Technology: Competitive & Complementary

Nanotubes improve solar

Universities of Bologna,Trieste and Notre Dame researchers have found a way to alter carbon nanotubes so they can separate electrical charges efficiently, leading to better solar cells.

Researchers attached ferrocene molecules to the wall of every hundredth nanotube in a mass of nanotubes. The molecules contain two flat carbon rings, sandwiching an iron atom. When light hits the altered nanotubes, the ferrocene molecules give up electrons, which are absorbed by the nanotubes.

Electrons are then diverted tint oa useful flow electricity. The researchers are working on adding light collectors like dyes to nanotubes. This could be used in practical applications in 10-20 years, say researchers.

Taiwan interest in SOI

Soitec reaffirmed its commitment to support and help Taiwanese foundries move from R&D to device production at the 90-nm node using SOI wafers.

Key to this, Soitec, and its partner Soisic, the first to focus solely on SOI IP and design technology, are to develop the infrastructures and design kits to respond to their fabless customers' demands for SOI substrate for next-G devices.

"Soitec is witnessing increasing interest in SOI technology among Taiwanese foundries. As these begin their move toward the production of thenext-generation products, they are realising that SOI can help address the increasingly stringent process performance requirements associated with manufacturing advanced devices," said Michael Wolf, Soitec's VP marketing and sales.

QHE key to spin electronics and quantum computing

Researchers Shuichi Murakami, University of Tokyo and Shoucheng Zhang, Stanford University may have discovered a spin current associated with holes rather than electrons in semiconductors. The predicted current would be able to inject spin momentum into quantum dots and would interact with conventional electron currents, bridging electronics and spin-based quantum circuits.

The spin current is completely reversible, minimising power dissipation, and does not need liquid-helium temperatures or a magnetic field. Manipulating the spin of electrons in QD has become a major move in the attempt to build quantum computers.

Predictions for the 3-D boundary of a four-dimensional QHE liquid are specific. A particular band structure, found in Si, Ge and GaAs and some other compounds is needed to support the 3-D model. Holes have been ignored in spintronic studies having a short coherence lifetime.

The new theory predicts that in the spin current region, the holes can sustain coherence indefinitely, only disturbing equilibrium when they reach a boundary.

The predicted effect critically depends on spin-orbit coupling, which is very weak with electrons but strong for holes. Although currently the work is theoretical , Murakami and Zhang are proposing experiments to detect it, based on their analysis.

Parallel micros bypass failures

UK based picoChip Design's new PC101 is a huge parallel device integrating 430 16-bit processors on a single die. Resources are so abundant that they are expendable and the chip's internal bus fabric can bypass a few processors ruined in manufacture Designed for cellular-telephony and wireless-network base stations, the PC101 is the first execution of picoChip's picoArray architecture based on a three-field long instruction word (LIW), but with greater execution resources than other LIW or VLIW processors. PicoChip believes massive parallelism is the best approach for the compute-intensive tasks of wireless communications, because it can deliver high performance at low clock speeds, saving power. In addition, dividing a complex application into parallel tasks is well suited for large-team software development projects. TSMC is to manufacture the PC101 in a 0.13-micron, eight-layer-metal, digital CMOS process, packaged in a 528-pin BGA. Samples are available now. Volume production begins 1Q 2004.

Protein circuitry

A new research project is underway in Japan. Matsushita Electric Industrial Co, the Tokyo Institute of Technology, the Nara Institute of Science and Technology and Osaka University have joined forces to develop a large-capacity memory device that uses protein circuitry. Proteins aggregate in predictable ways under certain conditions. The research team will exploit this. The memory of the planned device will be comparable to that of top-level silicon devices which can store 8Gb/cm2 of data. However, protein circuitry will consume just 1% of the power requirement of the silicon memory device. The Japanese Government is funding the research effort with ¥4bn over five years.

Keeping quantum simple

The basic component of quantum computers, the qubit, is made from an atom or sub-atomic particle. Quantum computers require that qubits exchange information, which means interactions must be precisely controlled. UK researchers at University of Oxford and University College London, propose a type of quantum computer that could greatly simplify the way qubits interact.

The plan allows qubits to be constantly connected to each other instead of repeatedly connected and disconnected, and it allows a computer's qubits to be controlled all at once so they do not have to be wired separately. This simplification is made possible by using qubits that contain three constantly interacting electrons, rather than a pair of electrons and an electrode. When the energetic state of the middle electron matches the others, the other two can exchange energy to produce an "on" signal.

Tessera signs licensing agreement with Cochlear

Cochlear Limited has signed an agreement licensing Tessera's semiconductor packaging technology for use in Cochlear's Nucleus implant system, which includes implantable hearing devices designed to allow individuals with severe to profound hearing loss to perceive sound.

