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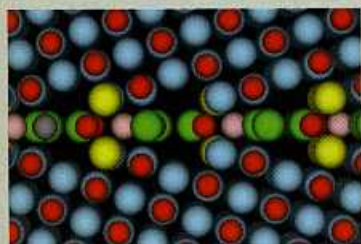
307 QUANTUM INFORMATION

The conundrum of secure positioning
Quantum attempts to prove a person's exact spatial position
Gilles Brassard

MATERIALS SCIENCE

Whole grain

Atomic resolution of grain boundaries in a polycrystalline solid. **PAGE 380**



ON THE COVER

Flying high



A blow-fly (*Calliphora* sp.) takes to the air. The *spalt* gene determines flight muscle fate during development in insects separated by 280 million years of evolution and *spalt* may also determine fibrillar stretch-activated muscle fate in vertebrates. **PAGE 406**

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X Yang, Z Ren, J Kuk & K Moffat



NEUROSCIENCE

Ion channel

Texas coral snake toxin opens new avenues in pain research. **PAGE 410**

SILICON ELECTRONICS AND BEYOND

REVIEWS

310 Multigate transistors as the future of classical metal-oxide-semiconductor field-effect transistors

After several decades of miniaturizing the silicon transistor, its conduction channel has become so short that the electrical characteristics of the device are degraded. One strategy to tackle this roadblock is to abandon the planar configuration that has ruled for decades and make use of electrodes that are wrapped around several sides of the conduction channel to improve electrostatic control and, therefore, the overall electrical performance.

Isabelle Ferain et al.

317 Nanometre-scale electronics with III-V compound semiconductors

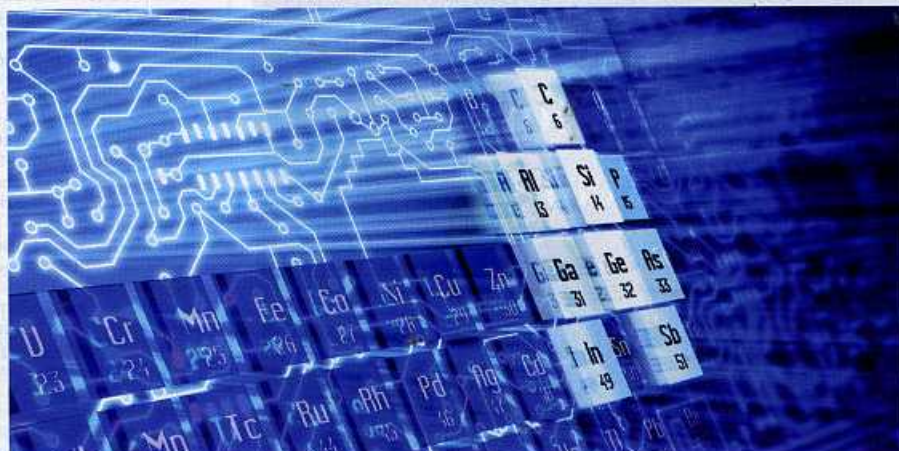
The scaling down of the silicon transistor is approaching its endpoint, and the semiconductor electronics industry is looking to other materials to improve computer performance. III-V compound semiconductors are already familiar in the industry because of their use in high-frequency analog electronics, and research is under way to exploit these materials for logic applications. This approach is promising, but there are practical challenges to overcome before III-V materials can become the basis for a new semiconductor electronics approach.

Jesús A del Alamo

324 Academic and industry research progress in germanium nanodevices

Before silicon took over, germanium was the main material used in the early stages of the transistor. Now, more than half a century later, the industry is re-investigating germanium because of its distinct advantage over silicon. Germanium could be the basis, probably with III-V compound materials, for a new semiconductor electronics approach that offers higher speed and lower power consumption than silicon-based electronics.

Ravi Pillarisetty

**329 Tunnel field-effect transistors as energy-efficient electronic switches**

The next generation of transistors could offer a range of new functionalities targeted at specific applications. One possible strategy, for ubiquitous, mobile computing applications, would be to focus on low-power consumption, rather than high performance and speed. The development of tunnel field-effect transistors is a promising approach, because they operate as a switch in a fundamentally different way from conventional transistors.

Adrian M Ionescu & Heike Riel

338 A role for graphene in silicon-based semiconductor devices

With its unique electronic and optical properties, graphene could fulfil various roles in enhancing and adding function to conventional silicon-based electronics. Of particular interest are graphene's high charge-carrier mobility and strong interaction with

photons, which makes the material of significant interest for high-speed electronics and optical modulators. There are a number of design and fabrication strategies, based on hybrid silicon-graphene devices, to realize such applications.

Kinam Kim et al.

345 Embracing the quantum limit in silicon computing

As silicon transistors continue to shrink in size, quantum effects begin to play a part in their operation. Redesigning the transistor so that it operates using quantum rules opens up a richer and more powerful way of computing. Silicon is a particularly attractive platform for this purpose because it is possible to design quantum bits based on electron spins that are relatively robust to information loss.

John J L Morton et al.



Spin control with a magnetic field. PAGE 349

PERSPECTIVE

354 Environmental effects of information and communications technologies

Concerns over the environmental sustainability of technological progress are becoming ever more urgent. It therefore seems imperative to consider the environmental implication of any emerging technology. These include implications for microelectronics, both direct and indirect, and their complex interactions with industry and society.

Eric Williams