Researchers discover new way to control particle motion

Chemical engineers at The University of Texas at Austin have discovered a new way to control the motion of fluid particles through tiny channels, potentially aiding the development of micro- and nano-scale technologies such as drug delivery devices, chemical and biological sensors, and components for miniaturized biological "lab-on-a-chip" applications.

The researchers learned that particle motion is strongly linked to how the particles arrange themselves in a channel.

“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 Dr. Thomas Truskett, associate professor of chemical engineering at the university.

The research by 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, appears in the March 21 issue of the journal *Physical Review Letters*.

Civic planners and schoolteachers have long appreciated that the motion of cars on highways or children through hallways proceeds smoothly if lanes of traffic are formed. Truskett's research team found that a similar principle applies for the motion of fluid particles in narrow channels. Specifically, their computer simulations reveal that fluid particles move past one another more easily if they first form "layers" aligned with the boundaries of the channels.

The team has 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.

If layering leads to faster particle dynamics, it is natural to ask why bulk fluids adopt a more disordered structure with no layering, said Truskett.

“The reason: thermodynamics determines the structure of a fluid, not dynamics - and thermodynamics favors a disordered state for bulk fluids because it lowers the system's free energy,” he said.

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

Source: University of Texas at Austin