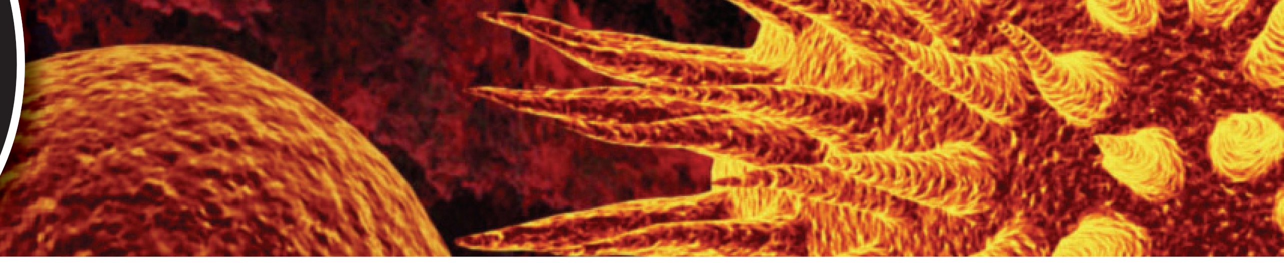

Nanotechnology Leading the Way in Life Sciences

The field of medical science is developing rapidly and there is no doubt that nanotechnology is helping to resolve some of the industry's most significant challenges.

In 2008, the biotechnology and pharmaceuticals industry had exports of over £17.2 billion and a balance of trade of £6.0 billion. With an estimated 308 Nano-Life Science companies internationally, it is no surprise that nanotechnology has attracted a huge amount of attention from global media and governments.

"Pharmidex and Genzyme Pharmaceuticals have formed a partnership to develop CerenseSM that brings together a patented CNS drug delivery technology, to overcome these twin obstacles. CerenseSM is able to unlock the blood-brain barrier and measure brain penetration"

Author Details:

Dr Mike Fisher, Theme Manager - Life Sciences & Healthcare, Nanotechnology KTN

In February 2010, the Nanotechnology Knowledge Transfer Network (NanoKTN) and The Wellcome Trust hosted its second Nano4Life event. This annual conference is dedicated to exploring key areas within the life sciences, where nanotechnology offers the opportunity to advance healthcare and improve product discovery.

The conference brought together leading medical technology and pharmaceutical companies to encourage networking and discuss the key issues within bionano, looking for areas where nanotechnologies can be used to help solve the issues that healthcare currently face.

Presentations were delivered by leading biotech organisations and research institutions including Pharmidex Pharmaceutical Services Ltd, Imperial College London and the University of London.

Imperial College London – Microsystems & Nanotechnology in Biosensors and Point of Care Diagnostics:

Professor Tony Cass, Imperial College London, addressed the need for advanced point of care diagnostics, an area that has considerably increased in importance as our knowledge of disease becomes more complex and multi-factorial. By moving testing from tertiary care to primary care, medical professionals aim to lower overheads and achieve better outcomes through regular testing.

Point of care diagnostics has already shown benefits in therapeutic drug monitoring, infectious disease detection, cancer therapy and diagnosis, and in the treatment of chronic conditions.

By using technology to analyse samples of blood, interstitial fluid, urine and saliva, medics are able to readily obtain results from samples that have been easily collected with minimal stress and discomfort to patients.

Using nanotechnology in diagnostics means that by reducing the size and cost of equipment, biosensors can be made available at the point of care, whether that is within a healthcare setting or within the patient's home. In many cases, providing a diagnosis whilst the patient is still with the doctor can ensure the right treatment is received early on, avoiding complications and additional stress caused by delays.

The same micro and nanotechnology diagnostic devices can also provide closed-loop systems, which continuously monitor patients and immediately respond to changes in physiological conditions. This is particularly important in Intensive Care Units where simple parameters, such as oxygen levels, can be critical in ensuring drug concentrations are within the therapeutic range.

