Abstractions

LAST AUTHOR

Magnetic resonance imaging is an indispensable medical tool, and produces images of matter by scanning the magnetic fields of a sample's atomic nuclei or electrons. Imaging at the single-molecule level is an unachieved goal that could have new applications such as quantum computing. On page 644, Mikhail Lukin at Harvard University and his colleagues report creating a novel quantum magnetic sensor able to achieve nanometre-scale resolution by manipulating the spin of an individual electron in an impurity in diamond. In a companion paper on page 648, a group led by Jorg Wrachtrup of the University of Stuttgart in Germany uses a similar approach to create an image scanning system. Lukin tells *Nature* that, together, these papers may make a new quantum-imaging device a reality.

How is your 'nanosensor' innovative?

In the past, scientists couldn't get a magnetic sensor in close enough proximity to a magnetic source at such small scale. The fundamental sources of magnetic resonance in molecules are the atomic nuclei, which produce extremely weak magnetic fields and so require a sensor that is small but sensitive. During the past few years we've studied how single spins evolve in diamond and realized two things: first, that single spins act as sensitive probes of their magnetic environment and so can be used as tiny detectors and, second, that we can control these spins very well. By applying quantum-control techniques to a single spin in a diamond nanocrystal, we achieved a sensor with high sensitivity and nanoscale resolution.

How do the papers complement each other?

Combined, these two techniques are a big step towards a long-standing goal of creating quantum devices. We made a nanosensor by controlling individual spins in diamond. Jorg's group showed how a scanning system could use diamond nanocrystals, which contain single spins, for imaging. Together, the techniques may result in a nanometre-scale magnetic-imaging approach.

Will this work have a major impact?

Our sensor should allow the reading, writing and possibly transportation of quantum bits of information encoded in electron or nuclear spin 'memory', which are necessary for quantum computing. And because the sensor works at room temperature, it could be used in living cells or to monitor the structure and dynamics of complex molecules.

Will this work transform your career?

I don't know. I'm extremely intrigued by its range of possibilities, but at the same time the work is only a stepping stone towards practical sensors. ■

MAKING THE PAPER

Gerard Evan

Protein inhibition that puts normal cells on hold but kills cancerous ones.

Gerard Evan knows all about the cancer-promoting properties of the protein Myc. But he couldn't have predicted the result of blocking Myc activity in a living organism. Then a postdoctoral fellow with a nifty tool joined his lab at the University of California, San Francisco. Now, thanks to that innovation, Evan's group has shown that, in mice, inhibition of Myc can reverse cancer with minimal damage to normal tissues — in stark contrast to today's cancer therapies.

Myc functions as a 'super-coordinator' of growth in both healthy tissues and tumours. Cancer researchers generally avoid targeting such 'hub functions' because they are necessary for normal cell function. "You'd kill the tumour, but you'd also kill normal cells," Evan explains.

Myc regulates thousands of genes, and is expressed at high levels in a dysregulated manner in most human cancers. Directly activating Myc in normal tissues causes tumours in mice, and Evan's lab and others have studied such transgenic models in detail. When Myc is switched off in these Myc-induced cancers, the tumours regress. However, such tumours are a special case. "The problem is that most cancers are not driven by activated Myc, they're driven by different mutations in many other cancer-causing genes," says Evan. "In such cancers, Myc itself is typically normal and nobody knew whether it had an important role in tumour maintenance."

Enter postdoctoral fellow Laura Soucek, who had worked extensively with a Myc mutant during her doctoral studies with Sergio Nasi at the University La Sapienza in Rome. This mutant, called Omomyc, acts as a very potent Myc inhibitor. "I was lucky enough to recruit Laura to my lab," says Evan. "She wanted to keep working on this. I thought it was interesting, but didn't really know where it would go. Bless her, she built a mouse in which she could express Omomyc transiently, at will, in all tissues of the animal." The mutated Myc gene could be turned on by giving the mice an antibiotic, and switched off by withdrawing drug treatment.

The researchers tested the effect of Myc inhibition in a mouse model of lung cancer, with only modest hope. At best, Evan says, they suspected Myc inhibition would halt tumour growth. Instead, it eradicated tumours altogether (see page 679).

This was promising, but it seemed likely that Myc inhibition would destroy normal proliferating tissues, such as skin, intestine and bone marrow, as do current chemotherapy and radiation treatments. However, when the group examined these tissues, the effects of Myc inhibition were "dramatic, but surprisingly mild", says Evan. "There was no tissue damage at all. Proliferating tissues just went to sleep." And despite the 'shutdown' of these tissues, the mice appeared generally healthy. Moreover, the effects of Myc inhibition were quickly reversed when drug administration was halted.

In short, the results showed a clear difference between the response of tumour cells and normal cells to Myc inhibition. "That was completely unexpected and so exciting," Evan recalls. His lab is currently extending the work to study Myc inhibition in a variety of mouse cancer models to see whether the phenomenon is a general one.

Evan credits Soucek with the initiative to apply her doctoral tool to a mouse. But most lab heads would have considered that pointless, because of Myc's essential role in many normal tissues. Luckily for Soucek, Evan is not most lab heads. "This was her true love," Evan says. "It was a tool that was looking for a problem." ■

FROM THE BLOGOSPHERE

Can wiki encyclopaedias work better with the guidance of scientists? Citizendium, a next-generation wiki encyclopaedia, hosted Biology Week last week (22–28 September) — an online open house for biologists and biology students to explore contributing to this 'citizens' compendium' (see http://tinyurl.com/4bfwml).

During the week, biologists tested the Citizendium system by writing and editing content about their subject. Editors and authors from the project's Biology Workgroup 'met' new online visitors to show them the ropes. Gareth Leng, a physiologist at the University of Edinburgh, UK, and a Citizendium author and editor, described the project: "Our role will not be to tell readers what opinions they should hold, but to give them the means to decide, rationally, for themselves. The role of experts is critical — not to impose opinions, but to support accuracy in reporting and citing information."

Unlike Wikipedia, Citizendium requires contributors to provide their real names and asks them to sign a 'social contract' to ensure the quality of the content and to prevent vandalism. ■

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