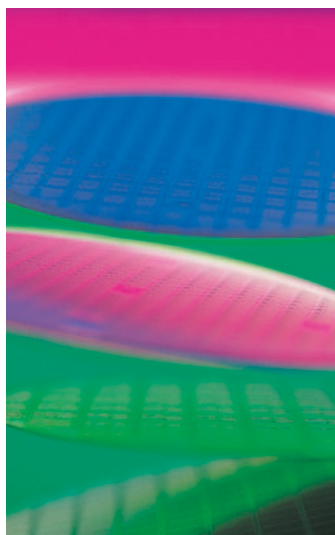


Implanted optics



Separation by implantation of oxygen (SIMOX) is a technique used in the micro-electronics industry to isolate a thin layer of silicon at the surface of a silicon wafer. This is achieved by implanting oxygen ions at a well-defined depth into a pristine silicon wafer followed by high-temperature annealing, which results in a layer of silicon oxide buried within the wafer's bulk. As well as increasing the speed and lowering the power consumption of

microelectronic devices, it also provides a simple and scalable tool for making optical waveguides for photonic and optoelectronic applications (B. L. Weiss *et al.* *IEEE Photonics Technology Letters* **3**, 19–21; 1991). Writing in *Applied Physics Letters*, Prakash Koonath and colleagues at the University of California, Los Angeles, now develop this technique, combining multiple implantation steps and conventional lithographic processing to form multiple waveguide structures at different depths into the surface of a silicon wafer (*Applied Physics Letters* **83**, 4909–4911; 2003). By optimizing their process, they substantially reduce the optical losses often associated with submicrometre waveguides formed using SIMOX. And by creating stacked waveguides at different depths, they demonstrate the feasibility of making complex optical circuitry in three dimensions using standard micro-fabrication techniques.

Investigating exciton dynamics in nanotubes

The recent discovery of fluorescence due to excitons in single-walled nanotubes (M. J. O'Connell *et al.* *Science* **297**, 593–596; 2002) has prompted further exploration of electron–hole and electron–electron interactions in nanotubes. Oleg Korovyanko and colleagues have now investigated the ultrafast dynamics of photoexcitations in films containing both semiconducting and metallic nanotubes (*Physical Review Letters* **92**, 017403; 2004). The researchers find a number of optical transitions from semiconducting nanotubes that cannot be explained by the tight binding model for free charge carriers. However, these optical transitions can be ascribed to photoexcited excitons, as the simultaneous intersubband transitions of electrons and holes allow both linear and angular momentum to be conserved. In metallic nanotubes, the picture is different, and the researchers hypothesize that the primary photoexcitations are free carriers with extremely fast decay. The results highlight the important role of electron–hole and electron–electron interactions in nanotube optics.

Structure regained in supercooled liquid silicon

Despite recent advances in carbon electronics, crystalline silicon still dominates semiconductor technology. The large wafers of silicon used to fabricate electronic devices are grown from the melt, and future techniques for producing silicon chips may involve imprinting of a thin molten layer. The properties of the liquid and supercooled liquid state of silicon are therefore of some importance. But because of silicon's high melting point (1,414 °C) and corrosive nature, measuring the properties of these liquid states has been rather difficult. Using a contactless 'levitation' technique, in which a silicon sample is heated from above and below by two lasers, Noel Jakse and colleagues have now investigated the atomic structure of liquid silicon deep into the supercooled region (*Applied Physics Letters* **83**, 4734–4736; 2003). The researchers find that the coordination number of the liquid phase decreases with temperature into the supercooled region. The tetrahedral structure of the solid phase is also apparent in the supercooled liquid, and the researchers expect a liquid–liquid phase transition to occur at still lower temperatures.

LIQUID-CRYSTALLINE COLUMNS

Columnar liquid crystals with one-dimensional charge carrier mobility along the columns are promising as active components in organic electronics. And although the preparation of these molecules is straightforward and simple, it usually requires multistep synthesis that excludes the addition of useful electro-active functionalities. Klaus Muellen and colleagues at the Max Planck Institute for Polymer Research (Mainz) writing in the *Journal of the American Chemical Society* (<http://dx.doi.org/10.1021/ja037519q>) describe a rational approach to a mesogenic building block for preparing highly ordered discotic liquid-crystalline materials that can be subsequently functionalized by standard transition-metal-catalysed coupling reactions. A remarkable feature of their methodology is that it involves several chemical transformations despite insoluble starting materials or products. This allows functionalization as the final step, thereby broadening the scope of functionalities that may be incorporated, and makes these materials potential candidates for hole-conducting layers in photovoltaics devices, organic semiconducting materials in field-effect transistors, or light-emitting diodes and molecular wires in molecular electronics.

Smart contact lenses for diabetics

Diabetes sufferers are often likely to need sight correction. A contact lens capable of continuously monitoring their glucose level, which they need to keep in constant check, would avoid the need for the frequent finger pricking—the old enzyme-based test performed on a blood droplet. Just like blood, the tear fluid contains glucose and its concentration tracks the blood levels. Based on this notion, researchers at the University of Maryland propose to introduce a fluorescent probe for glucose in commercial contact lenses (R. Badugu, J. R. Lacowicz, & C. D. Geddes *Analytical Chemistry* <http://dx.doi.org/10.1021/ac0303721>). The probe is a boronic acid-containing fluorophore developed by the authors to be sensitive



to the micromolar levels of glucose found in the tear liquid. On binding with glucose, a spectral change detectable through fluorescence spectroscopy occurs. The authors developed a whole range of probes by changing the electron-rich group present in the fluorophore.

Although these probes seem to give a promising response in solution, in the lens their behaviour seems to change, due to the polarity and pH of the lens material. The authors are now aiming to design improved probes to obtain suitable spectral responses to glucose within the lens.