There are a significant number of companies developing these 'lab-on-chip' technologies that function using biosensors but not all will make it to market. Ultimately it will not be the technology that will limit success but instead the acceptance and support of patients and clinicians.

School of Engineering and Materials Science, Queen Mary, University of London – Nanostructured Materials in Tissue Engineering:

Professor Pankaj Vadgama, University of London, looked at the role of nanostructured materials in tissue engineering. Tissue engineering makes use of artificially stimulated cell proliferation by using nanomaterial scaffolds. The projected possibilities offered by tissue engineering may, in the future, replace the need for organ transplants.

One application offering such promise is Nanospun PLLA vascular scaffold, currently being used for easier and more efficient remodelling of arteries. Nanospun PLLA uses matrices to attach and grow artificial cellular structures. These electrospun matrices are central to tissue engineering and the construction of artificial blood vessels.

Cultured cells grow best on structured surfaces rather than on those that are flat. By growing human cells on artificial scaffolds, damaged tissues can be replaced and using these techniques, cells can be attached and grown at the nano and microscale, on surfaces that mirror the natural matrices in organic tissues.

Pharmidex - Nanotechnology in drug formation:

UK-based Phamidex focuses on developing new medicines capable of crossing the blood-brain barrier.

Unlike nearly all other organs of the human body, within the brain there is not a free exchange between blood and the extracellular fluid within it. Instead, the capillaries of the brain have tight junctions, which constrain the movements of molecules and cells between blood and brain tissue. The blood-brain barrier is a single layer of endothelial cells that line the inner surfaces of capillaries in the brain. It is semi-permeable, allowing selected materials to cross but not others. By doing so, it protects the brain from foreign substances and toxins in the blood that may cause damage.

The successful development of Central Nervous System (CNS) medicines face two major problems; difficulties in getting compounds to cross the blood-brain barrier and difficulties in successfully measuring blood-brain barrier penetration and neuro-pharmacokinetics.

Pharmidex and Genzyme Pharmaceuticals have formed a partnership to develop Cerense^{SM} that brings together a patented CNS drug delivery technology, to overcome these twin obstacles. Cerense^{SM} is able to unlock the blood-brain barrier and measure brain penetration. This is achieved through a combination of Genzyme Pharmaceuticals' patented CNS drug delivery technology and Pharmidex's knowledge of neuro-pharmacokinetics.

Traditionally, CNS drug delivery technology often fails to be effective, due to the poor transport from the blood into the extracellular fluid of the brain. As a result of this, traditional methods of delivering compounds into the brain require the direct injection of therapeutic agents into the brain via neurosurgery. This is both costly and invasive.

Cerense^{SM} is able to overcome these obstacles by improving penetration of the blood-brain barrier by opening the barrier and delivering unmodified drug compounds into the brain.

There is an obvious need for safe and reliable methods of delivering compounds across the blood-brain barrier and Cerense^{SM} has the potential to facilitate this and offer development and delivery of drugs to treat CNS disorders including Alzheimer's disease, Parkinson's disease, multiple sclerosis, traumatic brain injury, anxiety, depression and schizophrenia.

Conclusion

Over the past decade there has been significant interest in the promises that nanotechnology holds for the life science industries. It is clear that nanotechnology has a lot to offer medical science and it has already helped to resolve some of the pharmaceutical and biotechnology industries' most significant problems.

The three key areas where nanotechnology is set to make a difference within healthcare include: diagnostics and imaging, targeted drug delivery and release and regenerative medicine. Nanomedicine is already successfully being used in diagnosis, treatment and prevention and is helping clinicians gain a stronger understanding of complex underlying disease mechanisms.

Despite the promises that nanotechnology offers to the life sciences, there are still challenges it must overcome before we see international acceptance and results. Public awareness and approval is crucial for early-stage development and providing companies are able to offer solid and reliable data, with positive results, the public will see benefits.