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NO SMALL FEAT

Nanotechnology researchers discover that shrinking computer chips is a tall order

By Mitch Mitchell
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Researchers at Texas Instruments and the University of North Texas in Denton received \$2.2 million this summer to find a way to build computer chips half the size of those currently in use.

The new chips would be about 500 atoms across, said Phillip Matz, a TI researcher working on the project. By comparison, a human hair is about 100,000 atoms across. The goal is smaller, more powerful chips.

About half the money is a National Science Foundation grant. The other half comes from contributed services from TI and UNT.

Most of the grant money will go to support the graduate students who will work on the project.

The grant is part of a nationwide push to help scientists deliver on the promise of nanotechnology, an emerging discipline geared toward making smaller and smaller devices.

"Our economy is currently being driven by shrinking chips," said Rick Reidy, a UNT project researcher. "If we, and people like us, are not successful, people will not be able to shrink their chips, and there will be an economic price to pay."

Computer chips have continuously gotten smaller since they were invented.

Consumers win because they get machines that are smaller, smarter and cheaper. But if that type of innovation ceases, the economic fortunes of the companies involved stagnate, Reidy said.

To keep the economic engines revving, UNT and TI researchers are working on a problem that is blocking efforts to make chips even smaller: a kind of electron interference called cross-talk.

It's caused when electrons are uncontrolled. The researchers will try to get electrons to travel down copper wire in an orderly way.



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Rick Reidy, a University of North Texas researcher, is reflected in a pattern silicon wafer. If the research project is unsuccessful, "people will not be able to shrink their chips, and there will be an economic price to pay," Reidy says.



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Rick Reidy, left, and UNT physics professor Dennis Mueller are among those working on a nanotechnology research project. Researchers at Texas Instruments and UNT received \$2.2 million this summer to find a way to build computer chips half the size of those now in use.

"If you want electrons to do something useful, you have to direct them," said Dennis Mueller, a UNT physics professor.

Reidy said: "What you have is a bleed-through of electricity. As you get the wires closer together, the problems are worse, so the insulation has to keep getting better and better."

This is a recurring problem in nanoresearch. The devices have gotten so small that scientists have to figure out ways to handle problems caused by their size.

"When you get down to that level, things stick when they should be slipping, and slip when they should be sticking," said Wade Adams, a nanotech expert at Rice University in Houston.

Sometimes, the components are so small that they just float away, Adams said.

"You can't just put an atom somewhere and expect it to stay there," Adams said.

Finding a tool to handle something several molecules in size without damaging it can be difficult. Even with the right tool, some molecules will stick to the tool.

The process can be so frustrating that some researchers contend that using mechanical tools is a waste of time.

"You cannot use any mechanical force to manipulate molecules," said J.C. Chiao, associate professor of electrical engineering at the University of Texas at Arlington. "You use a laser tweezer. That uses optical force to manipulate molecules."

Others disagree.

"Clearly people are doing it," Mueller said, describing an early demonstration in which scientists at IBM used mechanical tools to drag xenon atoms that spelled out the company logo.

Nanotechnology was first popularized by science fiction writers. In the movie *Fantastic Voyage*, a miniature submarine injected into a man propelled itself through his bloodstream.

Chiao said he does not expect anything so extraordinary to come out of nanotechnology research anytime soon.

"We will see gradual improvements or enhancements in our daily lives, but not anything dramatic," Chiao said. "Before we actually have the sci-fi machines, a lot of things will have to happen along the way. I would say that robots that will be able to clean away the plaque from your bloodstream will not be available anytime soon."

The technology has shown promise. Smaller components can mean smarter machines. If you double the electronics that make your laptop computer useful, and it still fits in the same 10-pound package, the result is a more powerful computer, Chiao said.

That smarter computer would also use less energy than the older model, because the smaller the components, the less energy they need, Chiao said. Some researchers envision a day when complex devices might even be powered by body heat or solar energy.

Nanotechnology is a globally competitive endeavor that is attracting billions of dollars in investment.

The United States is planning to spend about \$800 million on nanotechnology research next year, but Japan is spending about \$1 billion this year, said James Von Ehr, chief executive officer and founder of Zyvez.

Texas is listed No. 5 in the nanotechnology business among states, but the state is at the bottom of the list in investment, said Von Ehr, who is also president of the Texas Nanotech Initiative, a consortium of universities and businesses promoting the industry.

"We are in a position to be among the leaders in the technology, but we will not stay there indefinitely," Von Ehr said. "This is a very aggressive field right now, and staying in the top five will be very difficult if we don't continue to invest. It may be that we decide that the future is somewhere else. But I'll be very disappointed if that happens."

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