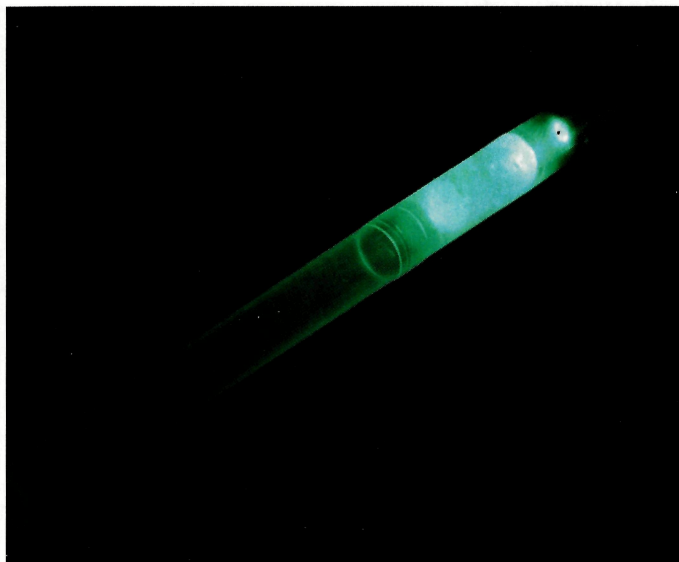


Edited by Archana Sharma

## Magnetism comes out of the blue



*Future memory? A plastic light-tunable magnet developed by Ohio State University and the University of Utah is bathed in green laser light. Blue light induces magnetism while green light erases it. (Jo McCulty, Ohio State University.)*



*Arthur J Epstein (left) and Dusan Pejakovic of Ohio State University's Center for Materials Research demonstrate the use of laser light to tune the strength of their plastic magnet. (Jo McCulty, Ohio State University.)*

A light-sensitive plastic magnet that works at record temperatures has been developed by Ohio State University and the University of Utah, offering new opportunities for light-controlled magnetic materials. The new plastic magnet becomes 1.5 times more magnetic when blue light shines on it. Green light partially reverses the effect. Such magnets have potential for new applications in electronic data storage.

A key factor in enabling commercial applications for this technology is that the magnet functions up to a temperature of 75 K. This temperature, which approaches that of today's high-temperature superconductors, represents an important first step towards future light-based forms of electronics.

The plastic magnet is made from a polymer comprised of tetracyanoethylene (TCNE)

combined with manganese (Mn) ions. The researchers deposited the Mn-TCNE powder into a thin film. After they "charged" the material with an initial 6 h dose of blue laser light, the magnet maintained a higher degree of magnetism – 150% of its normal level – even in the dark.

Green laser light reversed the effect somewhat, by decreasing the material's magnetism to 60% of its normal level. Why should light have this effect? The researchers think the different wavelengths of blue and green light cause the TCNE molecules to change shape in different ways. Once one molecule in the magnet locks into a different shape, its magnetism changes, and it encourages its neighbouring molecules to change shape too.

Scientists and engineers worldwide are working to develop computer data storage

based on light and magnetism. Such magneto-optical systems would theoretically work faster and much more efficiently than traditional electronics. A light-tunable magnet would be a critical component, because it would allow computers to write and erase data magnetically. In a future memory device, information could be encoded in the material as regions of stronger or weaker magnetism, which could be written and erased using tightly focused lasers. This could lead to information storage at very high densities. The organic magnet still has a long way to go, however, before it has the properties demanded of commercial devices.

### Reference

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## Spin-logic gates point to smaller low-power electronic devices

Ever-smaller mobile devices demand progressively more highly integrated and lower-power implementations. A research team from Siemens in Germany and the University of Bielefeld has developed magnetic techniques for a new generation of low-power reconfigurable logic that could open the door to increasing miniaturization.

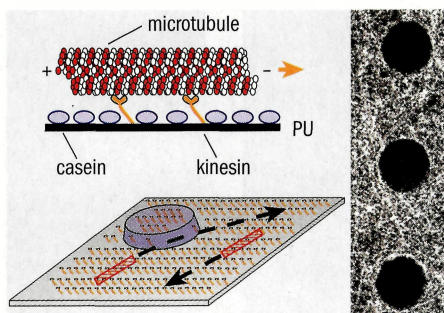
The team used spin-dependent tunnelling structures in which a thin

insulating layer separates two magnetic layers. The degree of quantum tunnelling through the insulator is influenced by the relative orientation of the magnetization in the two layers. These structures have been used to make non-volatile reconfigurable logic elements called spin-logic gates. The non-volatility of the gates allows logic operations to be performed with lower power consumption. *Electronic Engineering Times*

# Nanobot explorers map out new terrain

Just like underground explorers finding their way with head torches, gangs of molecular robots can roam the surfaces of materials, avoiding obstacles and jumping crevices. These roaming nanobots are able to chart surface structure. Researchers at the University of Washington in Seattle have used such nanobots by stacking cylinders of the protein tubulin together to form molecular machines called microtubules. These normally act as scaffolding inside cells, providing a route along which materials are transported by proteins called kinesins.

The Washington team has turned this effect on its head, synthesizing self-propelled nanoscale robots by fixing kinesin molecules all over a surface. The microtubules then propel themselves randomly across the surface. A fluorescent dye added to the microtubules acts as their "head torches", permitting the researchers to track their paths



*Left: kinesin "motors" adsorbed to a surface drive 24 nm microtubules around, allowing the surface to be mapped. Right: this array of 10  $\mu\text{m}$  diameter posts has been imaged by recording the position of several hundred microtubules every 5 s for 2500 s and superimposing their paths.*

as long as the surface being investigated is transparent to the light emitted.

Microtubule nanobots can probe holes,

cavities and pores that cannot be normally seen with a microscope. Their only limitation is steep walls, where they are too rigid for kinesin molecules to guide them. According to the Washington team, custom robots could be designed to study specific aspects of a surface, such as mapping out regions that are hygroscopic. This could help in understanding the structure of porous materials.

The resolution of the Washington nanobots is expected to be around 50 nm. The number and speed (typically 200–250 nm/s) of the robots determines the time taken to explore an accessible surface completely. Superposition of several hundred images enables mapping of the entire surface.

## Reference

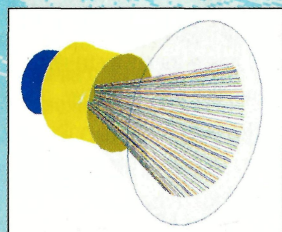
H Hess, J Clemmens, J Howard and V Vogel 2002 "Surface imaging by self-propelled nanoscale probes" *Nano Letters* **2** 113–116.

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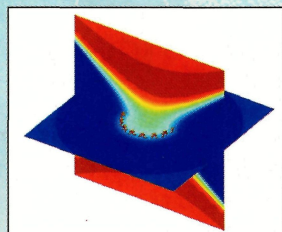
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