AMAZING POSSIBILITIES OF NANOTECHNOLOGY

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Nanotechnology originates from the Greek word meaning "dwarf". A nanometre is one billionth (10^{-9}) of a metre, which is tiny, only the length of ten hydrogen atoms, or about one hundred thousandth of the width of a hair! Although scientists have manipulated matter at the nanoscale for centuries, calling it physics or chemistry, it was not until a new generation of microscopes were invented in the nineteen eighties in IBM, Switzerland that the world of atoms and molecules could be visualized and managed.

In simple terms, nanotechnology can be defined as 'engineering at a very small scale', and this term can be applied to many areas of research and development – from medicine to manufacturing to computing, and even to textiles and cosmetics. It can be difficult to imagine exactly how this greater understanding of the world of atoms and molecules has and will affect the everyday objects we see around us.

Because of the opportunities nanotechnology offers in creating new features and functions, it is already providing the solutions to many long-standing medical, social and environmental problems. Because of its potential, nanotechnology is of global interest. It is attracting more public funding than any other area of technology, estimated at 3.8 billion euros worldwide in 2005. It is also the one area of research that is truly multidisciplinary. The contribution of nanotechnology to new products and processes cannot be made in isolation and requires a team effort, which may include life scientists – biologists and biochemists – working with physicists, chemists and information technology experts. Consider the development of a new cochlear implant, and what that might require – at least a physiologist, an electronic engineer, a mechanical engineer and a biomaterials expert. This kind of teamwork is essential, not only for a cochlear implant, but for any new, nano-based product whether it is a scratch-resistant lens or a new soap powder.

Nano scientists are now enthusiastically examining how the living world 'works' in order to find solutions to problems in the 'non-living' world. The way marine organisms build strength into their shells has lessons in how to engineer new lightweight, tough materials for cars; the way a leaf photosynthesizes can lead to techniques for efficiently generating renewable energy; even how a nettle delivers its sting can suggest better vaccination techniques. These ideas are all leading to what is termed 'disruptive' solutions, when the old ways of making things are completely overtaken and discarded,

in much the same way as a DVD has taken over from videotape, or a flat screen display from a cathode ray tube.

Carbon nanotubes are a recently discovered unique material possessing amazing electronic, thermal, and structural properties They are highly conductive both to electricity and heat, with an electrical conductivity as high as copper, and a thermal conductivity as great as diamond. They offer amazing possibilities for creating future nanoelectronic devices, circuits and computers. Carbon nanotubes also have extraordinary mechanical properties – they are 100 times stronger than steel, while only one sixth of the weight. These mechanical properties offer huge possibilities, for example, in the production of new stronger and lighter materials for military, aerospace and medical applications. Other applications include lubricants, coatings, catalysts and electro-optical devices.

The cost, purification, separation of nanotube types (Single Walled NanoTubes from Multi Walled NanoTubes), constraints in processing and scaling up and assembly methods are still hurdles for some applications. However, there are already products containing nanotubes on the market, for example, in some tennis racquets nanotubes are used to reinforce the frame and improve the racquet's ability to absorb shocks.

Some engineered nanoparticles, including carbon nanotubes, although offering tremendous opportunities also may pose risks which have to be addressed sensibly in order that the full benefits can be realized. We have all learned how to handle electricity, gas, steam and even cars, aeroplanes and mobile phones in a safe manner because we need their benefits. The same goes for engineered nanoparticles. Mostly they will be perfectly safe, embedded within other materials, such as polymers. There is some possibility that free nanoparticles of a specific length scales may pose health threats if inhaled, particularly at the manufacturing stage. Industry and government are very conscious of this, are funding research into identifying particles that may pose a hazard to health or the environment, and how these risks may be quantified, and minimized over the whole lifecycle of a given nanoparticle. There is no doubt that nanotechnology has great potential to bring benefits to society over a wide range of applications, but it is recognised that care has to be taken to ensure these advances come about in as safe a manner as possible.

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