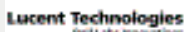


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## Bell Labs Scientists Discover Technique to Control Fluids Using Specially Fabricated Silicon 'Nanograss'

MURRAY HILL, N.J.--(BUSINESS WIRE)--March 12, 2004--

Potential applications include more efficient cooling of integrated circuits, novel photonic components for optical communications, and lab-on-a-chip sensor modules

Scientists at Bell Labs, the research and development arm of Lucent Technologies (NYSE: LU), have discovered an entirely new method to control the behavior of tiny liquid droplets by applying electrical charges to specially engineered silicon surfaces that resemble blades of grass. The new technique of manipulating fluids has many potential applications, including thermal cooling of integrated circuits for powerful computers, novel photonic components for optical communications, and small, low-cost "lab-on-a-chip" sensor modules.

Details of the technique, which is the result of Bell Labs' research efforts in nanotechnology, are being published in the May 11, 2004, issue of the American Chemical Society's journal, *Langmuir*.

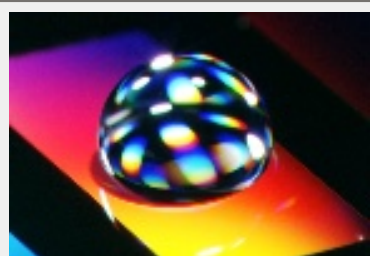
"Once in a while, we get a research breakthrough that has wide applicability across many fields," said David Bishop, vice president of nanotechnology at Bell Labs and president of the New Jersey Nanotechnology Consortium. "The techniques resulting from this research might be applied to fields that range from optical networking and advanced micro batteries to self-cleaning windshields and more streamlined boat hulls."

The advance that made this possible was a breakthrough technique that Bell Labs scientists developed for processing silicon surfaces, so that these surfaces resemble a lawn of evenly cut grass, with individual "blades" only nanometers in size. (A nanometer is a billionth of a meter, roughly one hundred thousand times smaller than the diameter of a human hair).

This new capability to process silicon surfaces to produce "nanograss" lets liquids interact with surfaces in a novel way, thereby providing a way to precisely control their effects. In everyday experience, fluids tend to wet surfaces and stick to them. For example, a raindrop sticks to a car's windshield; when water is spilled, it splatters every which way. The individual blades of the nanograss are so small, however, that liquid droplets sit on top and can be easily maneuvered.

"Physically, this technique reduces the surface area that the droplet feels, and reduces the interaction between the liquid and the substrate by a factor of a hundred to a thousand," said Tom Krupenkin, the Bell Labs scientist who led the research.

Krupenkin and his team coated the nanograss with a non-stick, water-repellent material, and when the droplets are put on the



Lucent Technologies' Bell Labs scientists have figured out a way to electrically control the behavior of liquid droplets. The technology may have applications from thermal cooling of chips to liquid lens for optical networking. The attached picture shows a liquid droplet with its shape distended using the Bell Labs technique.

Credit: Lucent Technologies' Bell Labs



surface, they can move about without wetting it. By applying a small voltage, however, the team could tailor the behavior of droplets, making them sink in and wet the surface as directed. The droplets also respond to a change in temperature, allowing for thermal cooling applications.

"Such behavior may be harnessed to cool computer chips," Krupenkin said. "A droplet could be sent to a hot spot on the chip, where it would sink in and absorb the heat, and then go on its way, avoiding the expense and inefficiency of applying a coolant or a heat sink to an entire chip."

Another application for this technique may be in optical networking. For example, moving a droplet of fluid into a nanoglass surface can alter the physical properties of the transmitting medium through which light signals are sent, and this may lead to better methods for optical switching. Novel optical components, such as filters, could be created by moving the fluid into and out of nanoglass areas, Krupenkin said.

Bell Labs and the New Jersey Nanotech Consortium are also exploring using the technique to create powerful, next-generation reserve micro batteries. Conventional batteries have electrochemical reactions proceeding at some level all the time, even when batteries are not being used. Over time, the batteries degrade. By using the Bell Labs technique to isolate the liquid electrolyte so that electrochemical reactions do not take place until power is actually needed, nanoglass-based micro batteries may be ideal for long-term, higher capacity battery applications, especially where bursts of power are needed. Examples would be sensors out in the field that only need a lot of power when they detect something and need to transmit the information as a wireless signal.

Yet another application for the nanoglass may be "lab-on-a-chip" devices. "Potentially, one can envision lab-on-the-chip devices that use thousands of different reagents, each deposited in a small spot at the bottom of the nanoglass, thus providing novel devices for combinatorial chemistry, genetic analysis, and so on," Krupenkin said. "Some other possible applications where nanoglass can be used may be for low-friction torpedoes, self-cleaning windshields, and faster boats where the fluid-repellent properties of the nanoglass would be important."

Other members of the interdisciplinary team involved in the research were Ashley Taylor of Bell Labs, Bell Labs intern Tobias Schnieder, and University of Pennsylvania professor Shu Yang.

#### About Bell Labs and Lucent Technologies

Bell Labs is the leading source of new communications technologies. It has generated more than 30,000 patents since 1925 and has played a pivotal role in inventing or perfecting key communications technologies, including transistors, digital networking and signal processing, lasers and fiber-optic communications systems, communications satellites, cellular telephony, electronic switching of calls, touch-tone dialing, and modems. Bell Labs scientists have received six Nobel Prizes in Physics, nine U.S. National Medals of Science and eight U.S. National Medals of Technology(R). For more information about Bell Labs, visit its Web site at [www.bell-labs.com](http://www.bell-labs.com).

Lucent Technologies designs and delivers the systems, services and software that drive next-generation communications networks. Backed by Bell Labs research and development, Lucent uses its strengths in mobility, optical, software, data and voice networking technologies, as well as services, to create new revenue-generating opportunities for its customers, while enabling them to quickly deploy and better manage their networks. Lucent's customer base includes communications service providers, governments and enterprises worldwide. For more information on Lucent Technologies, which has headquarters in Murray Hill, N.J., USA, visit [www.lucent.com](http://www.lucent.com).

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