Silicon breakthrough could lead to new high-performance bendable electronics

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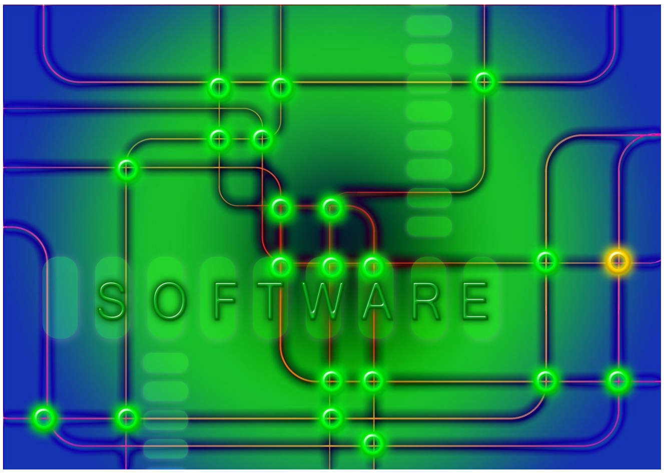

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A new method of creating bendable silicon chips could help pave the way for a new generation of high-performance flexible electronic devices.

In two new papers, University of Glasgow engineers describe how they scaled up the established processes for making flexible silicon chips to the size required for delivering high-performance bendable systems in the future, and discuss the barriers which will need to be overcome in order to make those systems commonplace.

In the first paper, published in the journal Advanced Electronic Materials, researchers from the University's Bendable Electronics and Sensing Technologies (BEST) show how they have been able to make for the first time an ultrathin silicon wafer capable of delivering high-performance computing while remaining flexible.

Flexible electronics have many potential applications, including implantable electronics, bendable displays, wearable technology which can provide constant feedback on users' health. The BEST group has already made significant progress in wearable technology, including a flexible sensor and accompanying smartphone app which can provide feedback on the pH levels of users' sweat.

Professor Ravinder Dahiya, the head of the BEST group, said: "Silicon-based circuits have advanced in complexity with remarkable speed since their initial development in the late 1950s, making today's world of high-performance computing possible.

"However, silicon is a brittle material which breaks easily under stress, which has made it very difficult to use in bendable systems on anything other than the nano-scale.

"What we've been able to do for the first time is adapt existing processes to transfer wafer-scale ultrathin silicon chips onto flexible substrates. The process has been demonstrated with wafers four inches in diameter, but it can be implemented for larger wafers as well. In any case, this scale is sufficient for manufacturing ultra-thin silicon wafers capable of delivering satisfactory computing power."

The team's paper outlines the techniques they have developed to transfer several different types of ultra-thin silicon chips of around 15 microns in thickness onto flexible substrates—a human blood cell, for comparison, is about five microns in width.

In the second paper, published in the journal *NPJ Flexible Electronics*, Professor Dahiya and his team offer an examination of the current state of the art in flexible electronics – an area of industry which is projected to be worth $300 billion by 2028.

They identify the current research questions which need be answered before flexible electronics can reach the levels of computing, data handling and communication performance expected from modern devices.

Professor Dahiya added: "There have been many breakthroughs in the development of flexible electronics in recent years, and the technology is developing quickly, but there are still significant issues which need to be overcome to help systems like our ultrathin silicon wafers provide the kind of performance the market expects.

"We hope that our paper provides a valuable overview of the areas which still require research, and we're committed to helping to push the sector forward with our own research."

"Ultra-Thin Chips for High-Performance Flexible Electronics" is published in *NPJ Flexible Electronics*.

More information: Shoubhik Gupta et al. Ultra-thin chips for high-performance flexible electronics, *npj Flexible Electronics* (2018). DOI: 10.1038/s41528-018-0021-5

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