

Nanopowders

*nano*Engineered Materials™

...small answers, big opportunities

Nanopowders at nGimat are produced to your specifications. Off-the-shelf materials are also available for certain compositions.

Typical Specifications

Average Surface Area:
5 to >240 m²/gr

Primary Particle Size:
5 to 100 nm average

Primary Particle Range: >99.9% of particles <100 nm for <50 nm average

Composition: Most elements as simple oxides, mixed metal oxides, select metals, and non-oxides

Numerous surface modifiers can be formed for passivation and surface functionalization.

Quantity: grams to kilograms

Purity: 98% to 99.99%

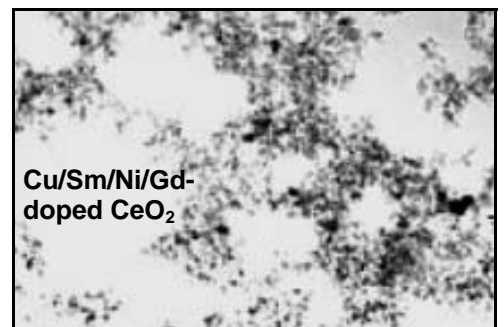
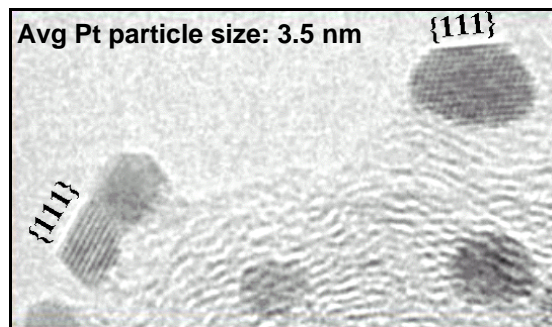
nGimat™ Co.

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The Bottom-up Approach

Nanopowders at nGimat™ are created with our proprietary NanoSpray™ Combustion Processing technology. We start with molecular clusters as building blocks dispersed in a vapor to initiate particle nucleation and growth. This means you have more options for particle size, composition, crystallinity, and stoichiometry compared to top-down approaches that reduce large materials to ultra-fine particles. nGimat has over 35 U.S. issued patents covering its products, materials, process, and equipment.



Compositional Flexibility

Starting from a vapor does not mean composition is sacrificed. Because simple liquid solutions containing one or more precursors are used in NanoSpray Combustion Processing, you have the option of multi-component materials, which are produced as readily as simpler compositions. In addition, surface modification and nanocoating of nanopowder is also an option. New performance occurs with such control.

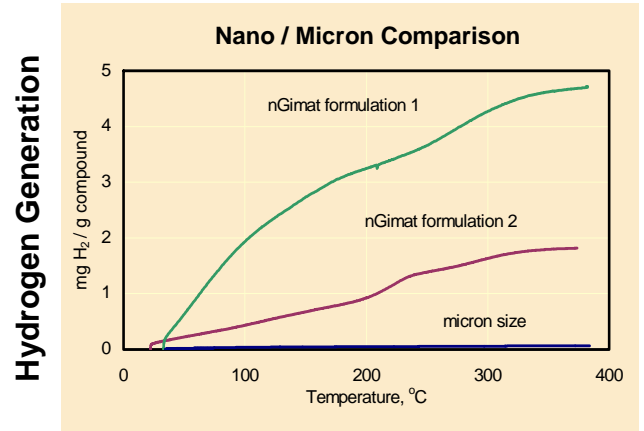
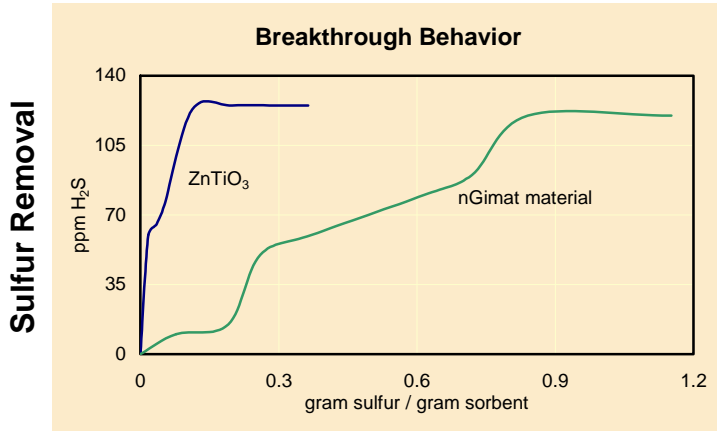


Quantity and Quality

Forming nanopowders from a vapor does not mean that quantity is sacrificed. Since the production process is fed liquid-based precursors at atmospheric pressure, continuous production is possible to make large quantities at affordable prices. Also, turn-around time is quick, so iterative testing and optimization for your specific applications can be easily accommodated. Finally, quality is not reduced from small to large quantity processing.

