1st International Electronic Conference on Materials

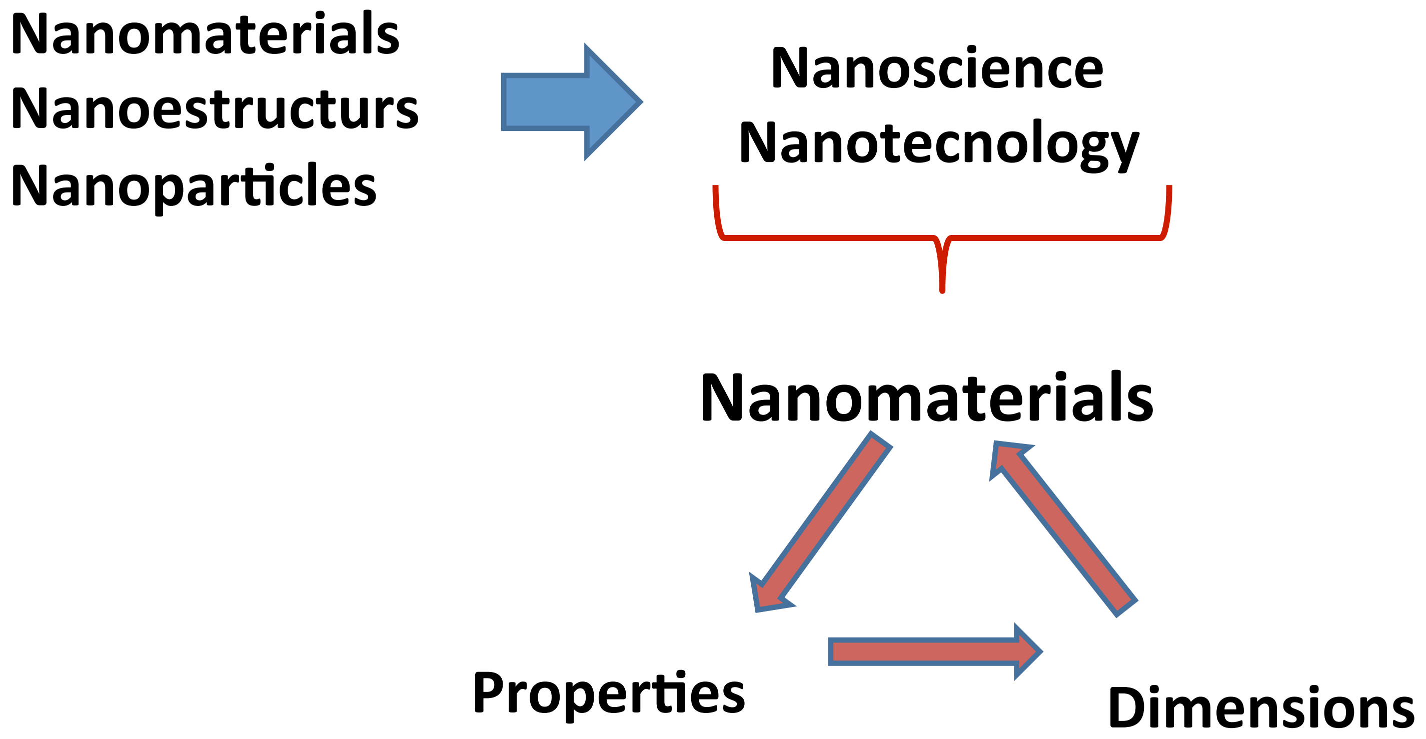
26 May - 10 June 2014

Sol-gel Synthesis and Antioxidant Properties of Yttrium Oxide Nanocrystallites Incorporating P-123

