Technology Strategy Board

Driving Innovation

Enabling a better world – Our strategy for nanoscale technologies

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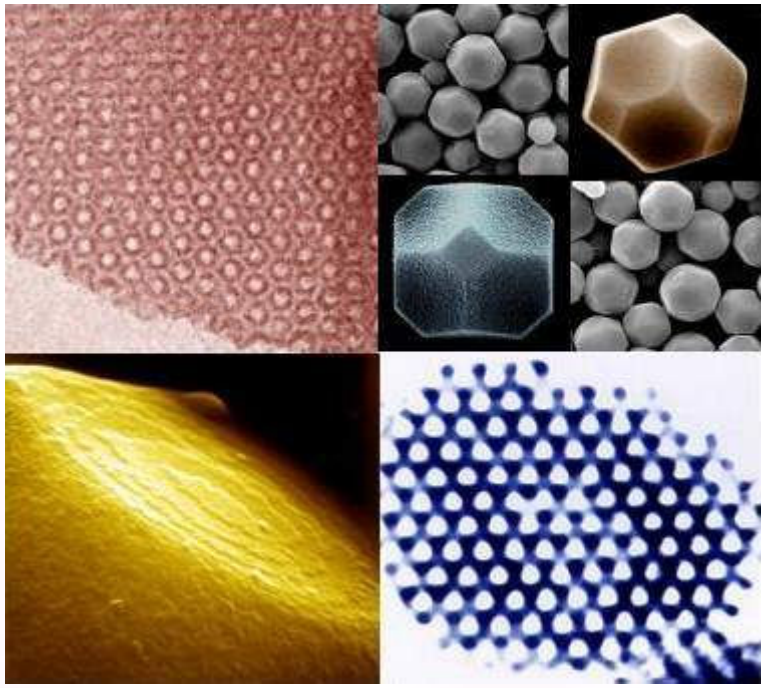
Agenda

- Introduction and presentation on strategy (15mins)
  - Christian Inglis
- Action plan session (15mins)
  - Christian Inglis, Alan Hooper
- Business speakers (2x10 mins)
  - Professor Peter Smith, Covesion
  - James Lewis, Bac2

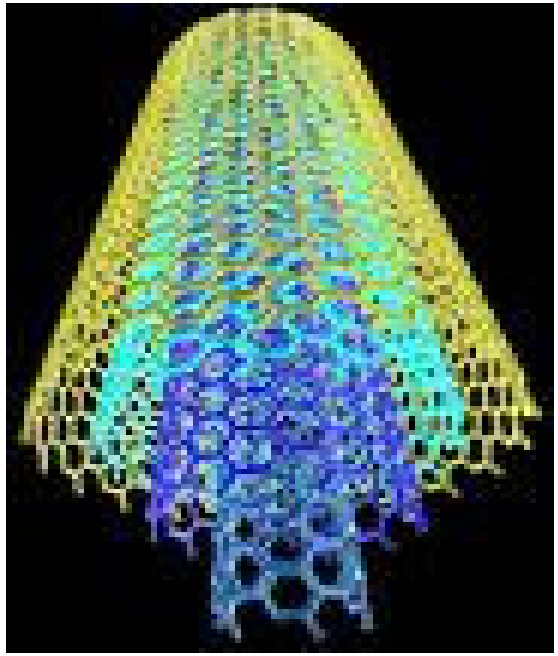
Purpose

- Inform UK companies about our approach, over 2009 -2012 and beyond, and the opportunities it creates
- Guide the Technology Strategy Board internally in its work on both nanotechnology and other topics e.g. Materials, Healthcare, Electronics, Energy
- Advise other areas of Government about our approach and areas of mutual interest

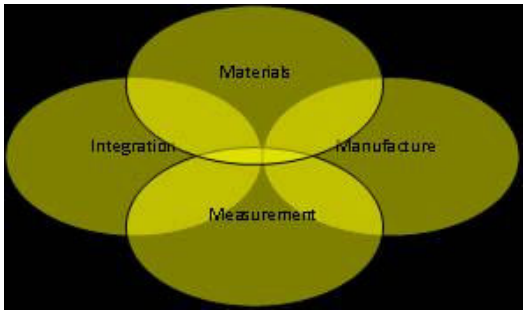


Content

- What is nanotechnology?
- Where are we now?
- Where do we want to be?
- UK aspirations
- Technology Strategy Board potential investment



