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Nanoparticles allow remote control of cells

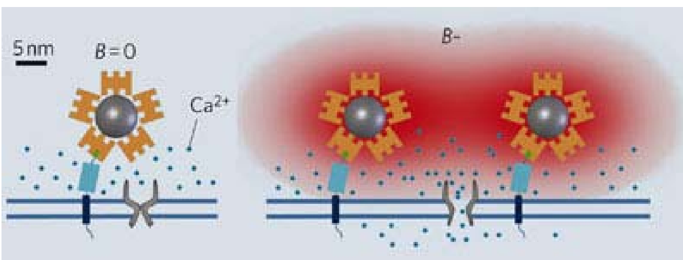
27 June 2010

In an experiment reminiscent of the mind-control rays that featured prominently in B-movies from the 1950s, scientists in the US have used a magnetic field to alter the behaviour of an animal.

The researchers, from University at Buffalo in New York, implanted nanoscale particles of manganese ferrite into the body of the nematode worm *Caenorhabditis elegans*. When the particles were exposed to a radiofrequency magnetic field the particles heated up and the worms changed the direction in which they were moving. By switching the field on and off, the researchers were able to make the worms move back and forth.

Temperature-sensitive fluorescent tags attached to the particles were able to measure the temperature of the nanoparticles, showing that the worms' behaviour changed when the particles reached 34°C - the same temperature at which the animals show heat-avoidance behaviour in nature.

The researchers also attached the nanoparticles to proteins in the membranes of cultured nerve cells by genetically modifying the proteins to bind to the particles. The membranes contain a temperature-sensitive ion channel - a biological 'gate' that can open and close to allow ions to flow across the membrane - which was activated when the nanoparticles were warmed by the magnetic field. This in turn triggered electrical activity in the nerve cells.



The ion channels opened as a result of the localised heating in the nanoparticles caused by the magnetic field

'Our method is important because it allows us to only heat up the cell membrane,' says Arnd Pralle, who led the research team. 'We didn't want to kill the cell: while the membrane outside the cell heats up, there is no temperature change in the cell.'

The highly localised heating that the nanoparticles permit could lead to a number of applications, such as targeting cancer cells, the researchers say. It could also be possible to investigate the effect of local temperature rises on other specific parts of cells and on whole organisms by attaching molecules to the surface of the nanoparticle that home in on specific cellular targets.

Commenting on the work, Jon Dobson from Keele University in the UK, an expert on the use of nanomagnetic particles in biomedicine, says, 'This is an interesting study that adds to the growing cannon of work aimed at remote activation of cellular ion channels using magnetic nanoparticles and applied magnetic fields.' One of the main advantages of this type of approach is that the actuator - the field - does not have to be in physical contact with the target, says Dobson. 'This is a nice example of combining genetic modification with nanomagnetic actuation and demonstrates the possibility of targeting and activating individual, genetically modified cells within a larger cell culture or organism.'

Simon Hadlington

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References

H Huang *et al*, *Nature Nanotechnology*, 2010, DOI: 10.1038/nnano.2010.125

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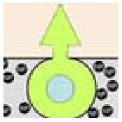

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