Rebeca Mellado-Vázquez, Margarita García-Hernández Arturo López-Marure, Perla Yolanda López-Camacho Angel de Jesús Morales-Ramírez, Hiram Isaac Beltrán-Conde

mgarciah@correo.cua.uam.mx

NANOMATERIALS: Small structures with high potential

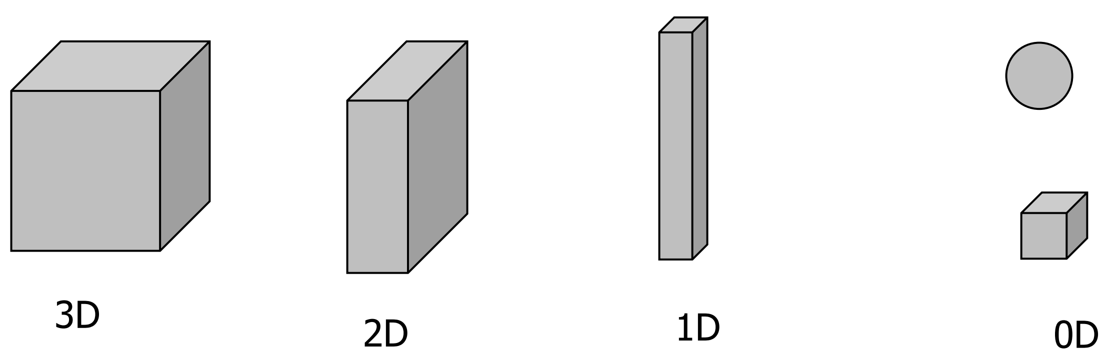


Nanomaterials
<u>1 - 100 nm</u>
one dimension

- **Ceramics**
- **Metals**
- **Semiconductors**
- **Polymers**
- **Combination of them**

In nanometer scale the properties are not the same to bulk materials.

Clasification



Aplications of Y_2O_3

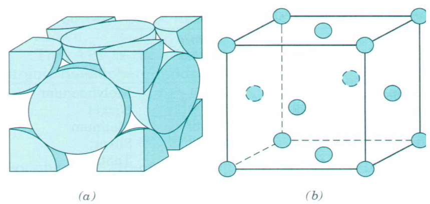
Aplications

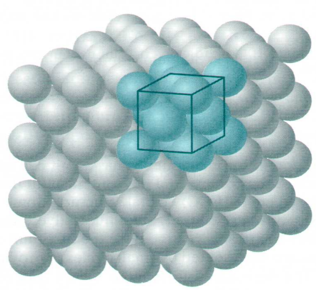
- ✓ Catalyst
- ✓ Medicine
- ✓ Biology
- ✓ Electronic
- ✓ Optique

