TECHNOLOGY

Complex fluids for control and immobilization of nanoparticles on a surface with nanometer precision

OVERVIEW

Background

Manipulation of micron or sub-micron objects in fluids has become an important technology for studying physical and biological processes of small groups of, or individual, molecules as well as in fabricating nanoscale devices. Positioning is most often achieved using either optical control or flow control. Particularly challenging is that the smaller the object that one wishes to control, the more difficult it becomes to control its position in the vertical dimension. As a result, most control schemes work best only in the horizontal dimensions.

Researchers at the University of Maryland have developed a water-based fluid that can be used to restrict nanoscale objects to regions within 200 nm or less of a surface, with the dimension of the restricted region being controllable based on composition. These fluids also maintain physical properties that are desirable for optical and/or flow control, such as low viscosity, optical clarity, and low refractive index. The key element in this novel fluid system is an additive that is not completely miscible with water, but near the miscibility point. For example, using a prepolymer and a rheology modifier, colloidal quantum dots are restricted to be within 100 nm of a glass or silicone surface. By changing the volume percent of prepolymer, the restriction distance can be controlled further. In another example, the fluid may also contain a water soluble radical photoinitiator, which does not affect the ability to control the position of nanoscale objects, but upon irradiation with ultraviolet light, allows them to be immobilized to selected delivery locations. In this manner the manipulation fluid can be used for controlled fabrication of devices and structures composed of nanoscale components.

Advantages
Nanometer Scale Precision
High optical clarity
Low refractive index

Applications
Nanoparticle Delivery
Single Photon Generators
Quantum Dot Lasers
Nanoscopic Photonic/Electronic Circuits
Quantum Information Processors

CONTACT INFO

UM Ventures
0134 Lee Building
7809 Regents Drive
College Park, MD 20742
Email: umdtechtransfer@umd.edu
Phone: (301) 405-3947 | Fax: (301) 314-9502

Additional Information

INSTITUTION

University of Maryland, College Park

PATENT STATUS

Patent(s) pending

LICENSE STATUS

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EXTERNAL RESOURCES

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