BIOMEDICAL NANOTECHNOLOGY

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Nanotechnology is the understanding and control of matter at dimensions of roughly 1 to 100 nanometers. Encompassing nanoscale science, engineering and technology, nanotechnology involves imaging, measuring, modeling, and manipulating matter at this length scale. A nanometer is one-billionth of a meter; a sheet of paper is about 100,000 nanometers thick. Nanotechnology is not a 21st Century idea; in fact many physicists including Richard P. Feynman theorized the possible manipulation of atomic particles.

Biomedical nanotechnology deals with using nanoscale technology in biological systems. Diagnostics, drug delivery, and prostheses-implants are three areas where nanotechnology is entering the bio-medical sector. In terms of products for use inside the human body, nanotechnology-based applications for anticancer drugs, implanted insulin pumps, and gene therapy are being developed, while other researchers are working on prostheses and implants which contain nanostructured materials.

In the US, a biosensor used to identify bacteriological infections in bio-warfare applications has been developed for the American army. In the field of commercial applications, developments include: a) sensors for environmental, medical and pharmaceutical surveys; b) lab-on-a-chip diagnostic techniques; c) sunscreens with nano-particles that absorb ultraviolet-light; d)longer-lasting medical implants; and g) techniques for mapping in a short time an individual's entire genetic code.

Nanodrugs are the next step in administering drugs into the affected cells themselves. Carbon nanotubes might be useful as drug delivery vehicles inside or on the surface of the human body.

Nanotechnology also has applications in the tissue engineering field, helping people who are in need of new bones, teeth, or other body tissues by replacing damaged or missing tissue with an equivalent material. The biological material is introduced into a mould to produce a body part with a characteristic shape, a bone for example. Nanostructured materials can also be used in artificial sensory organs – electronic eyes, ears and nerves, for example.

Semiconductor light-emitting diodes (LEDs) have great potential for biomedical imaging, but directing LED brightness is crucial. Researchers at the National Institute of Standards and Technology have found a way to make LEDs more than seven times brighter by etching nanoscale grooves in a surrounding cavity to guide scattered light in one direction. While LEDs typically emit 2 percent of the light in a desired direction, this technique would boost useful LED emissions to about 41 percent allowing for clear, sharp, and bright medical images. There is already a version of these LED's out on the market today made of nanostructured polymer films, known as OLEDs, or organic light emitting diodes. Among OLED screen advantages are brighter images, lighter weight, less power consumption and wider viewing angles.

The effects on human health of nanotechnology-based applications are still unknown. Nano-biotechnology could dramatically improve public health, but there is concern over possible unforeseen adverse effects. Therefore studies and monitoring methods are needed to determine what environmental and health risks are associated with nano-materials and nano-applications.

Sources: www.nano.gov, http://www.onboard-technology.com, www.den.hokudai.ac.jp, http://www.azonano.com, http://www.zyvex.com, www.nano.gov