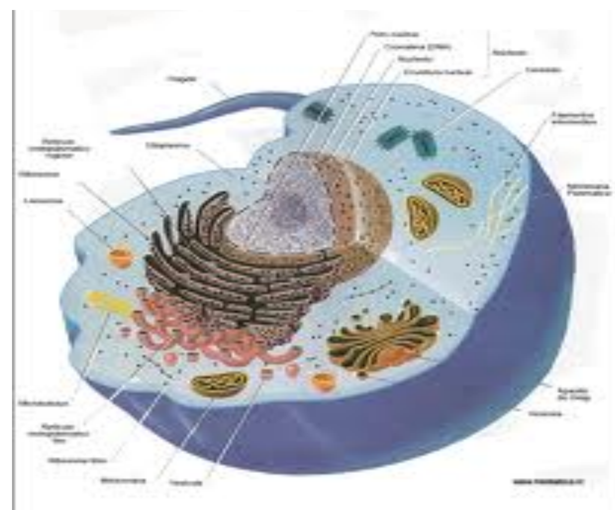
Antioxidants

Biological affinity

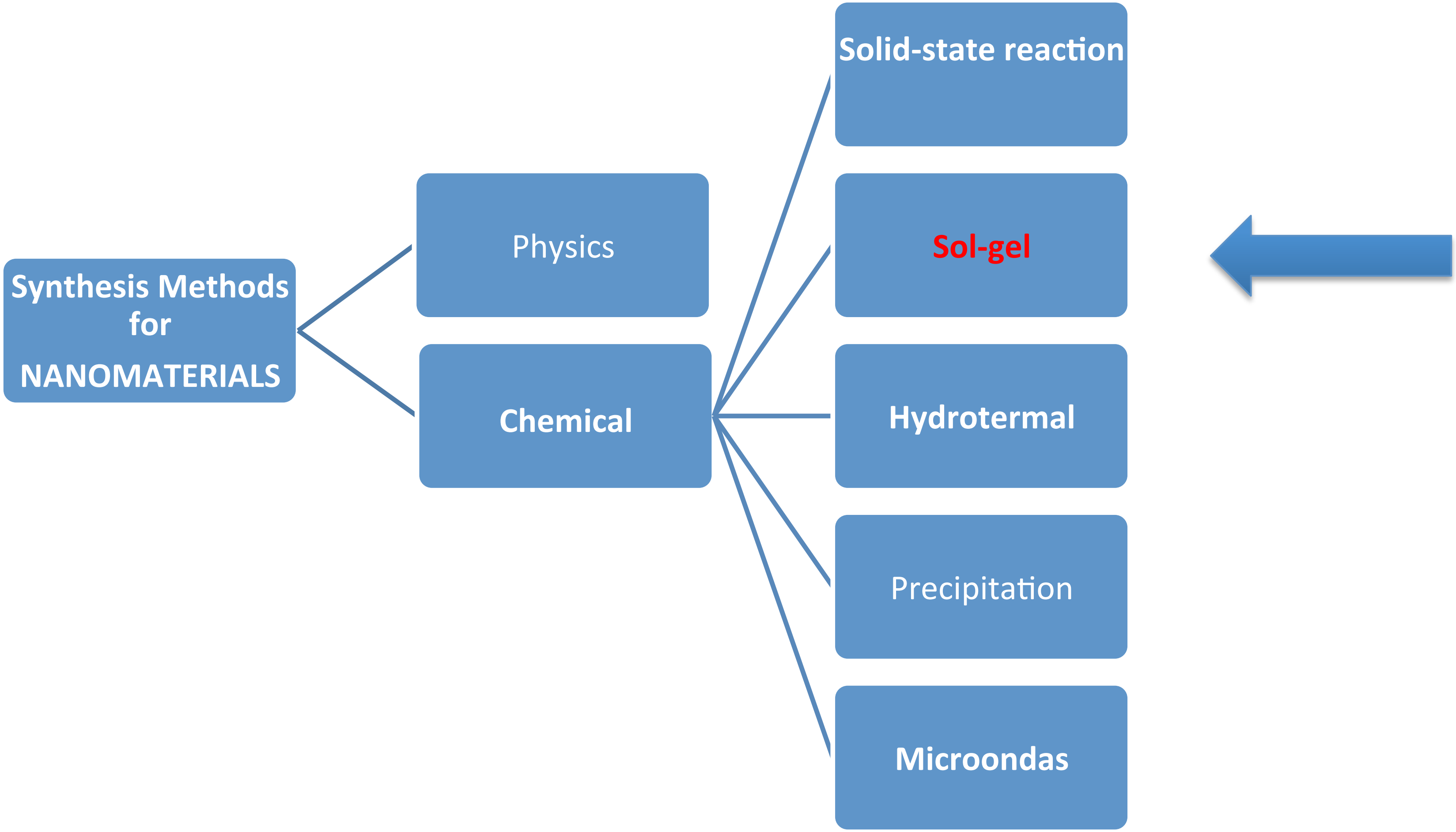
Cubic structure of Y_2O_3 [PDF cart 201412]







