The Mercury News
MercuryNews.com

Stanford scientists discover a possible successor to silicon

By Lisa M. Krieger
Mercury News

Posted: 06/15/2009 06:44:59 PM PDT

Updated: 06/17/2009 02:24:18 AM PDT

Related section

- More science news and video

Physicists at Stanford University have identified an important new trait of a chemical compound that could become an heir to silicon, perhaps transforming the computing industry.

The researchers found that electrons in a chemical compound called bismuth telluride have a unique property: They can travel without resistance, losing no energy. This suggests that there might be a new way to carry more information than silicon-based chips can handle.

It is one of many competing ideas in the search for new tools that could accelerate the development of even smaller, cheaper and more powerful computers.

"We're at the very beginning of understanding this new class of materials," said lead investigator Yulin Chen of Stanford Institute for Materials & Energy Science. "The next step is to apply what we've learned — to see if it can be fabricated and made functional."

Engineers have been doubling the number of components that fit on a piece of silicon, called a chip, every two years. This miniaturization trend, dubbed "Moore's Law," has produced modern computers that are enormously more powerful than their predecessors.

But soon the industry may hit a wall because there are limits to what silicon can do.

Scientists are exploring several different possible successors. One is optical computing, which relies on photons rather than electrons. Another is nanochemistry using tiny chemical processes.

The new discovery at the SLAC National Accelerator Laboratory uses electronic spin to carry information, part of a new field called spintronics.

Spintronics takes electronics down to the quantum level. Because electrons don't just carry charge — they also carry an "up" or "down" spin, which can be read as a binary pattern — they can be used to store information.

When voltage is put on top of Stanford's new material, electronics flow without resistance. This approach to energy flow means lower power use and makes it possible for smaller devices to process information.

Stanford scientists had speculated the bismuth telluride had this unique characteristic. But its unique property, called topological insulation, was finally revealed by using X-rays from the Stanford Synchroton Radiation Light Source at SLAC and the Advanced Light Source at Lawrence Berkeley National Laboratory. Their findings are published online in the June 11 issue of the journal Science Express.

However, the material — shiny, reflective and black, grown in special campus furnaces — can only carry small currents so it is not yet applicable.

The Mercury News
MercuryNews.com

But it could pave the way for a paradigm shift in microchip development, according to team member Xiaoliang Qi.

"This could lead to new applications of spintronics, or using the electron spin to carry information," Qi said. "I'm optimistic it can lead to new devices, transistors and spintronics devices."

But Dag Spicer, senior curator of the Computer History Museum in Mountain View, was cautious in interpreting the significance of the finding.

"It's exciting to think about potential applications for a new discovery — but such ruminations are often devoid of common-sense factors like economics, training, consumer desire, manufacturability and so on," Spicer said. "Silicon has had its death knell sounded for the last two decades."

Contact Lisa M. Krieger at lkrieger@mercurynews.com or 408-920-5565.