Generate Highly Spherical Micro and Nano Spheres

Researchers at UCF have developed a method for creating uniform, highly spherical particles as small as a few nanometers in diameter.

Advantages
From drug delivery to chemical and biological catalysis and cosmetics, micro and nano particles are a key to new advances. New technology forms particles by applying heat to a multi-layer fiber, drawing the core into uniform spheres within the outer layer. Specifiable to any application, the particles can be created from a variety of materials, such as glass, polymers, liquids, and metals, and in a wide range of sizes, from sub-millimeter to the tens of nanometers. Particles can be simple or complex in structure, and easily treated to prevent agglomeration. The formation method enables the controllable and scalable production of complex, well-defined micro-scale and nano-scale structures that are well-ordered, controllably oriented, and immobilized. Particle formation addresses an enormous range of applications from the fields of chemistry, physics, and biology. For example, you can produce three-dimensional optical and acoustic meta-materials, enable optical-resonance-based sensitive detection of chemical species and pathogens, and realize sophisticated controlled-release drug delivery systems.

Technical Details
Particles are created from multi-material fibers drawn near the plasticity temperature, “melting” the core into an evenly-spaced sequence of uniform droplets while still encased in an unaffected outer layer of a higher softening temperature material. The breakup process of the core is not based on chemistry, but on the physical parameters of viscosity and surface tension in the presence of specifically calculated temperature as determined by the Plateau-Rayleigh instability. As such, the materials used are chosen for their mechanical and melting compatibility for a given particle property and size. The core particles’ size is determined by controlling tapering speed during the drawing process. As the combination of materials cools, the material of the particles solidifies within the outer layer of the fiber, which can be left as-is or dissolved to release the particles.

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Benefits
• Scalable production
• Specifiable sizing
• Smaller-sized spheres
• Can produce complex structures: Janus particles, beach ball particles
• Prevents agglomeration

Applications
• Controlled-release drug delivery
• Chemical and biological catalysis
• Pigment suspension and colloids: cosmetics, paints
• Optical and acoustic meta-materials
• Optical-resonance-based pathogen detection

Tech Fields
Nanotechnology, Advanced Materials

Keywords
nanosphere, microsphere, sphere, drug delivery, pigment, fiber, nanoparticles, TFD, Thermal Fiber Drawing