

Materials Processing at *n*Gimat™

...NanoSpraySM Technology

*n*Gimat is an intellectual property company that develops engineered nanomaterials, including nanopowders and thin films. Thin films are deposited using our patented Combustion Chemical Vapor Deposition (CCVD) process while nanopowders are produced from the related Combustion Chemical Vapor Condensation (CCVC) process. These technologies excel when combined with our proprietary NanoSpray Combustion Processing technology, which is used to convert (by means of the proprietary Nanomiser[®] Device) a starting liquid solution into an ultra-fine aerosol that is subsequently ignited. Without combustion of the aerosol for CCVD and CCVC processes, organic nanopowders and thin films are also possible as is conversion of pharmaceuticals to small particles.

Product Development Target Markets

Nanopowders

Electronics • Fuel Cell
Layers • Catalysis •
Medical &
Pharmaceutical •
Cosmetics • Pigments •
Clean Combustion

Barrier Coatings

Food & Beverage
Packaging • Gas •
Moisture • Anti-
corrosion

Electronics & Optics

ReliaSense™ Optical
Sensor • Photonic
Devices • Embedded
Passives • Dielectrics &
Conductors •
Thin Polymers &
Composites

RF Wireless

Tunable Filters for
Cellular Phones •
Phase Shifters for
Wireless LANs, PDAs,
etc.

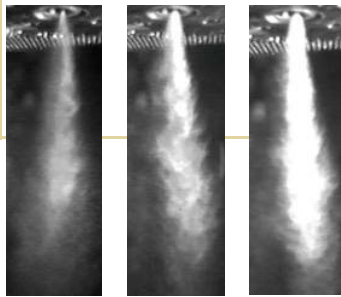
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nanoEngineered Materials™

Nanomiser Device

The Nanomiser Device is an innovative liquid atomizer that can produce an aerosol of controlled size down to sub-micron range from 0.002 to 4 L/min flow rates without any atomizing gas. The ability to produce small-size droplets with narrow size distribution is of critical importance to *n*Gimat's processes, where precursor solutions are converted to a fine mist that is efficiently combusted in nanopowder and thin film deposition applications.



NanoSpray Processing

The NanoSpray Process is a platform technology that relies on the proprietary Nanomiser Device to produce aerosols with controllable droplet size distribution. Ultra-fine atomization with the Nanomiser Device enables the use of any soluble precursor without concern for its vapor pressure; thus, inexpensive, environmentally friendly, soluble chemical reagents can be used. NanoSpray Combustion Processing allows complex, multi-component materials to be made via the CCVD or CCVC technique by simply adjusting the solution chemistry.

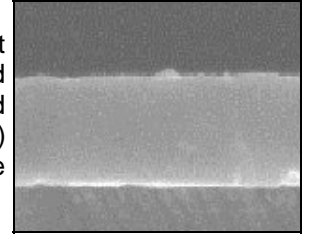
*n*Gimat's NanoSpray and NanoSpray Combustion Processing have been used for:

- CCVD processing of thin films
- CCVC processing of nanopowders
- Formation of polymer nanopowders
- Deposition of polymer coatings
- Complete/clean combustion applications
- Conversion of pharmaceuticals to micron- and nano-size particles

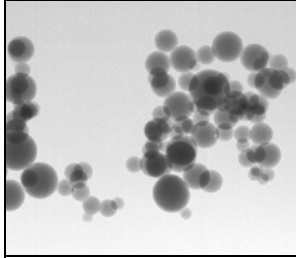


CCVD Process

In the liquid-sourced CCVD process, precursors, which are the metal-bearing chemicals used to coat an object, are dissolved in a solution, which typically is a combustible fuel. This solution is atomized via the NanoSpray Combustion Processing technology to form microscopic droplets that are carried by an oxygen stream to the flame where they are combusted. A substrate (the material being coated) is simply drawn in front of the flame. Heat from the flame provides energy required to vaporize the droplets and to react the precursors and deposit on the substrate.



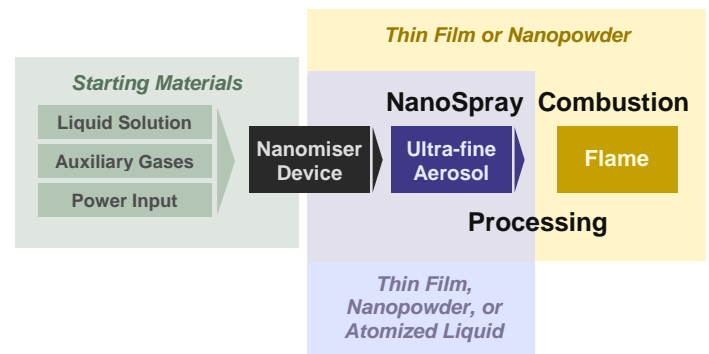
CCVC Process



In *nGimat's* CCVC production of nanopowders, the NanoSpray Combustion Processing technology is used to convert a starting liquid solution containing chemical precursors into an ultra-fine aerosol that is efficiently combusted to produce a variety of mixed metal oxide or metal nanoparticles. By adjusting solution concentrations and constituents, a wide range of compounds can be formed quickly and easily. In a production environment, the CCVC process enables economical, large-scale production of nanopowders because it takes advantage of inexpensive precursors dissolved in solvents that also act as the combustible fuel. The CCVC process can produce kilograms of nanopowders in *nGimat's* pilot-scale facilities.

NanoSpray Technology

To summarize, in the NanoSpray Combustion Processing technology, liquid solutions of soluble precursors are atomized via the Nanomiser device, and this aerosol is then ignited to form a flame from which thin films can be deposited or nanopowder condensed. On the other hand, if combustion is not desired, the finely atomized NanoSpray aerosol can be used, for example, to make polymer thin films or nanopowders, to convert pharmaceuticals to small particles, or to atomize a combustible fuel for cleaner burn.



CCVD and/or CCVC Process Advantages

- Production of tailored and complex materials
- No energy-intensive, highly specialized and expensive equipment (e.g., vacuum chambers, reaction furnaces, chemical scrubbers)
- Continuous manufacturing capability
- Low-cost and environmentally friendly precursors and other process chemicals
- Adjustment of size, crystallinity, shape, and morphology of nanopowders

The Company. *nGimat*, located inside the perimeter of Atlanta, is an intellectual property and manufacturing company that engineers nanopowders, thin films, and devices. Our facilities are equipped with instrumentation to perform cutting edge materials research, development, and manufacturing. The scientists and engineers at *nGimat* bring backgrounds in materials science, chemistry, physics, mechanical/chemical/electrical engineering, and biochemistry to the challenges of engineering nanomaterials. In addition, our analytical personnel provide rapid turn-around times and state-of-the-art materials analysis to support our materials development.

If you would like more information on *nGimat* or its technologies,

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