# NEWS RELEASE

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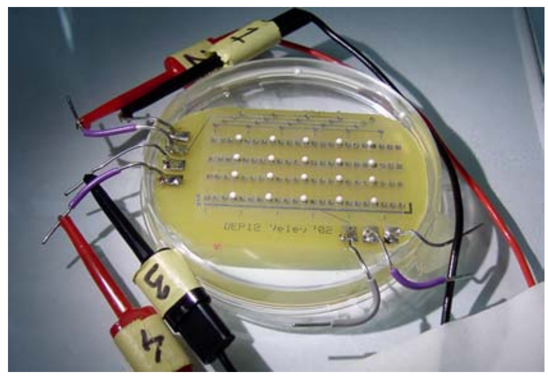
## Researchers Manipulate Tiny, Floating Droplets on a Chip

FOR IMMEDIATE RELEASE

In an innovative study, researchers at North Carolina State University have designed a way to control the movement of microscopic droplets of liquid freely floating across centimeter-sized chips packed with electrodes. The discovery allows the performance of new types of chemical experiments on the microscale.



**The new microfludic chip invented by Dr. Orlin Velev, Brian Prevo and Ketan Bhatt allows researchers to control the movement of tiny floating droplets.**

The breakthrough came as the researchers – Dr. Orlin D. Velev, assistant professor of chemical engineering, and two NC State doctoral students, Brian Prevo and Ketan Bhatt – learned how to circumvent friction by suspending the droplets of water inside a fluorinated oil, and then using electrical voltages to allow the liquid to 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.

The chip also allows researchers to conduct experiments with mixed droplets, as liquids can be moved along different paths and then merged or encapsulated in oil or polymer droplets.

The discovery has wide-ranging scientific implications. Besides analyses and characterizations of chemical samples, the chip can serve as a tiny factory, Velev says, allowing researchers to mix droplets to test chemical reactions, for example, or add specific amounts of toxin to a cell to see how long it takes the cell to die. Velev is also eager to synthesize new particle materials or crystals inside liquids.

The research was published in the Dec. 4 edition of *Nature*.

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"Moving droplets of liquid on solid surfaces as other researchers have done before us has a number of limitations," Velev said. Other research in moving droplets on solid surfaces was stunted by friction if particles or solids were moved along the channels or solid surface of a chip. "But the freely suspended droplets on this microfluidic chip never touch solid walls and thus can act as reactors for materials synthesis or precipitation," he said.

Velev's interest in microfluidic chips stems from his lab's work on growing self-assembling microwires by moving gold nanoparticles with alternating current in water, and his earlier work on using floating droplets as assembly sites for complex particles.

"Experiments and bioassays, or determinations of the presence or concentration of biological molecules, that we presently do with test tubes and beakers can now be done on the microscale. This device enlarges the scope and capabilities in the field of microfluidics, which is just a few years old," Velev said.

The chip – which was simple and inexpensive to make, Velev says, and is reusable – has received a provisional patent, with application in place for a full patent.

The research is funded by Velev's National Science Foundation Career Award and by an ARO-Stir grant.

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**Note to editors**: The first paragraph of the paper follows.

## "On-chip Manipulation of Free Droplets"

*Authors*: Dr. Orlin D. Velev, Brian T. Prevo and Ketan H. Bhatt, NC State University
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**First Paragraph**: 'Lab-on-a-chip' systems resemble factories with permanently rigged pipes, but their prefabricated microchannels could have problems in delivering materials such as suspended particles, biological cells or proteins, which may adhere to the walls and clog the channels. More flexible microfluidic systems allow liquids to be transported as droplets on a solid surface, but these suffer from similar drawbacks where the droplets are in contact with solid walls. Here we describe a liquid – liquid microfluidic system for manipulating freely suspended microlitre- and nanolitre-sized droplets of water or hydrocarbon, which float on a denser, perfluorinated oil and are driven by an alternating or constant electric field applied by arrays of electrodes below the oil. These microfluidic chips could be used as a versatile tool in microscale transport and mixing and in chemical and materials synthesis.