Universidad Carlos III de Madrid

OO/UC3M/50- PROCEDURE FOR SYNTHESIS OF NANOSTRUCTURED MATERIALS WITH IMPROVED FUNCTIONAL AND/OR STRUCTURAL PROPERTIES VIA AEROSOL METHODS (SPRAY PYROLYSIS)

The Spanish university Carlos III de Madrid has developed a new method in order to obtain nanostructured particles (ceramic, metallic and composite) with improved functional and structural properties. Spray pyrolysis is a way in order to obtain nanostructured particles. Optimization of synthesis process, evaluating the experimental parameter as pH, concentration and chemical nature of precursor solution, density, viscosity, carrier gas, temperature of reactor, etc. allow us to synthesize materials with improved properties.

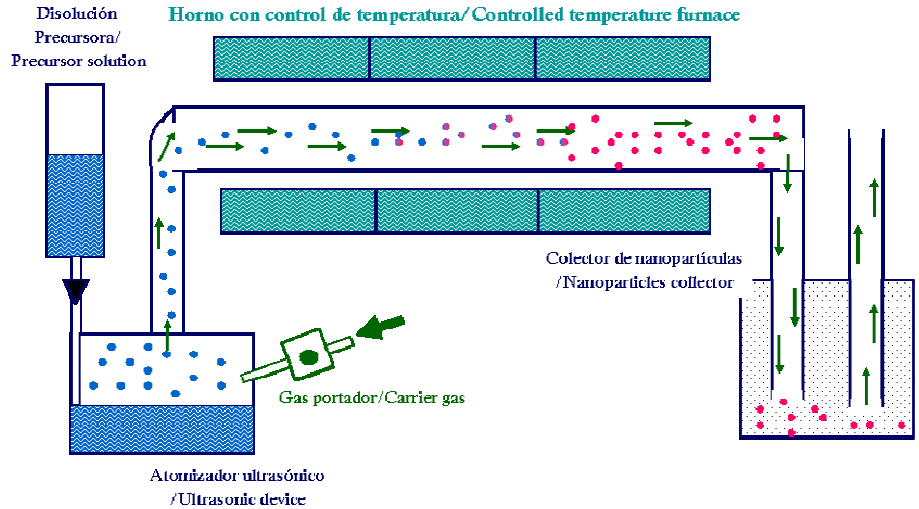
The group is looking for technical cooperation with companies.

Description and special features

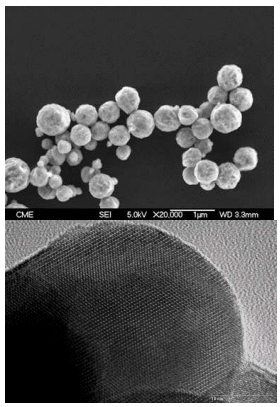
From the viewpoint of the application of the particles for advanced materials synthesis, particle morphology and crystalline phases are of great interest. In order to obtain nano-structural materials with improved properties in necessary to develop and optimize new methods of synthesis. One of them is Spray pyrolysis, which permits the synthesis of nanoparticles with different composition and stoichiometric ratio from different precursor solutions.

In the Spray pyrolysis method, single drops generated by ultrasonic device from a precursor solution are converted to nanoparticles in a low/intermediate temperature reactor. The aerosol is carried out by the flowing gas stream into a high-temperature tubular flow reactor. During the process, aerosol droplets undergo evaporation, drying and solute precipitation in a single-step process caused by the mechanisms of heat and mass transfer inside the droplets and between the droplets and surrounding gas.

Aerosol synthesis enables synthesis of various particle morphologies, either as hollow or dense spheres. It is presumed that certain particle morphology is formed during the evaporation/drying stage that encountered processes of evaporation and diffusion of both the solvent, and solute, changing in droplet temperature and crust formation. The opportunities for the synthesis of spherical, non-aglomerated particles with uniformly distributed components and phases are of special importance when considering materials for advanced applications.



Experimental procedure to nanoparticles synthesis by means of Spray pyrolysis.



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Innovative aspects
The synthesis by means of Spray pyrolysis permits to obtain nanoparticles with high chemical, morphological and structural homogeneity in order to improve the final properties. Consequently, spherical, solid or hollow, agglomerate-free, nanophased particles and with narrow size distribution will be obtained through the mechanisms of primary nano- particles coalescence, collision and sintering.

Competitive advantages
Since the stages of solid-phase precipitation, decomposition and sintering occur in a dispersion phase at the level of several micrometer sized droplets; the advantages of this process are good control of particle size, morphology, chemical and phase composition by adjusting solution and process parameters. In addition, a high droplet/particle heating rate and high surface reaction result in the formation of fine, spherical, homogeneous polycrystalline particles with a nanoscale composite structure. Aerosol synthesis also enables retaining of the solution stoichiometry and mixing level in the resulting powders that reflects in a remarkable way on the homogeneity and properties of selected functional and structural materials.

Technology Keywords
Micro and Nanotechnology related to sciences); Materials and ceramic powders; Inorganic Chemistry; Materials properties, corrosion/degradation); Energy storage, Batteries

Contact Person: María Dolores García-Plaza
Phone: + 34 916249016
E-mail: comercializacion@pcf.uc3m.es