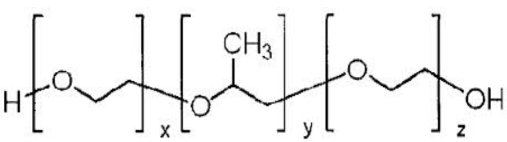
Synthesis Methods of Y_2O_3



SYNTHESIS PROCEDURE OF Y_2O_3

Precursors:

- ✓ $[Y(NO_3)_3]$
- ✓ $[YCl_3]$
- ✓ $[CH_3OH]$
  Acetylacetone
- ✓ Poloxámero P-123



XEROGEL / 24 h a 90 °C

Densify and cristallize:

Heat treatmeat at 270 °C (2 h), 500 °C, 700 °C, 800 °C y 900 °C for 1 h

Chemical, estructural and antioxidant characterization of Y_2O_3 nanocrystallites

SYNTHESIS PROCEDURE OF Y_2O_3

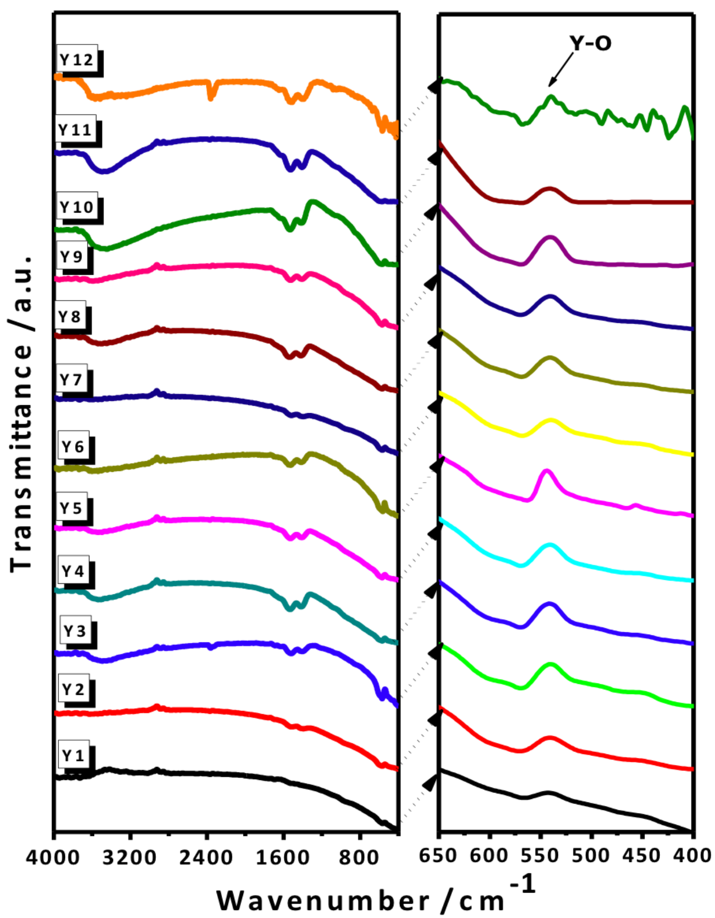
Table 1. Y_2O_3 systems prepared by sol-gel method, key words and general description.

Keywords	Precursor	Matrix	Poloxamer	Y:P123 Molar Rat.	T / ºC	Crystalite size / (nm)
Y1	$Y(NO_3)_3$	Y_2O_3	-	-	700	26
Y2					800	27
Y3					900	26
Y4	YCl_3		-	-	700	32
Y5					800	29
Y6					900	29
Y9	$Y(NO_3)_3$		P-123	1:1	900	21
Y10				2:1	900	28
Y11	YCl_3		P-123	1:1	900	29
Y12				2:1	900	29