Cochlear plans to incorporate Tessera's MicroBGA technology into its Nucleus cochlear implant systems. The MicroBGA technology, enables highly reliable, small form factor electronic products and is logical for medical applications where reliability and compact size are key requirements.

"Tessera's technology has been integrated into a range of consumer electronic products such as cellular phones, personal computers, and gaming stations," said Nicholas Colella, Tessera's senior VP of operations.

Included in Tessera's license with Cochlear are over 150 patents covering Tessera's Compliant Chip technology. This covers a broad range of chip-scale and multi-chip package types, including integrated circuit devices packaged in "face-down," "face-up," "fold-over," "stacked," and "system-in-package" (SiP) formats.

Tessera's intellectual property is used in many forms of advanced packaging, covering a wide range of materials and assembly processes.

Scanning Scandium

Researchers at the University of Arkansas and the College of William and Mary discovered that growing atomic layers of certain materials on a semiconductor surface creates a strain inducing a large energy conversion and emits light in the entire range of the visible spectrum. This could be used to design new multifunctional materials exhibiting both properties.

By "compressing" or straining the semiconductor Scandium nitride (ScN) at the atomic level, University of Arkansas physicist, Vivek Ranjan, Laurent Bellaiche, associate professor of physics and Eric J. Walter, College of William and Mary, show that the material goes through optical changes that take it through the visible spectrum.

As the ScN compound mechanically "compresses" itself to match a smaller atomic surface, it also changes from nonpolar to polar, exhibiting a piezoelectric response characteristic of ferroelectric materials.

The researchers plan to investigate other semiconductors to see if the same circumstances produce similar effects. As they believe other semiconductors will have this characteristic.

Single electron motion sensor

Researchers from the University of California at Santa Barbara have combined a single electron transistor and a nano-mechanical beam, which is a microscopic, vibrating cantilever. The SET, is very sensitive to electrical charge. The researchers put the SET very close to the nano-mechanical beam and put voltage through the resonator. The voltage made the beam vibrate, and the vibrations affected the way single electrons passed through the transistor. Displacement, or how much an object has moved, can be inferred from this measurement. The researchers are currently working on making a higher frequency resonator.

Spintronics

Recent successes by a Nottingham University group includes the growth of GaMnAs material with world record Curie temperatures, and ferromagnetic TiCoO2 and GaMnN which shows ferromagnetism at room temperature. A characteristic of the GaMnAs layers grown by the group is their low resistivity that is accompanied by very weak high field magneto-resistance. This has enabled the group to separate the normal and anomalous contributions to the Hall effect and make the first accurate measurements of hole densities across a range of Mn compositions. Using this information the first meaningful comparison of theoretically predicted Curie temperatures and extraordinary Hall conductivities with experiment have been made. The samples were grown by Low Temperature Molecular Beam Epitaxy (LTMBE) technique. The In composition of InGaAs superlattice spacers and InGaMnAs magnetic layers was chosen to be equal to 50% while the Mn concentration was equal to 5.5 % in GaMnAs single layers and 6 % in the magnetic layers of superlattice structures.

http://www.nottingham.ac.uk/unimat/expertise/electronics/ferro.phtml

Ultrasonic enhanced etching

Researchers from Shanghai's Fudan University, have devised a new way to fabricate porous silicon material. The ultrasonically enhanced anodic electrochemical etching is developed to fabricate luminescent porous silicon (PS) material. Samples prepared by the etching method exhibit superior characteristics to those prepared by conventional direct current etching. PS microcavities with much higher quality factors can be fabricated. The improved quality can be ascribed to increased rates of escape of hydrogen bubbles and other etched chemical species from the porous silicon pillars' surface. This process will cause the reaction between the etchant and the silicon wafer to proceed more rapidly along the vertical direction in the silicon pores than laterally.

Silicon forecasts

The leading suppliers of silicon wafers expect year-end wafer shipments for 2003 to be 10 % higher than 2002. The SEMI Silicon Manufacturers Group (SMG) Consensus Forecast, anticipate shipments will increase by 15% in 2004. The Consensus Forecast, obtained through surveying SMG members, who provide 95% of world polycrystalline or monocrystalline silicon and silicon wafers, provides a shipment outlook for 2003 through 2006. The survey forecast results show silicon shipments reaching 5,916m² inches in 2004, surpassing 6,300m² inches in 2005 and 6,600m² inches in 2006. The 300mm wafer shipments are key to anticipated growth, with the SMG expecting 300mm wafer shipments to reach 20% of total shipments by 2006.