SCIENCE NEWS
This Week

Previous studies have shown memory and learning deficits in such engineered mice. In the new study, the researchers implanted electrodes in the brains of some of the mice and tracked their brain function using electroencephalogram (EEG) readings as the mice moved freely about their cages. When a mouse was having a mini-seizure, as evident from its EEG readouts, it sometimes froze in its tracks.

Biochemical and anatomical analyses of the brains of these mice revealed high concentrations of neuropeptide Y, a chemical typically released to calm overexcited neurons. In this case, the protective reaction may be overcompensating for the problem of excessive signaling. "In mice with the most severe memory deficits, neuropeptide Y tended to be at maximal levels," Mucke says.

The net effect is dull signaling that depresses the mouse brain's agility, possibly paralleling symptoms in Alzheimer's patients, the scientists conclude.

"This is an important study for sure, suggesting that amyloid-beta isn't just causing neuron death but is also pruning back synapses," says neurobiologist Rudolph Tanzi of Harvard Medical School and Massachusetts General Hospital in Boston. "This adds to a growing body of literature on amyloid-beta deposition. I think this is just the tip of the iceberg. It's a great start toward understanding more about how amyloid-beta deposits disrupt neural circuitry."

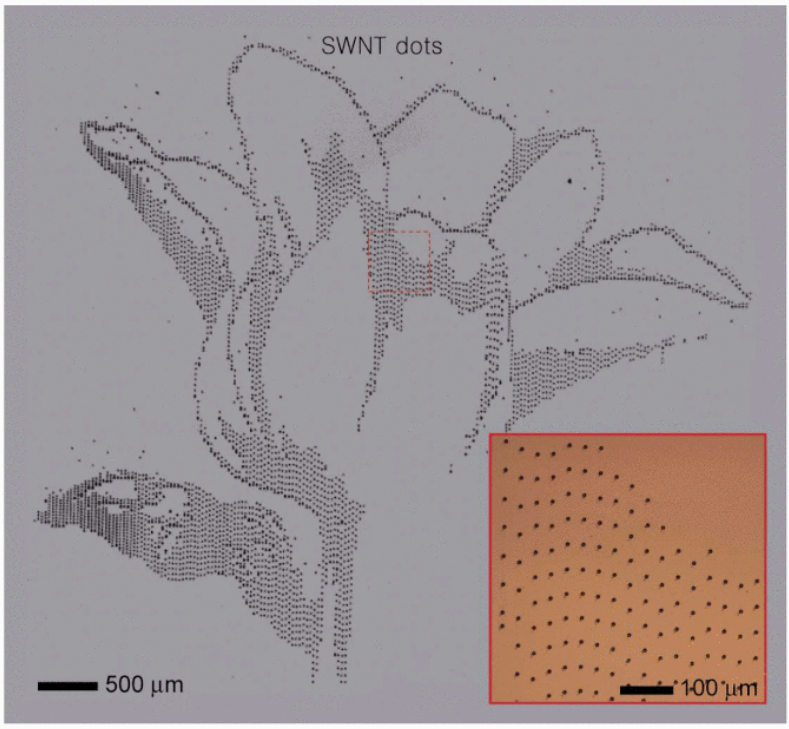
Mucke and his team are designing a trial that would use EEG readings to test for small seizures in people with early-stage Alzheimer's disease. —N. SEPPA

# Spot On

## Printing flexible electronics one nanodot at a time

**Plastic displays, solar cells, and other kinds** of gadgets are attractive for their flexibility and potential low cost. But they rely on materials—polymers, nanoparticles, and carbon nanotubes—that are incompatible with manufacturing processes designed for silicon-based devices. Now, researchers have developed a printing process that could make possible mass production of plastic electronic devices.

Many companies are experimenting with ink-jet systems to create flexible printed electronics, usually by adapting standard ink-jet printers to dispense fluids with useful electronic properties. But such systems generally can only print features down to 20 microns in diameter—too large for many applications.




**FLOWER POWER** This printed image of a flower was created with microscopic dots of electronic ink containing carbon nanotubes. Inset shows a magnified detail of the image.

John Rogers of the University of Illinois at Urbana-Champaign and his colleagues have devised an alternative strategy called electrohydrodynamic, or e-jet, printing. In contrast to conventional ink-jet printing, which relies on either heat or vibration to push ink droplets out of a nozzle, e-jet printing uses electric fields to pull droplets from the nozzle's tip.

The system consists of a glass nozzle coated with a thin, conducting layer of gold. The coating extends to the tip of the nozzle, where it makes contact with the emerging ink.

The researchers bring the nozzle close to a surface on which they wish to print a pattern, in this case a silicon wafer sitting on a conducting plate. Applying a voltage between the nozzle and the plate produces an intense electric field at the nozzle's tip. As the field draws the ink out of the nozzle, a cone-shaped meniscus forms at the tip and pinches off droplets of fluid.

"Those droplets then travel like bullets down to the substrate," says Rogers. The electric field guides the droplets so that they land directly below the nozzle.

By varying the diameter of the nozzle tip, the Illinois team can control the size of the droplets. The researchers can make nozzles with openings as narrow as 300 nanometers, which produce dots just 250 nm across. That's orders of magnitude smaller than drops produced by existing printers, says Rogers. The team describes its research in an upcoming *Nature Materials*.

Paul Calvert, a materials scientist at the University of Massachusetts, Dartmouth, says that the technology is promising. "I'm not aware of anyone else who has achieved this kind of resolution," he adds.

Rogers and his colleagues showed that their e-jet printer works with a wide variety of inks containing conducting or photosensitive polymers, silicon nanoparticles or nanorods, or carbon nanotubes.

To create patterns on a surface, the plate under the silicon wafer is mounted on a computer-controlled mechanical stage. The stage moves the printing surface horizontally while the nozzle remains in place. Rogers' team printed text and various drawings, including a picture of a flower and a portrait of the ancient Greek scholar Hypatia. As a preliminary step toward making functional transistors and other devices, the researchers used the technique to print various patterns of electrode structures.

The next step is to increase the speed of the e-jet printer by incorporating hundreds of nozzles. The Illinois team is working with several companies, including Dow Corning and Ford, with a view to printing solar cells and lighting systems, respectively. —A. GOHO

UNIV. ILLINOIS, URBANA-CHAMPAIGN