Scientists create microscopic alphabet

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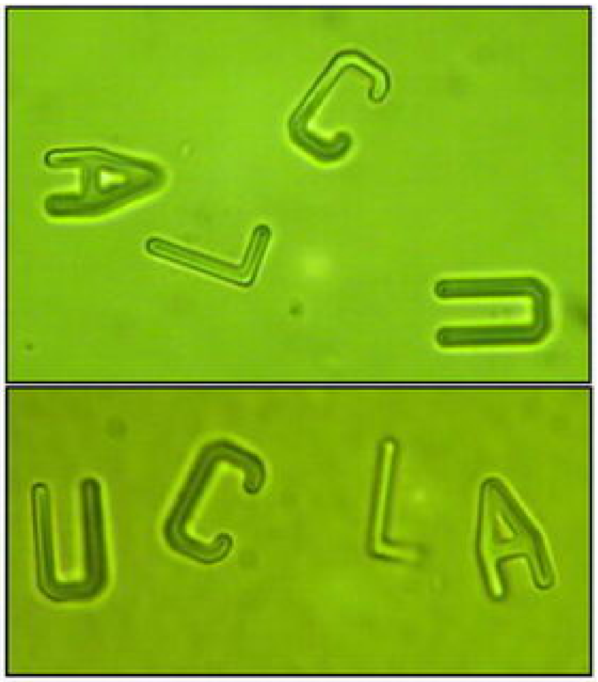
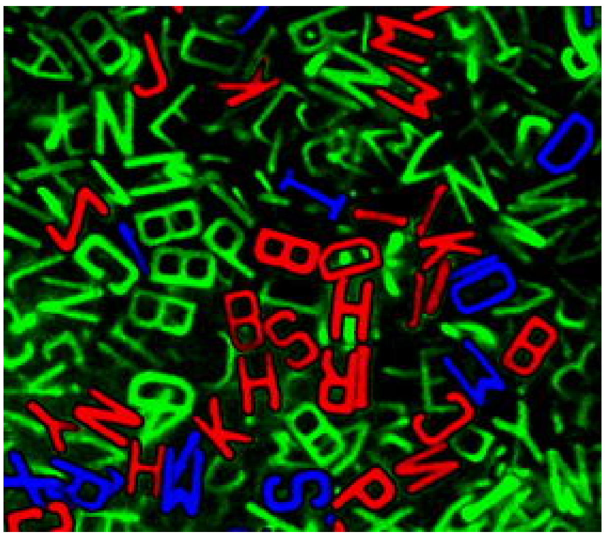


UCLA professor Thomas G. Mason and chemistry graduate student Carlos J. Hernandez produced microscale particles shaped like each letter of the alphabet. Graduate student James Wilking used "laser tweezers" to pick up the letters &acuteU, C, L, A&acute and move them in order "like skywriting in solution." Credit: James N. Wilking/Thomas G. Mason, UCLA Chemistry

UCLA scientists have designed and mass-produced billions of fluorescent microscale particles in the shapes of all 26 letters of the alphabet in an “alphabet soup” displaying “exquisite fidelity of the shapes.”

The letters are made of solid polymeric materials dispersed in a liquid solution. The research will be published March 29 in the *Journal of Physical Chemistry C*, where it will be illustrated on the cover. The scientists anticipate that their “LithoParticles” will have significant technological and scientific uses.



UCLA professor Thomas G. Mason and chemistry graduate student Carlos J. Hernandez have designed and mass-produced billions of fluorescent microscale particles in the shapes of all 26 letters of the alphabet in a "colloidal alphabet soup." Credit: Carlos J. Hernandez/Thomas G. Mason, UCLA Chemistry

“We can even choose the font style; if we wanted Times New Roman, we could produce that,” said study co-author Thomas G. Mason, a UCLA associate professor of chemistry who holds UCLA’s John McTague Career Development Chair.

Lead author Carlos J. Hernandez, a UCLA chemistry graduate student, designed a customized font for the letters and produced them.

"We have demonstrated the power of a new method, at the microscale, to create objects of precisely designed shapes that are highly uniform in size," said Mason, a member of UCLA's California NanoSystems Institute. "They are too small to see with the unaided eye, but with an optical microscope, you can see them clearly; the letters stand out in high fidelity. Our approach also works into the nanoscale."

Hernandez and Mason also have produced particles with different geometric shapes, including triangles, crosses and doughnuts, as well as three-dimensional "Janus particles," which have two differently shaped faces.

"We have made fluorescent lithographic particles, we have made complex three-dimensional shapes and, as shown by UCLA postdoctoral fellow Kun Zhao, we can assemble these particles, for example, in a lock-and-key relationship," said Mason, whose research is at the intersection of chemistry, physics, engineering and biology. "We can mass-produce complex parts having different controlled shapes at a scale much smaller than scientists have been able to produce previously. We have a high degree of control over the parts that we make and are on the verge of making functional devices in solution. We may later be able to configure the parts into more complex and useful assemblies.

"How can we control and direct the assembly of tiny components to make a machine that works?" Mason asked. "Can we cause the components to fit together in a controlled way that may be useful to us? Can we create useful complex structures out of fundamental parts, in solution, where we can mass-produce a small-scale engine, for example? We will pursue these research questions."

Because each letter is smaller than many kinds of cells, possible applications include marking individual cells with particular letters. It may be possible, Mason said, to use a molecule to attach a letter to a cell's surface or perhaps even insert a letter inside a cell and use the letter-marker to identify the cell. The research also could lead to the creation of tiny pumps, motors or containers that could have medical applications, as well as security applications.

In addition to creating the letters, Mason's research group can pick up letters and reposition and reorient them in a microscale version of the game Scrabble (see image).

"We have used 'laser tweezers' to pick up the jumbled letters 'U, C, L, A' and move them together in order, like skywriting in solution," Mason said. UCLA chemistry graduate student James Wilking moved the letters to spell "UCLA."

Mason's research is funded in part by the National Science Foundation. He also receives research support from UCLA's John McTague Career Development Chair, which provides research funding for five years.

"UCLA's Office of Intellectual Property has applied for patent protection on this platform technology and is beginning to speak with potential corporate partners to bring new products to market based on this technology to benefit the public good," said Earl Weinstein, who handles technology business development and licensing for UCLA's technology transfer office.

As a graduate student at Princeton in the early 1990s, Mason founded a field called "thermal microrheology," the techniques of which are now used by scientists worldwide. Microrheology is a method for examining the viscosity and elasticity of soft materials, including liquids, polymers and emulsions, on a microscopic scale. Mason and Hernandez's research in the Journal of Physical Chemistry C provides novel probes for microrheology.

For centuries, scientists and engineers have studied the deformation and flow, or rheology, of soft materials on a large, laboratory scale. However, until Mason developed the field of microrheology, which relies on the random Brownian motion of probe particles, scientists had not done so on the microscopic level.

As with much cutting-edge science, Mason's research opens up the possibility for developments that sound like science fiction. Are microscale devices that can actively identify cancer cells and eliminate them a real possibility? Could Mason's research help achieve this goal? The answer, he said, will probably not come anytime soon, but perhaps in his lifetime. Understanding microrheology in synthetic materials is the first step to understanding what occurs in active materials like the interior of cells and may help us understand how cells function while alive and how they die.

Source: University of California - Los Angeles