Visualizing floating cereal patterns to understand nanotechnology processes

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Small floating objects change the dynamics of the surface they are on. This is an effect every serious student of breakfast has seen as rafts of floating cereal o's arrange and rearrange themselves into patterns on the milk. Now scientists have suggested that this process may offer insight into nanoscale engineering processes.

"Small objects floating on the fluid-air interface deform the surface and attract each other through capillary interactions, a phenomenon dubbed `The Cheerios Effect,'" explains student Khoi Nguyen. "Interesting motions occur here caused by attractive and repelling forces and torques. Studying how the shape of the objects influences this motion helps us understand colloidal self assembly."

Nguyen, along with graduate student Michael Miller and their advisor Shreyas Mandre, Ph.D., study "The Cheerios Effect" and will present some early findings at the American Physical Society's Division of Fluid Dynamics in San Diego, Nov. 18 – 20.

Colloidal self assembly is a process in which nanoscale materials – technology built to a scale of 1-100 millionths of a meter – organize by themselves into crystalline structures. These structures can be used to efficiently and cost-effectively make many things, from pharmaceuticals to telecommunications.

The forces causing self assembly originate from the curvature of the meniscus around objects. Meniscus means "crescent" in Greek and

refers to the curve in the top surface of a liquid cause by surface tension around a floating object. This curvature, and the ensuing motion, is controlled by the shape of the object.

To visualize particle motion related to the meniscus, the team cut various acrylic shapes with a laser, floated them in a Petri dish, filmed the interactions and observed. "Our goal is to optimize the force fields around objects floating on a surface, and understanding meniscus dynamics may be one way to do that," explains Miller.

More information: The talk, "Fluid Surface Deformation by Objects in the Cheerios Effect," is at 5:50 p.m. on Sunday, Nov. 18, in the Ballroom 20D foyer.
http://absimage.aps.org/image/DFD12/MWS_DFD12-2012-001998.pdf

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