Straining opto to piezo

Researchers from the University of Arkansas and College of William and Mary have found that strain can induce changes in the optical, electromechanical and polar properties of a semiconductor material, which could mean one material could be used to serve multiple functions, creating cheap, fast, efficient lasers, cell phones, computers, military sonar devices and medical ultrasound devices. Two classes of compounds of interest are semiconductors with optical properties of use in lasers and computers and ferroelectric materials which convert small changes in mechanical energy into a piezoelectric response.

Researchers find that growing atomic layers of some materials on smaller surfaces creates a strain that induces both a large energy conversion and emits light in the entire range of the visible spectrum. Scandium nitride (ScN) squeezed at the atomic level, goes through optical changes that take it through the width of the visible spectrum. The material also changes from non-polar to polar, exhibiting the leap in piezoelectric response characteristic of ferroelectric materials. The piezoelectric response in this material represents the shape change as the ScN compound forces itself to match atom-for-atom the smaller atomic surface. Research is planned to investigate other semiconductors to see if this trait presents itself, given the same circumstances.

Integrating a micro fuel cell on Si

A research group of the Institute for Microelectronics and Microsystems (IMM) of the National Council of Research (CNR) in Catania, Italy is working to integrate fuel cells and conventional electronic devices on the same silicon chip. By using innovative micromachining processes, based on advanced and smart material engineering, they succeeded in fabricating electrocatalytic porous membranes, with a wide and tunable surface, positioned above a micro-channel system. These processes only consist of surface micromachining, fully compatible with the standard ULSI silicon technology.

The micromachining processes (protected by two patents) starts by the realisation of micro-channels for uniform distribution of oxygen and fuel. Then the electrocatalytic membrane is formed above the micro-channel structure by electrolytic deposition of a catalytic element in a silicon porous structure positioned above the micro-channels. Finally, all the porous layers are impregnated with the polymeric proton-exchange membrane. The expertise of the IMM group in Catania, the sophisticated instrumentation for controlling the electrochemical processes, collaboration with STM, has the group searching for further R&D or venture capital/spin-off funding.

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Shock Waves Tune Light

MIT researchers have used a computer simulation to show that shock waves through photonic crystals could lead to faster, cheaper telecom devices, and more efficient solar cells.

Photonic crystals contain periodic patterns that bend light so that only certain wavelengths can pass through. Researchers showed that when a shock wave moves through a photonic crystal, it temporarily changes the patterns and induces two changes: a large Doppler shift, and a bandwidth narrowing. A shock wave can be produced physically; sound waves or electricity can also produce shock-wave-like effects. The Doppler shift changes the frequency of light waves in a way similar to the familiar pitch change that happens in sound waves when a train goes by. The effect is strong enough that the colour of the lightwave changes visibly, and it can be used to efficiently convert light to frequencies useful for communications devices. The second effect could lead to solar cells that convert more light to electricity. The effects could be used in practical applications in 1-5 years.

SiC coating and Al

A Spanish University has developed a technology for coating SiC particles used as reinforcement in the manufacture of aluminium composites. The coating is composed of a continuous ceramic layer of silicon oxide. This layer behaves as an active barrier that prevents the interfacial reactions between the aluminium and the SiC particles. The group is looking for chemical companies for license or commercial agreements.

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Sumitomo's PLED

Sumitomo Chemical has developed a new blue light-emitting material for polymer light emitting diodes (PLED). The material has also achieved a chromaticity and the 10,000-hour service life level necessary for commercial use. Compared to organic LEDs, PLEDs require a much simpler production process because they are easily applied to flat panel displays by printing, slashing manufacturing costs. This coupled with low energy use, self-luminance that eliminates the need for a backlight, make PLEDs a major future display element. The biggest hurdle to date has been PLED life, at only a few thousand hours.

Sumitomo Chemical has developed a unique new structure, different from phenylene vinylenes and fluorenes, and characterised by light emitted at much closer to pure blue, and capable of maintaining luminance for about 10,000 hours. By applying this technology to red and green light-emitting materials, it intends to develop full-colour display applications by fiscal 2005. Concurrently, it is working to develop a phosphorescent material, a next-generation material following organic LEDs. Based on the new PLED material technology, it is developing a green phosphorescent material that emits light at a low drive voltage of 3.5V, a high level of efficiency not achieved by any other polymer phosphorescent materials. Eventually, this material will be increasingly used for Hi-vision and other large-sized displays.