NANOSTRUCTURED LANTHANIDE-DOPED $\text{Y}_2\text{O}_3$ OBTAINED BY PROPELLANT AND GELATION SYNTHESIS

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Yttrium oxide, both undoped and lanthanide-doped, is an important material, which has numerous applications in disparate fields, from traditional refractories and advanced ceramics, to phosphor material, diluted magnetic semiconductors and catalysts. When $\text{Y}_2\text{O}_3$ is obtained in a nanocrystalline form, several new and interesting phenomena arise. For this reason, we recently investigated nanosized undoped and lanthanide-doped yttria[1-3] with the aim of correlating structural and optical properties. Samples were obtained by two different preparation procedures and were characterized using SAXS, WAXS, TEM and SEM.

All the $\text{Y}_{2-x}\text{Ln}_x\text{O}_3$ (Ln = Ce, Pr, Nd, Eu, Gd, Ho and Er) powders obtained by propellant synthesis showed a very porous, open microstructure with fractal scaling properties. The building blocks of the fractal aggregates are nanocrystallites (20÷50 nm), with variations in the cubic lattice parameter proportional to the composition of the solid solution and to the lanthanide ionic radius. From this dimension, up to at least 200 nm, the particle aggregate is a mass-fractal with a fractal dimension, $D_f$, in the 1.6÷2.0 range.

Samples obtained by the wet synthesis procedure have a completely different morphology and show no fractal property. The obtained powders are large, compact aggregates on the micron scale built up of 200 nm or larger crystalline platelets about 10 nm thick. Platelets have a porous structure with pores of 2-4 nm which limit the coherence length of diffraction to about 10 nm.