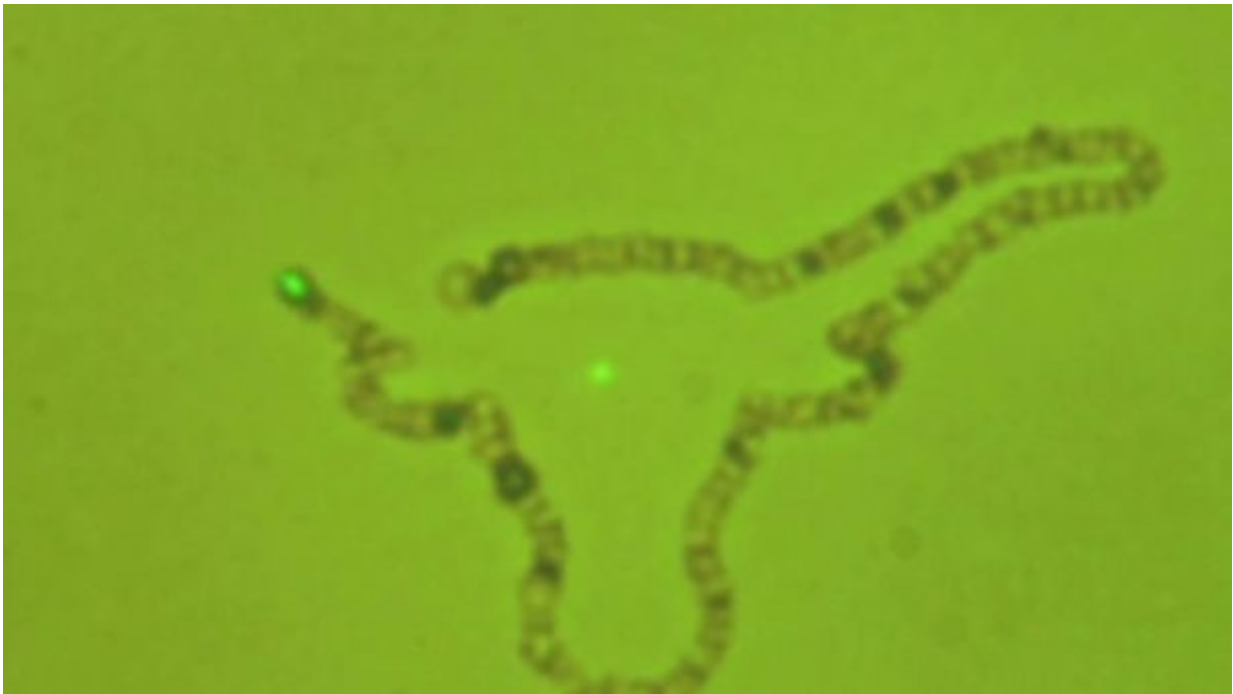


# Engineers invent a bubble-pen to write with nanoparticles

January 14 2016

---



Researchers in the Cockrell School of Engineering at The University of Texas at Austin have solved a problem in micro- and nanofabrication—how to quickly, gently and precisely handle tiny particles—that will allow researchers to more easily build tiny machines, biomedical sensors, optical computers, solar panels and other devices.

They have developed a device and [technique](#), called bubble-pen [lithography](#), that can efficiently handle nanoparticles—the tiny pieces of gold, silicon and other materials used in nanomanufacturing. The new method relies on microbubbles to inscribe, or write, nanoparticles onto a surface.

Researchers' interest in nanoparticles, which are between 1 and 100 nanometers in size, has grown rapidly because of their versatility and strength. Some nanoparticles have optical properties that are useful for electronics. Others have the ability to absorb solar energy. In biomedical applications, nanoparticles can serve as drug carriers or imaging agents.

But working with these particles while keeping their properties and functions intact can be difficult. And existing lithography methods, which are used to etch or pattern materials on a substrate, are not capable of fixing nanoparticles to a specific location with precise and arbitrary control.

A research team led by Texas Engineering assistant professor Yuebing Zheng has invented a way to handle these small particles and lock them into position without damaging them. Using microbubbles to gently transport the particles, the bubble-pen lithography technique can quickly arrange particles in various shapes, sizes, compositions and distances between nanostructures. This advanced control is key to harnessing their properties. The team, which includes Cockrell School associate professor Deji Akinwande and professor Andrew Dunn, describe their patented device and technique in a paper published in the Jan. 13 issue of *Nano Letters*.

Using their bubble-pen device, the researchers focus a laser underneath a sheet of gold nanoislands (nanoscale islands) to generate a hotspot that creates a microbubble out of vaporized water. The bubble attracts and captures a nanoparticle through a combination of gas pressure, thermal

and surface tension, surface adhesion and convection. The laser then steers the microbubble to move the nanoparticle on a site on the surface. When the laser is turned off, the microbubble disappears, leaving the particle on the surface. If necessary, the researchers can expand or reduce the size of the microbubble by increasing or decreasing the laser beam's power.

"The ability to control a single nanoparticle and fix it to a substrate without damaging it could open up great opportunities for the creation of new materials and devices," Zheng said. "The capability of arranging the particles will help to advance a class of new materials, known as metamaterials, with properties and functions that do not exist in current natural materials."

The technique could be especially helpful for science and medicine because researchers would be able to precisely control cells, biological material, bacteria or viruses for study and testing, Zheng added.

Moreover, bubble-pen lithography can leverage a design software program in the same way as a 3-D printer, so it can deposit [nanoparticles](#) in real time in a pre-programmed pattern or design. The researchers were able to write the UT Austin Longhorn symbol and create a dome shape out of nanoparticle beads.

In comparison to other existing lithography methods, bubble-pen lithography has several advantages, Zheng says. First, the technique can be used to test prototypes and ideas for devices and materials more quickly. Second, the technique has the potential for large-scale, low-cost manufacturing of nanomaterials and devices. Other lithography techniques require more resources and a clean room environment.

Zheng says he hopes to advance bubble-pen lithography by developing a multiple-beam processing technique for industrial-level production of

nanomaterials and nanodevices. He is also planning to develop a portable version of the technique that works like a mobile phone for use in prototyping and disease diagnosis.

This research received funding from the Beckman Young Investigator Award.

Provided by University of Texas at Austin

Citation: Engineers invent a bubble-pen to write with nanoparticles (2016, January 14) retrieved 28 June 2024 from <https://phys.org/news/2016-01-bubble-pen-nanoparticles.html>

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.