RESULTS

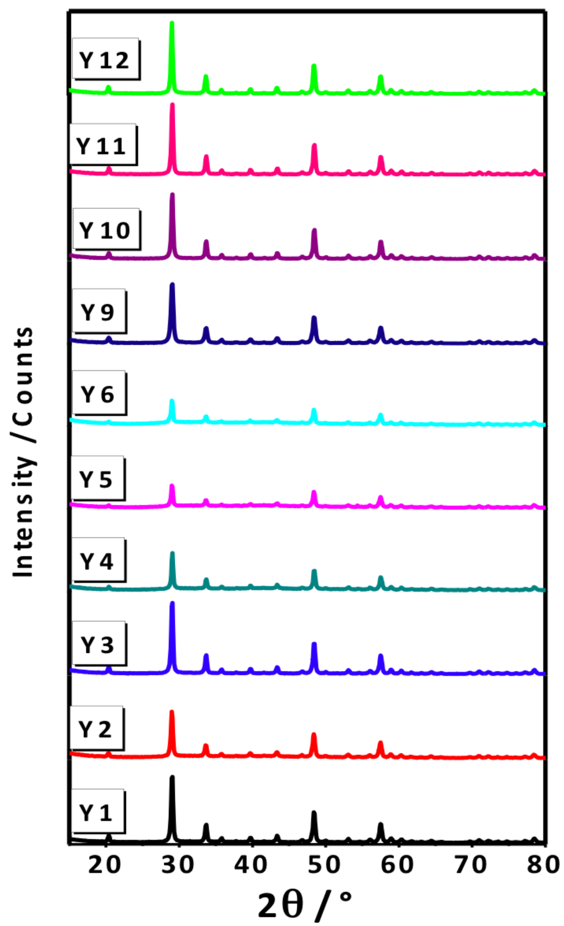
FTIR – DRX of Y_2O_3

igure 1. IR spectra of Y_2O_3 systems heat treated at 700 and 900 °C.



In the samples Y1 and Y2 is only observed the absorption band of oxygen-metal in around 500 and 600 cm^{-1}

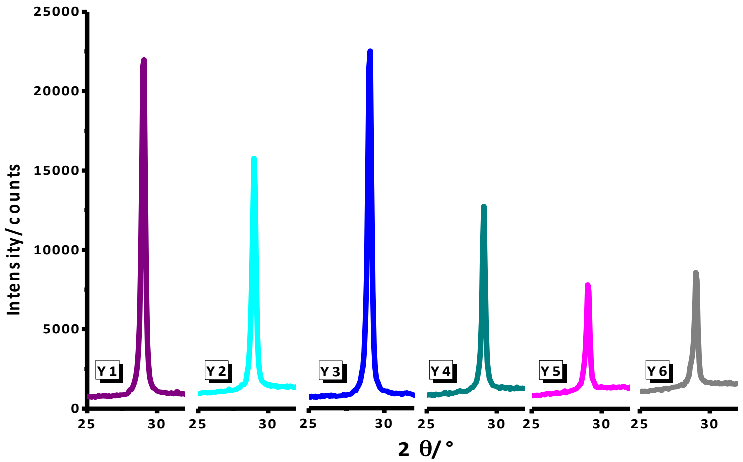
Figure 2. XRD patterns of Y_2O_3 systems heat treated at 700 and 900 °C.



No secondary phases are found. It can be notice that the cubic structure of Y_2O_3 is formed at 700 ºC and its remained stable until 900 ºC [PDF cart 201412].

DRX of Y_2O_3

Figure 3. Y_2O_3 systems prepared from yttrium nitrate and yttrium chloride at different temperatures.



The samples synthesized from yttrium nitrate (Y1-Y3) showed a greater degree of crystallization compared with synthesized from yttrium chloride (Y4-Y6).

Figure 4. Y_2O_3 powder synthetized from yttrium nitrate with and without P-123 poloxamer heat treated at 900 °C for 1 hour.

