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Engineers Create Tiny Wires With Old Technique

By Jesse Emspak

As microprocessors have shrunk, the wiring between them hasn't always kept up. But engineers at the University of Illinois are changing that with a decades-old metalworking technique.

It's called electrodeposition. It's basically the same process used in electroplating, but instead of depositing metal on a surface, as when trying to make a gold-plated piece of jewelry, the metal is deposited in a wire. "People weren't thinking about how to fabricate a wire in three dimensional space," said Min-Feng Yu, a professor of mechanical science and engineering.

Yu noted that the amount of processor power needed on chips is growing. That means the wires have to be thinner and smaller, and sometimes have to be constructed in three-dimensional space.

Yu and a graduate student, Jie Hu, realized that water is easy to shape, and at small scales the surface tension is quite strong. The phenomenon is easy to see when tiny droplets of water stretch between small objects.

Yu and Hu put the water in tiny pipettes. The pipettes were notched in a specific way, much like calligraphy pens. When the pipette is brought near another object, the water stretches out between them.

To deposit the metal, copper was dissolved in the water. Then the water was hit with an electric current, which forced the copper out of the solution - and onto the surface near the tip of the pipette.

The water gives a kind of structure that holds together, acting like a scaffold. As the pipette is drawn across the surface, a trail of copper is left behind.

But it needn't work only on two-dimensional surfaces. As the copper is deposited, the pipette can be lifted and another layer of molecules is laid on top of the first. This way, any three-dimensional shape can be made.

Yu said the wires can be made much thinner than those currently available. The smallest is 100 nanometers thick, but most are in the range of one micron, which is about two hundred times thinner than a human hair.

Scaled up to industrial size, the method could save microprocessor companies a lot of money, Yu said, because about 30% of the space in a microchip wafer is taken up by the wires between components. This technique could reduce that drastically, allowing more chips to fit in a given space.

Another plus is that the process uses only water, and wastes almost none of the metal. "Every molecule of copper is used," he said.