Production of Dense and Uniform Nanoparticle Films

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Reference: Film Deposition

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Reference

McLeod, M. C.; Anand, M.; Kitchens, C. L.; Roberts, C. B. *Nano Lett.*; **(Letter)**; **2005**; 5(3); 461-465. (pdf)

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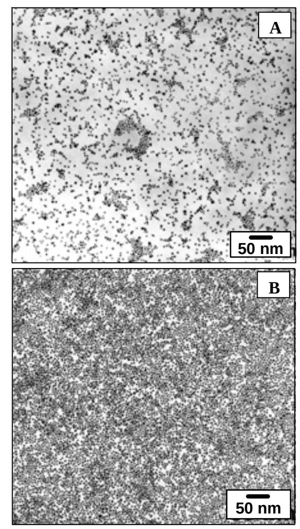
Overview

Auburn University seeks a licensee for a technique to create highly uniform and dense nanoparticle films. This novel technique utilizes CO_2 as an antisolvent and allows for controlled deposition of particles, resulting in more consistent nanoparticle thin films with fewer defects than films made using standard solvent evaporation techniques. This technology has applications in optical devices, sensors, catalysis and semiconductors.

Advantages

- Deposits dense, uniform nanoparticle films on surfaces via simple solvent/antisolvent interactions
- Allows for recovery of intact films by eliminating standard solvent evaporation steps that typically disrupt films in post-processing
- Allows for control of film density, quality, spacing and ordering by manipulating such parameters as particle size, particle polydispersity and system pressure
- Uses moderate temperatures, allowing for film deposition on materials incompatible with CVD
- Reduces operating costs and environmental impact through use of CO_2 as the antisolvent
- Reduces post-processing time and costs via simple and effective particle cleaning and solvent recovery



Electron micrographs of particle films:
(A) solvent evaporation
(B) Auburn process

Description

A major thrust of research is currently focused on post-synthesis nanoparticle manipulation for application in such fields as catalysis, optical systems, electronic devices, and sensors. Full utilization of nanoparticles for these applications requires the ability to effectively process and maneuver particles onto surfaces. Such deposition is typically performed by evaporating a liquid solvent containing dispersed nanoparticles. This method, however, can give rise to undesirable features in the film due to surface tensions in the liquid/vapor interface that moves across the surface during evaporation.

In the Auburn process, CO_2 is introduced into the system to form a gas-expanded liquid that results in nanoparticle precipitation and deposition. Additional CO_2 is then pumped into the system until the original solvent is removed, at which point the pressure is lowered to release the CO_2 without causing the typical defects caused by evaporation. This method is simple, efficient, allows for easy solvent recycle, and leaves no residual liquid solvent.

Status

- A companion technology exists that fractionates nanoparticles by size with less time, processing and cost than existing methods
- US Patent 7,384,879; A European application is pending
- This invention has been successfully verified by laboratory experiment with various ligand-coated metallic nanoparticles
- These technologies are available for exclusive or non-exclusive licensing in most fields of use