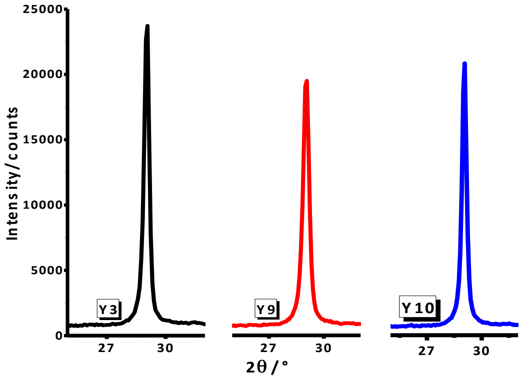
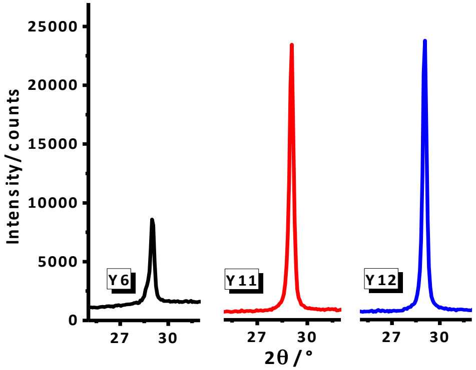


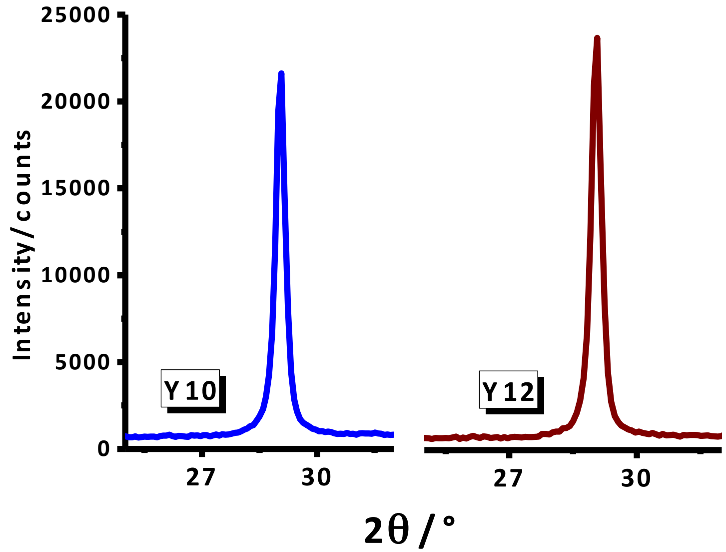
Figure 5. Y_2O_3 powder synthetized from yttrium chloride with and without P-123 poloxamer heat treated at 900 °C for 1 hour.



The crystallization degree comparison of the system prepared from yttrium nitrate and yttrium chloride with and without P-123 poloxamer.

DRX of Y_2O_3

Figure 6. XRD pattern of Y_2O_3 powder synthesized from yttrium nitrate and yttrium chloride using P-123 poloxamer in a molar ratio of P-123:Y, 2:1.



The XRD results revealed that the yttrium oxide systems embedded in P-123 poloxamer in a molar ratio of P-123:Y; 2:1presented better crystallization degree.

