Circuits on demand: Engineer prints electrical components on paper

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(Phys.org) —One of humankind's biggest technological steps was the ability to print words on paper. Now, thanks to College of Engineering assistant professor Anming Hu, it's technology itself that is being printed.

Hu, of the Department of Mechanical, Aerospace, and Biomedical Engineering, has researched a way to print circuits on paper, the main impact of which could be a decrease in cost and an increase in portability for any number of devices.

"Being able to design the circuit you want and then print it out allows for more responsive designs, easier control, and lower costs," said Hu. "The ability to print out the exact circuit you need the moment you need it can revolutionize a number of things."

One of the biggest advancements made possible by the technology could be in the world of medicine.

Currently, endless numbers of people suffer from a disease or affliction that requires them to frequently check in with a doctor or conduct medical testing. Diabetics, for example, rely on daily finger pricks to test their blood sugar levels.

With a paper circuit enclosed in a liquid-proof barrier, those same patients could one day have a sensor implanted in them that could not only detect when their levels were out of kilter, but also signal itself to

release insulin into their body.

"Being able to have an enclosed waterproof system with its own power source would open up a lot of areas medically," said Hu. "Right now, the focus is on being able to make the lines that form the circuit smaller."

The easiest way to picture how Hu's system works is to think of an inkjet printer, but replace the ink cartridge with one that dispenses liquid metal.

Hu's team tested more than thirty different types of paper before realizing that standard inkjet paper worked as well as anything, and was cheaper than most to secure.

The metal they use, on the other hand, is anything but ordinary.

"We use silver to make the nanowire," said Hu. "It's still much cheaper than making electric circuits the 'normal' way, and it holds up far better than copper, which has a tendency to oxidize too quickly."

Hu's team was able to fold the paper-thin circuit 5,000 times with a high level of functionality still intact, answering questions about the durability of the finished product.

While medical uses could have the most day-to-day impact for such circuits, their flexibility and ease of use means anything electronic could benefit.

"The global applications for this will drive development in a long-term way," said Hu. "For now we will focus on improving the mechanics of this new type of additive manufacturing, working on multiple-nozzle printing, things of that nature."

The research has already gotten plenty of attention, with the American Chemical Society journal *Applied Materials & Interfaces* publishing the team's work and several other scientific journals taking note.

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