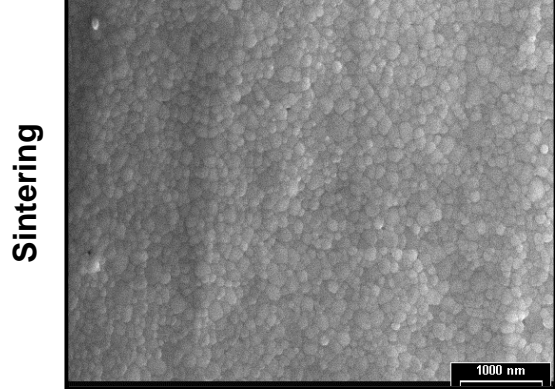
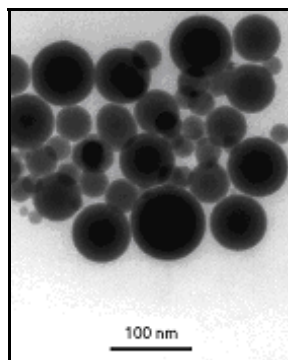
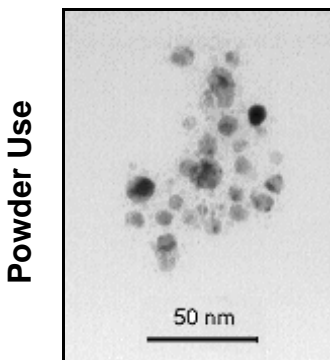


Nanopowder Technology. The unique properties of nanopowders, like large surface area quantum effects and formability, make them a good choice for countless applications. The following examples illustrate some nanopowder advantages. If you would like information about these or other applications of interest to you, please contact us.



LEFT: Sulfur removal capacity of standard zinc titanate micron-size powder compared to *nGimat* proprietary nanopowder is illustrated above. (Conditions: 1% H₂S 3.8 lpm; zinc titanate sorbent charge: 5.2 g; *nGimat* powder charge: 2 g.) The larger particle Zn-based powders have 10-20 times less sulfur filtering capacity than the nanomaterials, and gaseous levels rapidly rise after a brief period.

RIGHT: Hydrogen generation capacity of standard fluorite-based micron-size powder is compared above to that of *nGimat* nanopowder. (Furnace ramp 10°C/min in pure methane.) Low temperature reduces the cost of reforming.



LEFT: Conductive metal nanopowders, like silver (left above), are used in applications such as conductive pastes and ink-jet printing of electronic lines and components. Ceramic nanopowders (barium titanate, right above, and barium strontium titanate) have found use in multi-layer ceramic capacitors with advantages of lowered sintering temperature and high specific area.

RIGHT: An SEM image of Ce_{0.8}Gd_{0.2}O_{2-x} nanopowder is pictured after sintering at 1100 °C for two hours. The material is fully dense while maintaining a distinct nanostructure for improved performance in SOFC applications. A variety of nanopowders are also being developed for sintering into advanced laser host materials.

The Technology. The NanoSpray Combustion Processing technology is a platform method that relies on *nGimat*'s proprietary Nanomiser[®] Device to produce aerosols with controllable droplet size. The process is used to convert a starting liquid solution containing chemical precursors into an ultra-fine aerosol that is efficiently combusted into a flame to produce nanopowders via the Combustion Chemical Vapor Condensation (CCVC) process. Ultra-fine atomization with the Nanomiser Device enables use of low-cost, environmentally friendly, soluble precursors without concern for their vapor pressure.

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.

We at *nGimat* Co. would like to discuss with you your nanopowder challenges or needs.

Please visit us at www.ngimat.com or contact us:

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