IBM To Ditch Silicon For Carbon Nanotubes To Make Ultra-Powerful, Ultra-Efficient 1.8-Nanometer Chips

www.techtimes.com/articles/90658/20151003/ibm-to-ditch-silicon-for-carbon-nanotubes-to-make-ultra-powerful-ultra-efficient-1-8-nanometer-chips.htm

IBM is paving the way into a future of non-silicon electronics with a research breakthrough that allows Big Blue to develop faster, smaller chipsets with 1.8-nanometer nodes.

(Photo : Sean Gallup | Getty Images)

IBM has revealed a new semiconductor technology that it says will allow it to develop faster, smaller transistors down to the 1.8-nanometer node by using carbon nanotubes to replace the traditional silicon-based chips used today.

Big Blue's announcement could pave the way into a future without silicon in our gadgets. Silicon, which has long been used to create transistors for humongous mainframes to the tiny wrist-based computers we call smartwatches, is nearing its physical limit, so much so that Moore's Law might finally meet its end.

Moore's Law, which was created by Intel founder Gordon Moore half a century ago, states that chips will double the number of transistors every 18 months or so. For the past five decades, chipmakers and electronics manufacturers have relied on the stability of Moore's Law to deliver better, faster and cheaper computers, but as the semiconductor industry realizes it can't make silicon transistors any smaller, it has to look to other materials to delay the demise of Moore's Law.

IBM believes carbon nanotubes, which the company has previously discovered to be excellent material for moving electrons at dimensions less than 10 nm, or 10,000 times thinner than a strand of human hair, is the answer.

"These chip innovations are necessary to meet the emerging demands of cloud computing, Internet of Things and Big Data systems," says Dario Gil, vice president of Science & Technology at IBM Research, in a statement.

Although carbon is one of the most promising candidates to replace silicon because it can move electrons 10 times as fast, shrinking carbon transistors increases electrical resistance in contacts-the valves through which electrons move from metal into the channels-thus compromising the performance of the chip. However, by using a new process called "end-bonded contact scheme," IBM has found a way to shrink the size of contacts below 10 nm without affecting the performance of carbon nanotube chips.

IBM says the process is akin to microscopic welding. By binding molybdenum to the end of a single-atom carbon nanotube, IBM has discovered a new way to bring transistors as close as 3 nanometers. In the future, the company says its technology can scale to develop ultra-fast, ultra-small and ultra-efficient 1.8-nanometer semiconductors. The current crop of advanced chipsets have transistors 11 to 14 nanometers apart.

Wilfred Haensch, senior manager of Physics & Materials for Logic and Communications, uses a parking lot as an analogy to explain the technology. Haensch describes a parking space that is too tightly packed next to other spaces that passengers have difficulty getting out the door of their cars. A possible solution would be to widen the spaces, but that would limit the number of cars the parking lot can contain.

Instead of changing the spaces, however, IBM proposes to change the design of the cars, specifically the car doors, which stand for the contacts in the transistors. Instead of designing doors that open out to the sides, IBM says to have sliding doors instead. This way, cars can still park close to each other without making it difficult for people to get in and out of them.

"We changed the architecture of the contacts, which means we went from hinged doors to sliding doors," Haensch says. "And this allows us to be independent from the contact resistance, or the difficulty of the electrons to get into the device, independent of the contact size. So this is really the breakthrough here."

In simulations, IBM says simply using carbon nanotubes instead of silicon for its microprocessors can deliver "significant" improvements in performance or energy efficiency. However, the first 3-nanometer applications of the technology is not expected to arrive until 2020, with the 1.8-nanometer chips still four technology generations away after that.