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Researchers explain particle motion in microchannels

By Wai Lang Chu

25-Mar-2008 - **Engineers from the U.S think they have discovered a new technique that allows them to control the motion of fluid particles as they pass through the tiny channels that characterise nano-scale technologies such as drug delivery devices.**

The discovery particularly bodes well for chemical and [biological sensors](#), as well as components for miniaturised biological "lab-on-a-chip" applications, which traditionally have suffered from slow particle transport.

'Lab-on-a-chip' technology has been hailed as the most effective solution that exists today that can provide unprecedented biological realism to shed light on the most challenging medical problems.

The devices enable scientists to study the kinds of fluid movements and chemical interactions that occur in cells, tissues, and even organs in ways that aren't possible with test tubes and Petri dishes.

However, while the scientific community has witnessed an explosive surge of miniaturisation schemes and designs, the measurement of fluid flow and hence its optimisation has not kept pace.

Chemical engineers at [The University of Texas](#) at Austin used computer simulations to reveal that fluid particles move past one another more easily if they first form "layers" aligned with the boundaries of the channels.

The team, consisting Ph.D. students Gaurav Goel, William Krekelberg and Truskett at the university along with Dr. Jeffrey Errington of the [State University of New York](#) at Buffalo, also introduced a way to systematically determine which types of channel boundaries will promote or frustrate the formation of the layers necessary for faster particle transport.

"Particle arrangements are determined by the interactions of the particles with their boundaries. Thus, we were able to use these interactions as a means for controlling how readily the fluid will self-mix, diffuse, and flow," said Truskett, associate professor of chemical engineering at the university.

How fluids behave in microfluidic channels is important in applications where the mixing of two liquids to required volumes is required, for example in the preliminary phases of drug discovery.

Reagents need to be well-mixed to produce purer test drugs with fewer unwanted by-products.

The team also provided insights into why bulk fluids adopted a more disordered structure with no layering if layering leads to faster particle dynamics.

"Thermodynamics determines the structure of a fluid, not dynamics - and thermodynamics favours a disordered state for bulk fluids because it lowers the system's free energy," said Truskett.

The Truskett team determined that confining a fluid to small length scales allowed them to tune the thermodynamically-favoured state to coincide with one that has layering and fast particle dynamics.

The paper: 'Tuning Density Profiles and Mobility of Inhomogeneous Fluids,' appears in the March 14 issue of the journal Physical Review Letters.

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