Researchers Construct Tiny, Floating 'Eyeballs,' 'Billiard Balls' on Microchip

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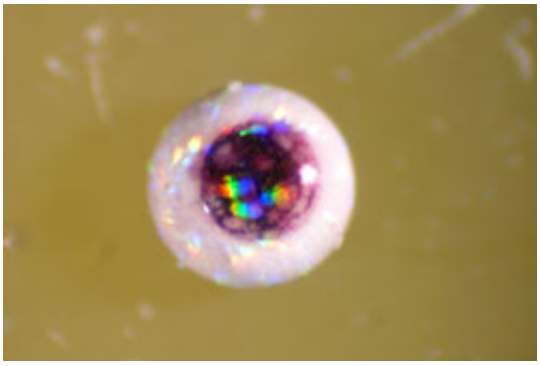

North Carolina State University chemical engineers have discovered a way to construct new microscopic devices that can act like tiny factories for materials with potential for a wide variety of chemical and biological uses.

The NC State researchers, advised by Dr. Orlin Velev, assistant professor of chemical and biomolecular engineering, include undergraduate student Jeffrey R. Millman and graduate students Ketan H. Bhatt and Brian G. Prevo. They created different types of tiny particles that could eventually be used in everything from drug delivery to determinations of the presence or concentration of biological molecules.

Image: One of the anisotropic "eyeball" particles created by NC State

researchers.

Some types of new particles look like microscopic eyeballs, but are really made of tiny particles of gold and latex. Others look like billiard balls, but are slivers of gold, silica and colored latex beads.

The research is published in the January edition of *Nature Materials*.

“We’re looking at scaling down microfabrication by making special microfluidic chips that can serve as microscopic factories,” Velev says. “All sorts of particulate materials – electrically conductive, magnetic, polymer, metallic, fluorescent – can be combined for special high-tech applications.”

In 2003, Velev and his students published in the journal Nature a technique to control the movement of microscopic droplets of liquid freely floating across centimeter-sized chips packed with electrodes. The breakthrough came as the researchers learned how to circumvent friction by suspending the droplets of water inside fluorinated oil, and then applying electrical voltages to make the liquid hover over the electrical circuits of the chip. Switching the chip’s electrodes on and off – either manually or with the aid of a computer – lets researchers move the droplets across the oil surface to any location on the chip.

In the current research, the NC State scientists create anisotropic particles, or particles with different layers or properties, on the microfluidic chip. The droplets contain tiny amounts of different materials, like gold and latex, along with a small amount of water; the scientists combine them and allow them to dry. The dried particles take on the look of eyeballs, with the gold slivers making a dark dot inside the latex white of the eye.

In the billiard-ball particles, tiny pieces of gold, silica microspheres,

yellow latex beads and water resemble something similar to a yellow-and-white striped nine-ball in billiards after drying, with the latex beads clustering at the top of the particle, the gold slivers forming a stripe of brown in the middle of the particle, and the silica microspheres congregating at the bottom of the particle. Similar striped particles were formed from tiny gold slivers, red latex beads and silica microspheres.

“The eyeball and striped particles could be used in electronic paper and as barcoded tags in biological and environmental research,” Velev says, “as well as in advanced drug delivery and targeted therapeutics.”

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Paper: “Anisotropic Particle Synthesis in Dielectrophoretically Controlled Microdroplet Reactors”
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