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FinFETs Promise Smaller Mobile Devices
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Will smartphones continue to become smaller and more powerful in the years ahead, or will the limits imposed by traditional semiconductor technology stall progress?

Purdue University researchers are working on a new type of transistor that uses a finlike structure instead of a conventional flat design. The new design may someday allow engineers to create faster and more compact electronic components, allowing the development of more powerful mobile devices within ever-smaller form factors.

The new fin-style transistors, called finFETs (for "fin field-effect-transistors"), aren't based on silicon like conventional transistors but on a material called indium-gallium-arsenide. Led by Peide Ye, an associate professor of electrical and computer engineering, the Purdue researchers are the first to create finFETs using a technology called atomic layer deposition. Because atomic layer deposition is commonly used in industry, the new finFET technique may represent a practical solution to the approaching limits of conventional silicon transistors. "We have just demonstrated the proof of concept here," Ye says.

New technologies will be needed for industry to keep pace with Moore's law, an unofficial rule stating that the number of transistors on a computer chip doubles about every 18 months. Doubling the number of devices that can fit on a chip translates into a similar increase in performance. But it's becoming increasingly difficult to continue shrinking electronic devices made out of conventional silicon-based semiconductors.

Besides making smaller transistors possible, finFETs also might conduct electrons at least five times faster than conventional silicon transistors. "The potential increase in speed is very important," Ye says. "The finFETs could enable industry to not only create smaller devices, but also much faster computer processors."

Transistors contain critical components called gates, which enable the devices to switch on and off and to direct the flow of electrical current. In today's chips, gate length is about 45 nanometers, or billionths of a meter. The semiconductor industry currently plans to reduce gate length to 22 nanometers by 2015. However, further size reductions and boosts in speed are likely not possible using silicon, meaning new designs and materials will be needed to continue progress.

Indium-gallium-arsenide is among several promising semiconductor alloys being studied to replace silicon. Such alloys are called III-V materials because they combine elements from the third and fifth groups of the periodic table. Creating smaller transistors will also require finding a new type of insulating layer necessary for the devices to switch off. As gate lengths are made smaller than 22 nanometers, the silicon dioxide insulator used in conventional transistors fails to perform properly and is said to "leak" electrical charge.

One potential solution to the leaking problem is to replace silicon dioxide with materials that have a higher insulating value, or "dielectric constant," such as hafnium dioxide or aluminum oxide. The Purdue researchers have done this by creating finFETs that meld an indium-gallium-arsenide fin with a so-called "high-k" insulator.

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 The preceding article was written by John Edwards, a freelance technology writer based in Gilbert, Arizona. He can be reached by phone at +1-480-854-0011.

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