Research news

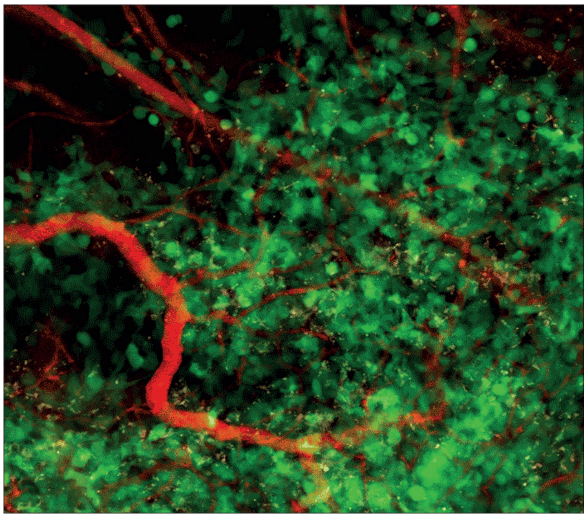
Nanotube-loaded cells target tumours

Single-walled carbon nanotubes (SWCNTs) can be rapidly taken up by white blood cells and delivered directly to tumours, according to a new study by researchers at Stanford University in the US (*Nature Nanotechnology* 10.1038/nnano.2014.62). The surprising discovery could ultimately help fight diseases including cancer, atherosclerosis and diabetes, according to the team. "Our finding points to a novel mechanism of nanoparticle targeting to disease and opens up a whole new area of research in cell-based delivery of nanotherapeutics," says lead author Bryan Ronain Smith.

One of the biggest obstacles confronting nanomedicine is the inefficiency of delivering nanoparticles to desired sites. Smith, however, thinks that his team's approach could in principle be used to treat all types of solid tumours because Ly-6C^{hi} monocytes – a type of white blood cell that is important for the immune system – naturally enter cancerous tissue and deposit their nanoparticle load there. "[It's] rather like a Trojan horse," says Smith.

The Stanford team made the discovery while investigating how SWCNTs interact with tumours in live mice. Using intravital microscopy, the researchers observed that the mice cells "gobbled up" nanotubes that were circulating in the bloodstream. On analysing blood samples, it became clear that of all the many different types of cells in blood only Ly-6C^{hi} monocytes took up nanotubes to any degree.

The team also found that by targeting ligands called RGD peptides conjugated to the nanotubes, the number of SWCNT-loaded monocytes reaching a tumour was significantly enhanced. Although the mechanisms behind this increased uptake are not yet known, experiments suggest that the peptides remain on the monocyte surface after they are taken up by the nanotubes. The studies are still at an early stage but the discovery could be used as a tool to help diagnose and treat diseases in which Ly-6C^{hi} monocytes are directly implicated, including cancer, heart disease and diabetes.



B R Smith

On track
Micron-scale image of a tumour in a live animal containing cancerous cells (green), blood vessels (red) and carbon nanotubes (greyscale) sequestered in Ly-6C^{hi} monocytes within the tumour.

Kostas Kostarelos of the Nanomedicine Lab at the University of Manchester in the UK, who was not involved in the current study, describes the observations as "peculiar". "The specific materials used were heavily coated with PEGylated lipids and it will be interesting to interrogate the role and physiochemical characteristics of the coating in the seemingly monocyte-specific internalization of the materials," he told *Physics World*. "Clearly, there is a lot of mechanistic work that is pertinent before any expectations of enhanced therapeutic activity."

The Stanford team now plans to investigate whether its findings can be used for specific tracking, manipulating or treating immune cells.

Belle Dumé

Solar cells

UK and India collaborate on renewable energy

Researchers from the University of Surrey, Queen's University Belfast and the Indian Institute of Science Education and Research have joined forces to explore how nanotechnology can impact the future of renewable energy. Initiated by a £150 000 grant (about $250 000) from the UK India Education and Research Initiative (UK-IERI), which will then be topped up by commercial funding, researchers will undertake two projects lasting two years each that involve collaboration with Tata Steel Research and Development UK.

In one of the projects, researchers from Surrey and Hyderabad will investigate cheaper and more-efficient solar cells based on carbon nanomaterials such as graphene.

Joining forces
India and the UK are involved in several nanotechnology projects via the joint UK-IERI.

IGCAR

Tata Steel will develop coating techniques and investigate the use of steel bipolar plates as potential substrates that could provide an interface with existing power-generation technology. "The work will attempt to integrate novel functionality into a single-material platform that has not previously been achieved in any materials format, much like the iPad or iPhone did," explains Chris Mills of Surrey's Nanoelectronics Research Centre.

The other project will examine the use of zinc-oxide nanomaterials in ultra-high-sensitivity gas sensors for environmental monitoring. In addition to making sensors more energy efficient, the nanomaterials could also be used in breathalysers or for sensing potentially explosive leaks in hydrogen-storage facilities, says the team.

"Nanotechnology projects such as these are hugely exciting and offer direct solutions for the key challenges that the energy sector faces," says project leader Ravi Silva, who is head of Surrey's Advanced Technology Institute. "Working with cutting-edge nanomaterials such as zinc oxide, graphene and carbon nanotubes, we can revolutionize energy storage and capture."

Matthew Chalmers