Researchers discover new method of making nanoparticles

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(PhysOrg.com) -- An engineering researcher at the University of Arkansas and his colleagues at the University of Utah have discovered a new method of making nanoparticles and nanofilms to be used in developing better electronic devices, biosensors and certain types of high-powered and highly specific microscopes used for scientific research.

The never-ending quest to build faster, more efficient and more reliable electronic devices starts deep down below the molecular level, where nanoparticles - far too small for the human eye to detect - make up the building blocks of the latest processing hardware. In pursuit of this goal, scientists and engineers are constantly investigating new materials and better methods of developing or assembling these materials.

The researchers' nanoparticles, made of gold and deposited onto silicon substrates by a unique chemical process, are nontoxic and inexpensive to make and have superior dimensions, densities and distribution when compared to other nanoparticles and conventional methods of producing nanoparticles. The unique deposition technique has the further advantage of being able to rapidly coat fragile, three-dimensional and internal surfaces at the temperature and pressure of its surroundings without requiring conductive substrates or expensive, sophisticated equipment.

"Using successive thermal treatments, we characterized optical and structural features of an inexpensive, molecule-to-molecule, bottoms-up approach to create thermally stable, gold-nanoparticle ensembles on silica," said Keith Roper, associate professor of chemical engineering at the University of Arkansas. "Images and analysis from scanning electron microscopy and atomic force microscopy revealed that particle densities are the highest reported to date. Our method also allows faster preparation than self-assembly or lithography and allows directed assembly of nanoparticle ensembles on 3D surfaces."

The researchers' unique approach improves upon a method that involves depositing atoms from a solution onto a substrate with a tin-sensitized surface. The researchers use a novel continuous-deposition process and then heat these deposited atoms to transform "islands" of nanoparticle material into desired forms. The resulting spherical nanoparticles can have diameters between 5 and about 300 nanometers. A nanometer is a billionth of a meter. A human hair typically has a diameter of 70,000 nanometers.

Roper said that microscopic images and spectroscopic data suggest that ultrathin films prepared by their new approach are smoother than conventional "sputtered" or evaporated gold films and may exhibit better optical features, such as reduced surface-roughness scattering. These features are desirable in devices such as photovoltaic cells in which narrow metal layers significantly affect local electromagnetic fields. Smoother thin films also could improve the limits of detection, sensitivity and photocurrent, respectively, in such applications.

The researchers' recent studies in this area have been published in *Langmuir* and *Journal of Physical Chemistry C*, journals of the American Chemical Society. The researchers were awarded U.S. Patent No. 8,097,295 on Jan. 17 for the development.

Provided by University of Arkansas

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