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Mix 'n' Match Flexible Circuitry May Brighten Cell Phones

A new "rubber stamp" method of printing elastic electronics may lead to improved handheld video displays and spherical night-vision sensors

by JR Minkel

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Ever had trouble reading the display on your cell phone or handheld video game? Don't worry, researchers are on it: a group has devised an improved method of creating bendable circuitry by slicing a thin, floppy piece of material from one surface and stamping it onto another. The technique combines multiple types of semiconductors into the same device with ease, its developers report.

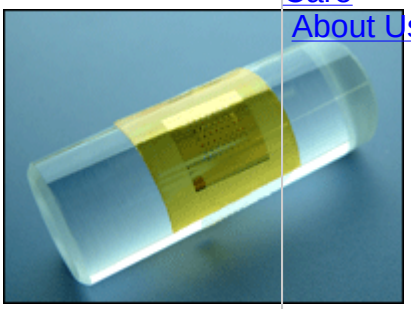

Image: JOHN ROGERS

BEND ME, SHAPE ME: A new technique for printing flexible electronics stamps several different semiconductors onto the same pliable surface.

Mixing and matching materials this way may pave the way to brighter displays for cell phones and handheld games, spherical light-sensitive "eyes" that take in a wide field of view, and flexible communications devices that can be folded and stuffed into a backpack, says materials scientist John Rogers of the University of Illinois at Urbana-Champaign. "It's a very straightforward path to making flexible displays," he says.

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Manufacturers build computer processors and most other conventional electronics from rigid wafers of crystalline silicon. They would like to mix in other semiconductors to take advantage of their faster speeds or greater power capacities, but methods of fusing them to silicon are typically clumsy or complicated, Rogers says.

To simplify the process, Rogers and his co-workers identified chemical solvents that erode semiconductor crystals much better across the plane of a surface than straight down. So instead of eating big holes in a material, the solvents separate layers or ribbons of it from the rest. The transferred pieces are also much more elastic because they are so thin--a tiny 1.5 microns or less, much thinner even than a human hair. "They're actually floppy and flexible," Rogers says, "and, as a result, it allows you to print them."

To transfer a material, the team first cleaved ribbons of silicon or another substance from a crystal. Next, they placed a silicone rubber stamp on the crystal, and when they peeled the stamp away, the pieces of semiconductor came along. Finally, they stamped the lifted pieces down onto a sheet of polymer and fixed them there by pouring on a liquid polymer that solidified.

Using this process, the researchers grew stacks of flexible electronics up to three layers high, mixed and matched from silicon, the semiconductors gallium arsenide and gallium nitride, as well as carbon nanotubes, they reported in *Science*. Rogers says the team deposited metal wires between layers in a standard way and confirmed that they could create simple circuits from the devices.

It's only a proof of concept but Rogers says he is already talking to companies about ways to juice up existing consumer products. For one thing, the technology could offer a route to cheaper, brighter

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LCD displays for mobile devices by crafting circuits from higher quality silicon than normal. "The engineering challenges are enormous," he says, "but there's no reason why it couldn't work."

He also envisions printing infrared-sensitive electronics onto a spherical surface, in effect creating a night-vision "eye" with a wide view. How long for a simple demo? Perhaps as little as six months, Rogers says.

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