



HOME | SCIENCE NEWS | COMPENDIUM | RESOURCES | SC BLOG |  
 Physics | Chemistry | Geology and palaeontology | Biology | Environment | Astronomy | Health |

## A novel form of stretchable silicon integrated circuit can wrap around complex shapes



Science Centric | 28 March 2008 16:55 GMT

### Integrated Circuit Design

Download Integrated Circuit (IC) Technical Papers Free, Try Now!  
[www.Mentor.com](http://www.Mentor.com)

### Silicon Manufacturer

Learn How Silicon Manufacturer Aids Alternative Energy in Michigan  
[www.dowcoming.com](http://www.dowcoming.com)

### Get Integrated Circuits

Use Our Quick Parts Search Stock Items Ship Same Day!  
[www.cci-inc.com](http://www.cci-inc.com)

### Silicon Wafer Processing

For 31 years, Semi Dice has been a world leading bare die distributor.  
[www.SemiDice.com](http://www.SemiDice.com)

Ads by Google

Scientists have developed a new form of stretchable silicon integrated circuit that can wrap around complex shapes such as spheres, body parts and aircraft wings, and can operate during stretching, compressing, folding and other types of extreme mechanical deformations, without a reduction in electrical performance.

'The notion that silicon cannot be used in such applications because it is intrinsically brittle and rigid has been tossed out the window,' said John Rogers, a Founder Professor of Materials Science and Engineering at the University of Illinois.

'Through carefully optimised mechanical layouts and structural configurations, we can use silicon in integrated circuits that are fully foldable and stretchable,' said Rogers, who is a corresponding author of a paper accepted for publication in the journal *Science*, and posted on its Science Express Web site.

The new designs and fabrication strategies could produce wearable systems for personal health monitoring and therapeutics, or systems that wrap around mechanical parts such as aircraft wings and fuselages to monitor structural properties.

In December 2005, Rogers and his U. of I. research group reported the development of a one-dimensional, stretchable form of single-crystal silicon with micron-sized, wave-like geometries. That configuration allows reversible stretching in one direction without significantly altering the electrical properties, but only at the level of individual material elements and devices.

Now, Rogers and collaborators at the U. of I., Northwestern University, and the Institute of High Performance Computing in Singapore report an extension of this basic wavy concept to two dimensions, and at a much more sophisticated level to yield fully functional integrated circuit systems.

'We've gone way beyond just isolated material elements and individual devices to complete, fully integrated circuits in a manner that is applicable to systems with nearly arbitrary levels of complexity,' said Rogers, who also is a researcher at the Beckman Institute and at the university's Frederick Seitz Materials Research Laboratory.

'The wavy concept now incorporates optimised mechanical designs and diverse sets of materials, all integrated together in systems that involve spatially varying thicknesses and material types,' Rogers said. 'The overall buckling process yields wavy shapes that vary from place to place on the integrated circuit, in a complex but theoretically predictable fashion.'

Achieving high degrees of mechanical flexibility, or foldability, is important to sustaining the wavy shapes, Rogers said. 'The more robust the circuits are under bending, the more easily they will adopt the wavy shapes which, in turn, allow overall system stretchability. For this purpose, we use ultrathin circuit sheets designed to locate the most fragile materials in a neutral plane that minimises their exposure to mechanical strains during bending.'

To create their fully stretchable integrated circuits, the researchers begin by applying a sacrificial layer of polymer to a rigid carrier substrate. On top of the sacrificial layer they deposit a very thin plastic coating, which will support the integrated circuit. The circuit components are then crafted using conventional techniques for planar device fabrication, along with printing methods for integrating aligned arrays of nanoribbons of single-crystal silicon as the semiconductor. The combined thickness of the circuit elements and the plastic coating is about 50 times smaller than the diameter of a human hair.

Next, the sacrificial polymer layer is washed away, and the plastic coating and integrated circuit are bonded to a piece of prestrained silicone rubber. Lastly, the strain is relieved, and as the rubber springs

### Similar

[circuit, deformations, device, electrical, electronic, silicon](#)

LATEST MOST POPULAR ARCHIVE

FLAMES instrument leave astronomers in a spin  
 STEREO spacecraft snaps first footage of a solar tsunami  
 Algae could be major hydrogen fuel source  
 Chemo-induced anaemia ups risk of local breast cancer recurrence  
 Drug does not appear to reduce risk of heart attack following CABG surgery  
 Mixed results for weight loss drug on slowing progression of coronary disease  
 NASA launches airborne study of Arctic atmosphere and air pollution  
 The evolution of Venus: first too fast, then too slow  
 Research finds majority of US physicians favour national health insurance  
 Integrating genetic information with breast cancer risk factors may help refine prognosis  
 Physical activity delays onset of Huntington's in mouse model  
 Poor kids four times as likely to be seriously injured on roads as rich kids  
 New research shows that lower food intake has a negative effect on immune system  
 'Programmed' oligonucleotides with three branches organise themselves into dodecahedra  
 Researchers reshape Y chromosome haplogroup tree gaining new insights into human ancestry  
 Creatinine increase in elderly means increased renal disease