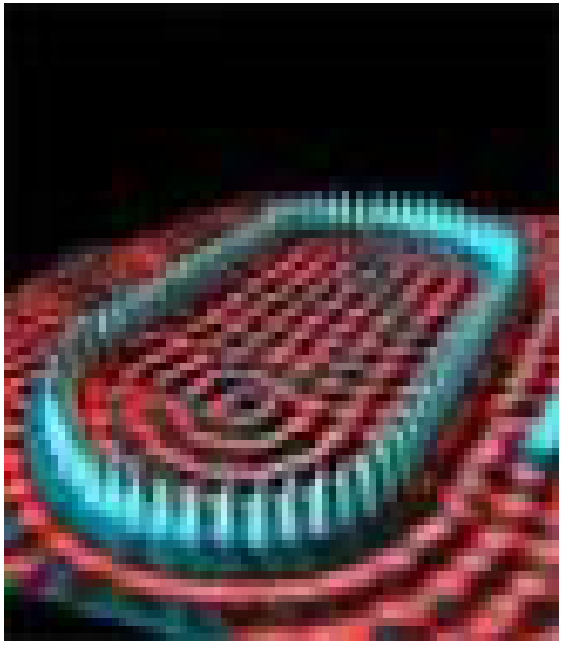
What is it ? – Four Areas



- Nanoscale **materials** (~1nm to 100nm) with one or more specific properties of:
  - High surface area and hence high surface activity, enabling self-assembly
  - Quantum effects becoming dominant
  - Changes in optical, magnetic, or electrical properties
- **Fabrication** techniques; the ability to produce and engineer nanoscale materials and structures via new approaches
- New **measurement** techniques to understand properties of materials and quality control in production
- **Integration** into a final product

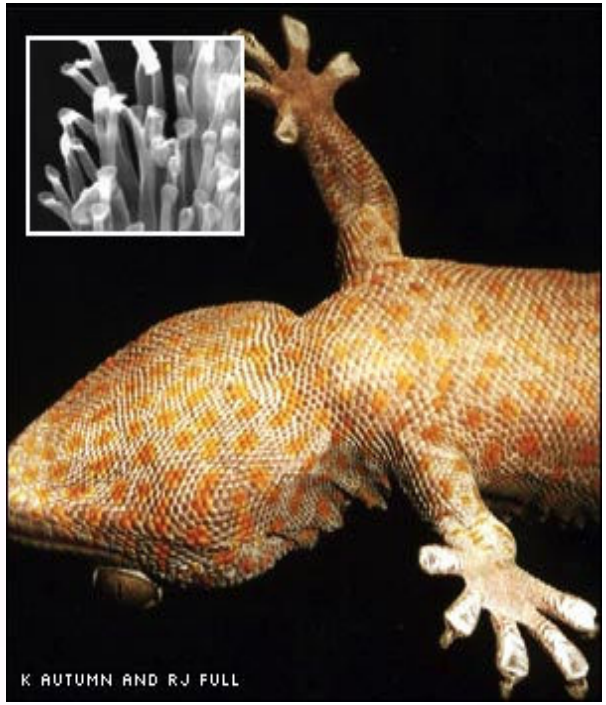
Highly Pervasive

- Nanoscale technologies are highly pervasive over a range of market sectors,
- Usually embedded into components and systems, which are not on the nanoscale e.g. sensors
- Considered as a set of enabling technologies, rather than end products in their own right



Nanoscale technologies have many links to nature:

- Bone – a nanostructured organic/inorganic composite giving excellent toughness properties
- Gecko feet - nanoscale fibres giving “sticky” feet due to Van der Waals’ forces and the concentration of fibres in a small area
- Lotus leaf - nanostructured topography giving control of surface tension
- Cell biology – e.g. molecular motors



Nanoscale technologies are not entirely new

Examples from history

- The Lycurgus cup, dichroic glass containing small amounts of colloidal gold and silver..made in 4th century AD
- Catalysts providing a high surface area for a number of applications
- Colloidal chemistry

Images courtesy of the British Museum

They are also not.....

