



ICSTI
IRELAND

Irish Council for Science,
Technology and Innovation

Nanotechnology in Ireland: A Snapshot

Forfás 

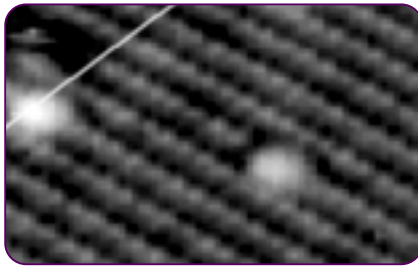
NANOTECHNOLOGY - THE SCIENCE OF SMALL THINGS

Nanotechnology refers to the manipulation of matter on an atomic or near-atomic scale to develop materials and devices with novel properties.

Nanotechnology encompasses a set of technologies and techniques with the potential to be applied across most industrial sectors with the common factor being size. Certain fundamental properties of matter, including melting temperature, electronic properties and colour, alter at the near-atomic scale. Nanoparticles (particles with nanometre sized dimensions) have a far greater surface area relative to their overall volume as compared with more conventionally sized particles and consequently interact differently with their physical surroundings. Matter and light also interact differently at the atomic level.

These altered properties and phenomena can be exploited to enhance the performance of existing products and components as well to develop completely new innovations and applications.

HOW SMALL IS SMALL?



Manipulation of hydrogen atoms on a silicon surface

A nanometer (nm) is one billionth of a metre. A single atom of hydrogen is about one tenth of a nanometer wide. A single human hair is around 80,000 nm in diameter. Nanotechnology generally refers to work performed at a resolution of less than 100 nm.

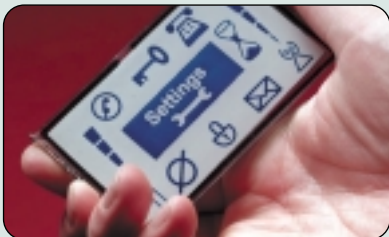
In recent years a whole suite of tools were developed, such as the

Scanning Tunnelling Microscope, that enable scientists to study and manipulate individual atoms and molecules, assembling them into 'nanostructures' that form the building blocks of nanomaterials, nanosystems and nanodevices.

Since the late 1990s, nanotechnology has gained increasing recognition worldwide - and funding - as a research topic in its own right. But it is a highly interdisciplinary activity, drawing on the basic science, analytical techniques and experimental approaches of physics, chemistry, electronics, materials science and molecular biology.

THE FUTURE IS NOW

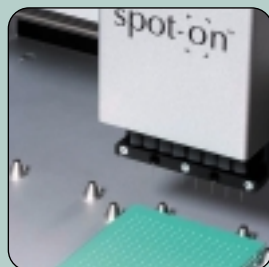
Nanotechnology has already become a key enabling technology in certain industrial settings and will have a significant impact on many other sectors in the next several decades, including those that are central to sustaining Ireland's economic prosperity. Important contributions to electronics, pharmaceuticals, energy, chemicals and consumer products have already been made.



Electrochromic displays developed NTERA Ltd. with ink-on-paper qualities

In Ireland, the first indigenous start-ups to emerge from university based research groups have already attracted international venture capital. NTERA Ltd., founded in 1997, a spin-out from University College Dublin, has developed a next generation display called Nanochromics™ Displays (NCD).

Deerac Fluidics, whose roots are in Trinity College Dublin, has developed nanolitre-scale liquid handling technology that is being deployed in high-throughput screening systems in drug discovery research.

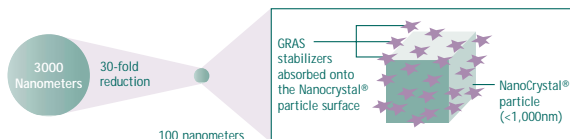


Deerac Fluidics™ spot-on™ technology

NanoCrystal® Particles have increased surface area



Micronization vs. Nanonization™ process



Elan is a pharmaceutical company based in Ireland that has been among the earliest adopters of nanotechnology in the sector. Its NanoCrystal® Technology is designed to improve the bioavailability of drugs and drug candidates that have poor solubility in water. Compounds are formulated as nanometer-sized particles,

which are then delivered in tablet form, in capsules, via inhalation devices or via injection with the potential for substantial improvements to clinical performance. Elan has put in place manufacturing capacity for NanoCrystal-based products at its Irish site in Athlone.

TOWARDS A NATIONAL NANOTECHNOLOGY STRATEGY

Recognising the importance of Nanotechnology, the Irish Council for Science, Technology and Innovation (ICSTI) produced a Statement in order to assess current capabilities, to map out the specific areas of opportunity for the Irish economy and to work towards an agreed strategy for promoting the development and commercialisation of nanotechnology in Ireland.

ICSTI recommend the following national definition of nanotechnology:

Nanotechnology is a collective term for a set of tools and techniques that permit the atoms and molecules that comprise all matter to be imaged and manipulated. Using these tools and techniques it is possible to exploit the size-dependent properties of materials structured on the sub-100 nanometer scale, which may be assembled and organised to yield nanodevices and nanosystems that possess new or improved properties. These tools and techniques, materials, devices and systems present companies in all sectors of the Irish economy with opportunities to enhance their competitiveness by developing new and improved products and processes.

[One nanometer (1 nm = 10^{-9} m), to give an idea of scale, would be around 80,000 times smaller than the diameter of a human hair.]

The particular sectors of the Irish economy in which nanotechnology either already plays or soon will play an important role include:

- Information and Communications Technology – Electronics & Photonics
- Healthcare - Pharmaceuticals
- Healthcare – Medical Devices
- Agriculture-Food
- Polymers and Plastic
- Construction

Although each sector is exposed to a differing market dynamic and each has differing needs operating over divergent timescales, they share one common necessity - the development of a national nanotechnology capability that can match their particular requirements.

There has been significant investment in research in the field of nanotechnology. The vast majority of this funding is derived from:

- Higher Education Authority (HEA)
- Science Foundation Ireland (SFI)
- Enterprise Ireland (EI)
- European Union (EU)

At Trinity College Dublin an SFI Centre for Research on Adaptive Nanostructures and Nanodevices (CRANN) is planned in partnership with University College Cork and University College Dublin. In accordance with the current IDA Ireland strategy, which is to 'anchor' overseas based multinationals in this country by ensuring that more research and product development takes place, Intel Ireland will be the principal industry partner in CRANN.

Enterprise Ireland, with its growing number of associated investment funds, aims to support the establishment and growth of indigenous nanotechnology based companies or nanotechnology enabled products within existing companies.

High potential start-ups, established indigenous companies and multinational companies with operations in Ireland all stand to benefit by developing, deploying or adopting nanotechnology. The opportunity is significant. International forecasts suggest that the global market for nanotechnology-enabled products will grow from an estimated \$300 billion in 2002 to \$1 trillion by 2010. The science may be small, but the stakes are large.

On this basis the ICSTI Statement on Nanotechnology outlines a sustainable vision and strategy for nanotechnology in Ireland and includes recommendations that will ensure that stakeholders can work together to fully exploit the nanotechnology opportunity for Ireland

ICSTI SECRETARIAT

The ICSTI Secretariat is provided by Forfás, the national policy and advisory board for enterprise, trade, science, technology and innovation.

Correspondence should be addressed to:

The ICSTI Secretariat
Wilton Park House
Wilton Place
Dublin 2
Ireland

Other contact details are:

Tel: +353 1 607 3186
Fax: +353 1 607 3260
E-mail: icsti@forfas.ie



ICSTI
IRELAND

Irish Council for Science,
Technology and Innovation