ANTIOXIDANT ASSAYS of Y_2O_3

Figure 7. *Time dependent of DPPH without nanocrystal.*

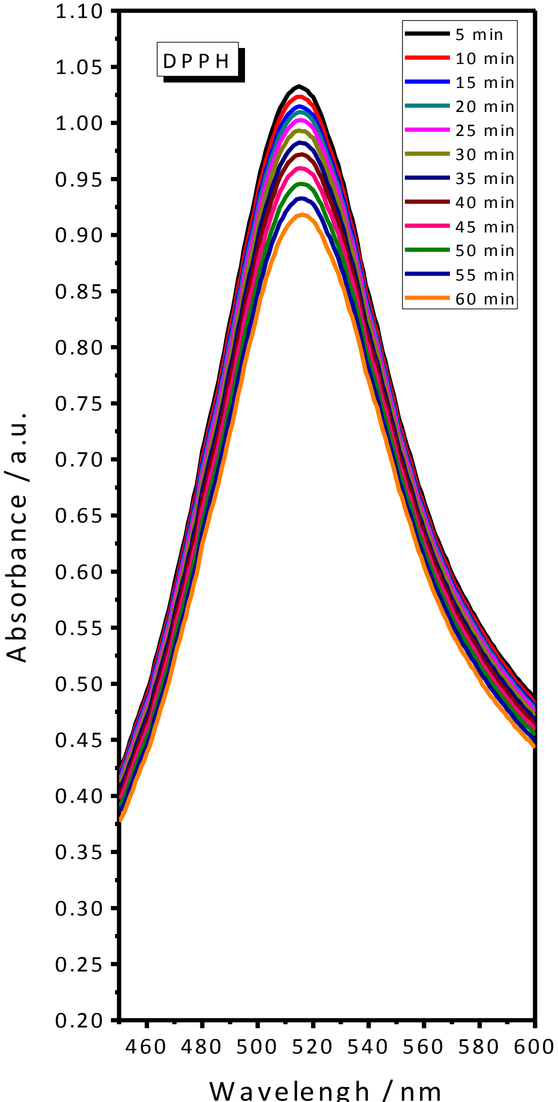
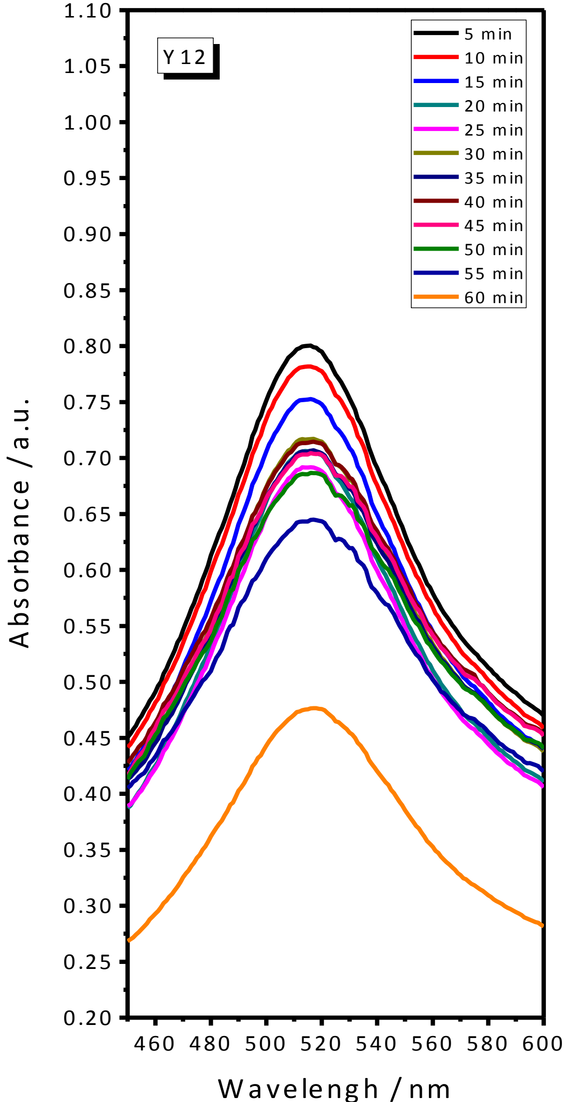


Figure 8. *Time depedent of DPPH scavenging by yttrium oxide nanocrystallites (sample Y12).*



The DPPH without nanoparticles does not revel changes in absorption characteristic peak.

the diminishing of the DPPH begin from first 5 min and it is evident after 60 min. It is known that the antioxidant property may be due to the neutralization of free radical character of DPPH which is by transfer a electron between the reactant.