[More recent stories...](#)

Paired earthquakes separated in time and space  
 Research suggests why scratching is so relieving  
 Scientists discover new species of giant elephant-shrew  
 Columbus launch set for 7 February  
 Asteroid 2007 TU24 zooms by Earth  
 Genesis of adult leukaemia mapped  
 Chemists track how drug changes, blocks flu virus  
 Lost City pumps life-essential chemicals at rates unseen at typical black smokers  
 ASU professor helps solve mystery of glassy water  
 Diabetes makes it hard for blood vessels to relax  
 Asteroid 2007 TU24 to make rare close flyby of Earth  
 Using flower power to fight foot woes  
 Scientists achieve major genetics breakthrough  
 Training on the correct way to lift heavy objects does not prevent back pain  
 Experience, not genetics, affects the brain responses of musicians  
 Electricity from a thin film

2007

— [I](#) [II](#) [III](#) [IV](#) [V](#) [VI](#) [VII](#) [VIII](#) [IX](#) [X](#) [XI](#) [XII](#)

2008

— [I](#) [II](#) [III](#)

back to its initial shape, it applies compressive stresses to the circuit sheet. Those stresses spontaneously lead to a complex pattern of buckling, to create a geometry that then allows the circuit to be folded, or stretched, in different directions to conform to a variety of complex shapes or to accommodate mechanical deformations during use.

The researchers constructed integrated circuits consisting of transistors, oscillators, logic gates and amplifiers. The circuits exhibited extreme levels of bendability and stretchability, with electronic properties comparable to those of similar circuits built on conventional silicon wafers.

The new design and construction strategies represent general and scalable routes to high-performance, foldable and stretchable electronic devices that can incorporate established, inorganic electronic materials whose fragile, brittle mechanical properties would otherwise preclude their use, the researchers report.

'We're opening an engineering design space for electronics and optoelectronics that goes well beyond what planar configurations on semiconductor wafers can offer,' Rogers said.

The work was funded by the National Science Foundation and the U.S. Department of Energy.

Source: [University of Illinois at Urbana-Champaign](#)

**Analog mixed signal ASIC**

Your complex analog & mixed signal ASIC design specialists  
[www.LinearChip.com](http://www.LinearChip.com)

**Semiconductor Training**

Full Service Semiconductor Training Books - Videos - Seminars  
[www.semiconductorservices.com/](http://www.semiconductorservices.com/)

**Prototype PCB Assembly**

24 hour turn, Full-service, RoHS Online instant quote and order  
[www.screamingcircuits.com](http://www.screamingcircuits.com)

**Fused Silica Wafer**

Cast Fused Silica Wafers Use for Thermal Shock Applications  
[www.Ceradyne-Thermo.com](http://www.Ceradyne-Thermo.com)



Ads by Google

**Leave a comment**

The details you provide on this page will not be used to send unsolicited e-mail, and will not be supplied to a third party!

Your name

Your e-mail

Comment

**SEND**

The last 4 —

**FLAMES instrument leave astronomers in a spin**

— A surprising analysis of material churned up from the depths of massive stars shows that the mixing processes in these hot, bright stars are much more complicated... — [full story](#)

**STEREO spacecraft snaps first footage of a solar tsunami**

— Images from the twin STEREO spacecraft show, for the first time, a solar tsunami blasting its way through the Sun's lower atmosphere. The discovery will be presented... — [full story](#)

**Algae could be major hydrogen fuel source**

— As gas prices continue to soar to record highs, motorists are crying out for an alternative that won't cramp their pocketbooks. Scientists at U.S. Department of... — [full story](#)

**Chemo-induced anaemia ups risk of local breast cancer recurrence**

— Patients with breast cancer who developed anaemia during chemotherapy had nearly three times the risk of local recurrence as those who did not, according to a study... — [full story](#)

[More](#) recent stories...

WWW Search |

powered by Google

Science Centric

— Info source in the field of natural sciences, breaking news, compendium, resources

[Front page](#) | [News](#) | [Compendium](#) | [Resources](#) | [SC Blog](#) | [Site map](#) | [Accessibility](#) | [About us](#) | [Contact us](#) | [RSS feeds](#)

Net Empire Group — [Free Photo World](#) · [Lepidopterology.com](#)

Copyright © 2008 Net Empire. [Terms of use](#) and [Privacy policy](#) are applicable to you. All rights reserved.