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**The Physics of Coffee Rings**

*Ubiquitous Stain Offers New Ideas on Industrial Coatings, Electronics, and Medicine  
Presentation at Fluid Dynamics Meeting Today in Long Beach, CA*

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EMBARGOED for release until 7:00 p.m. Eastern time (U.S.) on Tuesday, Nov. 23, 2010

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WASHINGTON, D.C., November 23, 2010 -- For centuries, intellectuals have met at the ring-stained surfaces of coffee shops to pore over the most pressing problems of the day -- but has anyone ever pondered the coffee rings they left behind? What causes the formation of stain patterns left behind by coffee droplets on a surface?

You might think coffee ring formation, first described quantitatively by Deegan et al in a heavily cited article, is the most widely and ritualistically performed experiment in the world, given the prevalence of caffeine in cultures. But most of us lack the scanning electron microscope and mathematical models to evaluate our stain data properly, or reach meaningful conclusions beyond "Use a coaster."

Now Shreyas Mandre of Brown University, Ning Wu from Colorado School of Mines and L. Mahadevan and Joanna Aizenberg from Harvard University have devised a predictive model that combines laboratory studies of microscopic glass particles in solution with mathematical theories to predict the existence, thickness and length of the banded ring patterns that formed.

Their results, presented today at the American Physical Society Division of Fluid Dynamics meeting in Long Beach, CA, suggest the patterned deposition of particles can be controlled by altering physical parameters such as evaporation and surface tension -- and perhaps one day manipulated to create small-particle tools.

"Controlling the ring deposition process would be useful for creating such things as new microphysics tools operating at a scale where pliers or other traditional tools for moving particles cannot operate," notes Mandre.

The team found that during ring deposition, a particle layer of uniform thickness is deposited if the concentration is above a certain threshold. Below that threshold the deposits form non-uniform bands. The threshold is formed because evaporation at the solid-liquid interface of the rim occurs faster than a replenishing flow of water from the center of the droplet can replace the evaporating rim fluid. This leaves the particles on the rim high, dry -- and deposited.

Exploiting this competition between evaporation and replenishment is the key to controlling the process as a microtool, says Mandre. Potential applications include printing, making industrial coatings, fabricating electronics, and designing new medicines.

The presentation, "Coffee ring deposition in bands" is at 4:23 p.m. on Tuesday, November 23, 2010 in the Hyatt Regency Long Beach Room: Regency A. ABSTRACT:  
<http://meetings.aps.org/Meeting/DFD10/Event/134397>

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#### MORE MEETING INFORMATION

The 63rd Annual DFD Meeting is hosted this year by the University of Southern California, California State University Long Beach, California Institute of Technology, and the University of California, Los Angeles.

It will be held at the Long Beach Convention Center, located in downtown Long Beach, California. All meeting information, including directions to the Convention Center is at:  
<http://www.dfd2010.caltech.edu/>

#### USEFUL LINKS

Main meeting Web site: <http://www.dfd2010.caltech.edu/>  
Search Abstracts: <http://meetings.aps.org/Meeting/DFD10/SearchAbstract>  
Directions to Convention Center: <http://www.longbeachcc.com/>

#### PRESS REGISTRATION

Credentialed full-time journalist and professional freelance journalists working on assignment for major publications or media outlets are invited to attend the conference free of charge. If you are a reporter and would like to attend, please contact Jason Bardi ([jbardi@aip.org](mailto:jbardi@aip.org), 301-209-3091).

#### ONSITE WORKSPACE FOR REPORTERS

A reserved workspace with wireless internet connections will be available for use by reporters in the Promenade Ballroom of the Long Beach Convention Center on Sunday, Nov. 21 and Monday, Nov. 22 from 8:00 a.m. to 5:00 p.m. and on Tuesday, Nov. 23 from 8:00 a.m. to noon. Press announcements and other news will be available in the Virtual Press Room (see below).

## VIRTUAL PRESS ROOM

The APS Division of Fluid Dynamics Virtual Press Room will be launched in mid-November and will contain dozens of story tips on some of the most interesting results at the meeting as well as stunning graphics and videos. The Virtual Press Room will serve as starting points for journalists who are interested in covering the meeting but cannot attend in person. See: <http://www.aps.org/units/dfd/pressroom/index.cfm>

## GALLERY OF FLUID MOTION

Every year, the APS Division of Fluid Dynamics hosts posters and videos that show stunning images and graphics from either computational or experimental studies of flow phenomena. The outstanding entries, selected by a panel of referees for artistic content, originality and ability to convey information, will be honored during the meeting, placed on display at the Annual APS Meeting in March of 2011, and will appear in the annual Gallery of Fluid Motion article in the September 2011 issue of the American Institute of Physics' journal, Physics of Fluids.

This year, selected entries from the 28th Annual Gallery of Fluid Motion will be hosted as part of the Fluid Dynamics Virtual Press Room. In mid-November, when the Virtual Press Room is launched, another announcement will be sent out.

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## ABOUT THE APS DIVISION OF FLUID DYNAMICS

The Division of Fluid Dynamics of the American Physical Society (APS) exists for the advancement and diffusion of knowledge of the physics of fluids with special emphasis on the dynamical theories of the liquid, plastic and gaseous states of matter under all conditions of temperature and pressure. See: <http://www.aps.org/units/dfd/>

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