The “Nano” satellite

The Ipod “Nano”

Tata Motors “Nano” car

Current Understanding & Application

- Our understanding of properties at the nanoscale has improved and has resulted in a desire to engineer and exploit the potential added functionality of these properties
- Current engineered products incorporating nanoscale technologies are generally evolutionary improvements to existing products:
    - Metal oxide nanoscale particles in sunscreens
    - Nanoscale filler materials in e.g. car bumpers
    - Nanoparticle drug delivery
    - Nanostructured materials and surfaces in batteries
    - Antibacterial coatings

Where are we now (Globally)?

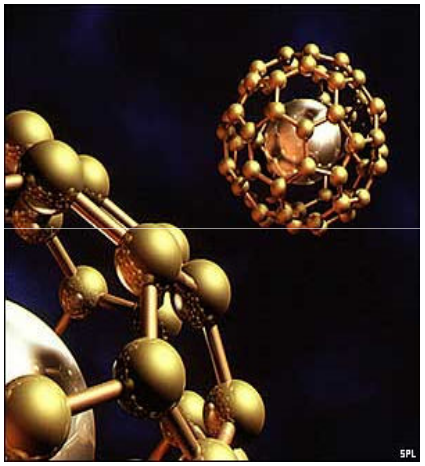
- Public and private investment into nanotechnologies is large ($10bn worldwide in 2007)
- Products currently manufactured use between $2.3billion to $10billion of nanomaterials globally across a wide range of markets
  - a subject of significant debate
  - The consensus is that markets will grow in the coming years
- Revenue generation comes in the main from coatings, particles, nanoporous structures, and composites
- Leaders in the field are USA, Japan, Germany, UK and South Korea with many other countries improving their standing significantly

Where are we now (UK)?

- Investment into infrastructure and R&D inclusive of the regions, and industry through the Micro and Nano Manufacturing initiative
  - Split approximately 50:50 between micro and nano
  - Challenge led investment resulting in projects utilising nanoscale technologies, e.g. Materials for Energy competition, Autumn 2007
- UK considered to be excellent in the research base through coordinated activity across the Research Councils
- UK currently leading in EHS and public engagement issues across government
- Significant knowledge transfer activity

Where are we now (UK)?

- UK well placed in nanoscale technologies at various stages of Technology Readiness Levels:
  - Coatings and surfaces
  - Structural and functional materials
  - Modelling, design and scale-up
  - Controlled release, diagnostics, therapeutics
  - Displays, memory, sensors
  - Instrumentation for measurement



- Technological barriers in scale up of manufacture, measurement, life cycle analysis and integration into systems and new products
- Other issues include perception of EHS, coordination of the public debate, appropriate regulation and cross discipline skills development within academia and industry

UK Aspirations

- **Obtaining more than our fair share of the potential global market for nanoscale materials predicted at ~$81billion by 2015**
- UK should focus efforts in creating wealth and a better quality of life by addressing priority challenge areas:
  - Living with environmental change (energy, sustainability, and environmental monitoring)
  - Living with an ageing and growing population (healthcare, and inclusive of food packaging)
  - Living in an intelligent connected modern world (creative industries, entertainment, safety and security, intelligent transport)

UK Aspirations

- Innovation should be based on collaboration across market sectors (e.g. healthcare, textiles, electronics), throughout the supply chain (e.g. materials suppliers, integrators, end users), and working closely with Research Councils/Universities
- Innovation should be responsible through dialogue between industry and government via available coordinated networks, and discussion and removal (where appropriate) of potential safety concerns

to catalyse UK aspirations we will:

- Invest in cross market sector collaborations by enabling supply chains to compete in **Collaborative R&D** competitions having a challenge-led focus, where the UK has strength.
- Partner closely with **Research Councils**, RDAs/DAs, and Government departments where appropriate to connect activities (e.g. nano grand challenges, national KTP scheme, SBRI, UK coordinated strategy) to pull ideas through the supply chain to commercialisation
- Ensure that the **UK facilities network** is appropriately coordinated, communicated and focused on developing exciting new technologies
- Engage appropriately within **Europe** and globally to enhance programmes for the benefit of UK industry (through Framework 7 and 8 activity, OECD working parties)
- Continuing to provide mechanisms for coordinated **knowledge transfer** and responsible development

