PURE AND LOOSE, NANO-SIZED PARTICLES MAKE BETTER MATERIALS

Can You Imagine . . .

. . . a process that can produce nanopowders to make smoother semiconductor polishes and stronger sun-blocking lotions.

As the feature sizes of electronics shrink below the wavelengths of visible light, semiconductor manufacturers will require nanopowder-based optical polishes for smoothing the surfaces of silicon wafers. To be effective, powder particles must have uniform sizes and must resist the tendency to clump together, or agglomerate. Larger-than-average particles or particle clusters can create defects on the surfaces of wafers, which can cost up to $50,000 to replace.

Under BMDO SBIR funding, Structured Materials Industries, Inc. (SMI; Piscataway, NJ), developed a nanopowder production process that may produce the next generation of ultrasmooth polishing compounds. The company can produce nonagglomerated nanoparticles with narrow size distributions for a variety of materials, including metals, oxides, and nonoxides.

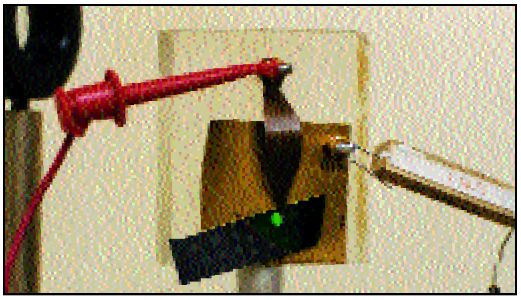
SMI formed a new division called Nanopowder Enterprises, Inc. (NEI; Piscataway, NJ), to manufacture and sell the nanoparticles to industry. NEI has already received orders from the semiconductor manufacturing industry for sample quantities of Nanomyte™ nanopowder abrasives. In addition, the company is making a titanium dioxide sun-blocking agent. Titanium dioxide particles in sun-blocking lotions tend to clump together, weakening their ability to deflect the sun's harmful rays. NEI's nonagglomerated nanoparticles eliminate this clumping effect, improving the lotion's sun-blocking properties.

TO MANUFACTURE AND SELL NANOPARTICLES TO INDUSTRY, SMI FORMED A NEW DIVISION CALLED NANOPOWDER ENTERPRISES, INC.

The company also sells a low-cost tool for producing nanoparticles. The Nanomyte One™ produces a wide variety of nanopowders in the 3- to 50-nanometer range. It features several modules that enable different processes to fabricate the nanoparticles.

SMI and Rutgers University originally developed the nanopowder production process to make silicon and germanium light-emitting nanocrystals for BMDO displays. The company continued the original research and recently demonstrated that silicon emits white light (full-color, including ultraviolet, visible, and infrared light) when electrically stimulated. More recently, SMI developed a line of transparent conductive oxides and electroluminescent and cathodoluminescent oxides.

With these initial successes in hand, SMI has already planned the first product for its films, a green electroluminescent flat-panel display. The NanoChrome Display could be an economical alternative to liquid crystal displays.



■ BMDO-funded research is helping SMI develop the first product for its film, a green electroluminescent flat-panel display

ABOUT THE TECHNOLOGY

SMI developed a dry, chemical vapor condensation process that produces nonagglomerated nanoparticles. In the process, reactant chemicals ride an inert carrier gas and pass through a reaction chamber. This chamber can be an evaporation chamber, a hot wall chamber, a combustion flame, or a plasma source, any of which will force condensation. During condensation, by-products dissipate as vapors. The remaining products are dry, nonagglomerated nanoparticles.

The nonagglomerated nanoparticles have a narrow size distribution, because the residence time for the reactant chemicals equals that of the carrier gas for all gas streams as they move through the chamber. Selecting an oxidizing, reducing, carbonizing, or nitridizing atmosphere controls the particular compound chemistry, as required. Multiple chemical reactant sources form multicomponent, multiphasic particles. This process controllably produces nanopowders from 3 to 50 nanometers in size.