CONCLUSION

- ✓ Yttrium oxide nanocrystallites were successfully synthesized by sol-gel method from yttrium nitrate and yttrium chloride as precursor.
- ✓ The yttrium oxide nanostructured powders elaborated from yttrium chloride and embedded in P-123 poloxamer in a molar ratio of P-123:Y 2:1 presented better physicochemical properties (crystallinity and purity) that systems prepared from yttrium nitrate precursor.
- ✓ Yttrium oxide powder presented crystallites size in the range of 21 to 32 nanometers.
- ✓ The DPPH studies are reported for first time for yttrium oxide synthesized by sol-gel method due to a directly comparison cannot be made.
- ✓ Yttrium oxide nanocrystallites show enhanced antioxidant potency which leading a new promising material in biological system.

Acknowledgments

The authors acknowledge to the financial support of SEP-ConacyT 178817, PROMEP 47310345 and UAM-C-CA-23 projects.

REFERENCES

1. De Aza P. N., De Aza A. H., Pena P., De Aza S.. Vidrios y Vitrocerámicos Bioactivos, Boletín de la Sociedad Española de Cerámica y Vidrio **2007**, *46(2)*, 45-55.
2. Chevalier J., Gremillard L., Deville S. Low-Temperature Degradation of Zirconia and Implications for Biomedical Implants. Annual Reviews Material Ressources **2007**, *37*, 1–32.
3. Ghulam M., Vijendra K.M., Pandey H.P. Antioxidant properties of some nanoparticle may enhance wound healing in T2DM patient. Digest Journal of Nanomaterials and Biostructures **2008**, *3(49)*, 159-162.
4. Park J.-H., Back N. G. Annealing Effect on Photoluminescence Intensity of Eu-Doped Y2O3 Nanocrystals. Journal of the Korean Physical Society **2005**, *47*, S368-S371.
5. Flores-Gonzalez M.A., Lebbou K., Bazzi R., Louis C., Perriat P., Tillem Preparing nanometer scaled Tb-doped Y_2O_3 luminescent powders by the polyol method. J.Cryst. Growth **2005**, *277*, 502–508.
6. Wang SY, Lu ZH. Preparation of Y_2O_3 thin films deposited by pulse ultrasonic spray pyrolysis. Mater Chem Phys **2003**, *78*, 542–545.
7. Bohus G., Hornok V., Oszkó A., Vértes A., Kuzmann E., Dékány I., Structural and luminescence properties of Y_2O_3:Eu^{3+} core–shell nanoparticles. Colloids and Surfaces A: Physicochemical and Engineering Aspects. **2012**, *405*, 6-13.
8. Mackenzie JD, Bescher EP. Physical properties of **sol-gel** coatings. J Sol-Gel Sci Tech **2000** *19*, 23–29.
9. Qiao Y, Guo H., Upconversion Properties of Y_2O_3:Er Films Prepared by Sol-Gel Method. J Rare Earhs **2009** *27*, 406–410.
10. Carrillo Romo F. de J., Morales Ramírez A. de J., García Murillo A., García Hernández M., Jaramillo Vigueras D., Garibay Febles V. Sol-gel Synthesis of $Eu^{3+;}Tb^{3+}$ Co-doped Y_2O_3 Scillinting Nanopowders. International Journal Of Materials Research **2012,** *103*, 1244-1250.
11. Carrillo Romo F., García Murillo A., López Torres D., Cayetano Castro N., Romero V.H., De la Rosa E., Garibay Febles V., García Hernández M., Structural and luminescence characterization of silica coated Y_2O_3:Eu^{3+} nanopowders, Optical Materials **2010**, *32*,1471-1479.
12. Naik GH, Priyadarsini KI, Satav JG, Banavalikar MM, Sohoni DP, Biyani MK, Mohan H. Comparative antioxidant activity of individual herbal components used in Ayurvedic medicine. Phytochemistry. **2003**, *63(1)*, 97-104.
13. Patterson L. A. The Scherrer Forumula for X-Ray Particle Size Determination, Physical Review **1939** *56* 978-982.

THANK YOU!