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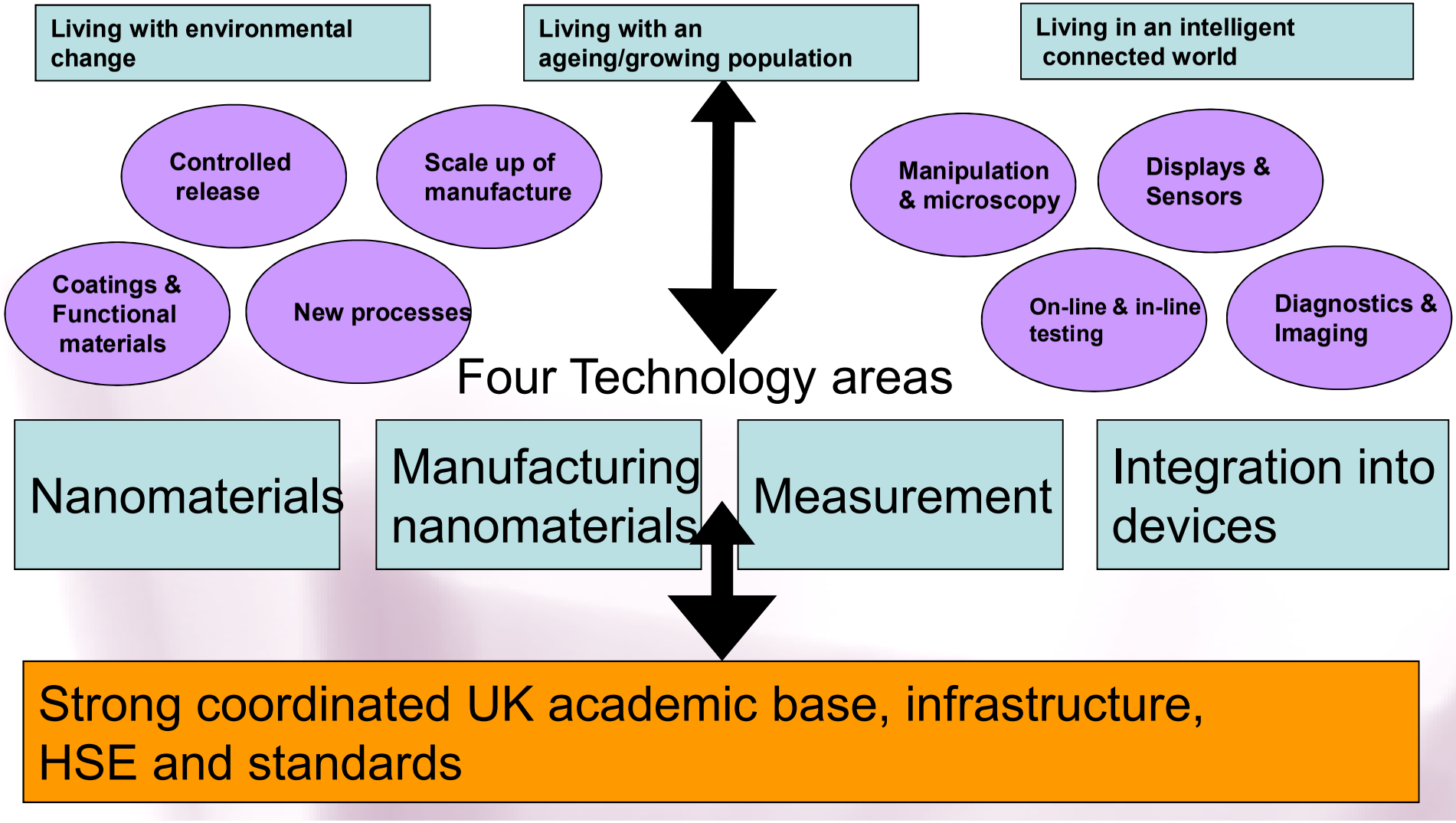
Nanoscale technologies

High value products and processes focused through challenge areas impacting a wide range of market sectors involving through supply chain working



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