHOSPHORS

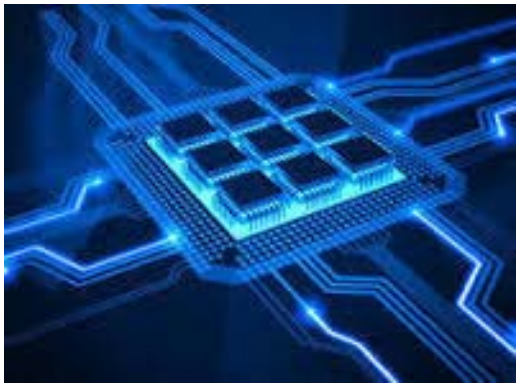
These phosphors could be used in a wide range of applications including display (CRTs and flat televisions), lighting (fluorescent lamps, mercury-free lamps, LEDs), and medical imaging among others.

Lighting

Biomedical applications



Optoelectronics



Photovoltaic panels

CONCLUSIONS

In view of the results exposed is possible to summarized that:

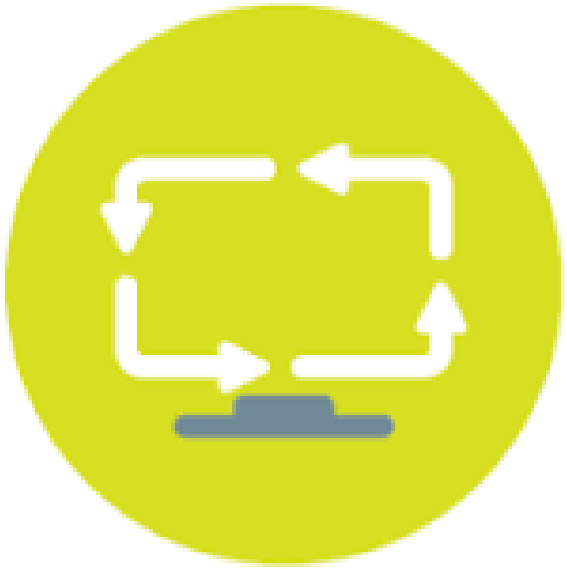
- ✓ The partners of the project has the technology to prepare homogeneous batches of single and mixed metallic oxide nanoparticles of a multitude of elements of the Periodic Table, with high stability under atmospheric conditions and humidity.

- ✓ Indeed, TECNAN, partner of the project, possess the biggest production capacity of nanoparticles by FSP in Europe

- ✓ $Y_2O_3:Eu^{3+}$ nanophosphor synthesized by FSP present a higher interaction with UV light even at ten times lower concentrations.

- ✓ So, nanoparticles of phosphors could be prepared by FSP technology. This fact can be translated in an impulse of already existent and new high technologies employing nanophosphors, reducing costs and increasing their performance.

THANK YOU FOR YOUR ATTENTION!



INTEREST ON RESULTS:

The Recyval consortium is interested in making available to third parties these technologies developed under the project. Third parties interested should in first instance contact to:

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Giiving information on their area of interest

SEVENTH FRAMEWORK PROGRAMME