The Royal Commission on Environmental Pollution

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27th Report

Novel Materials in the Environment: The case of nanotechnology

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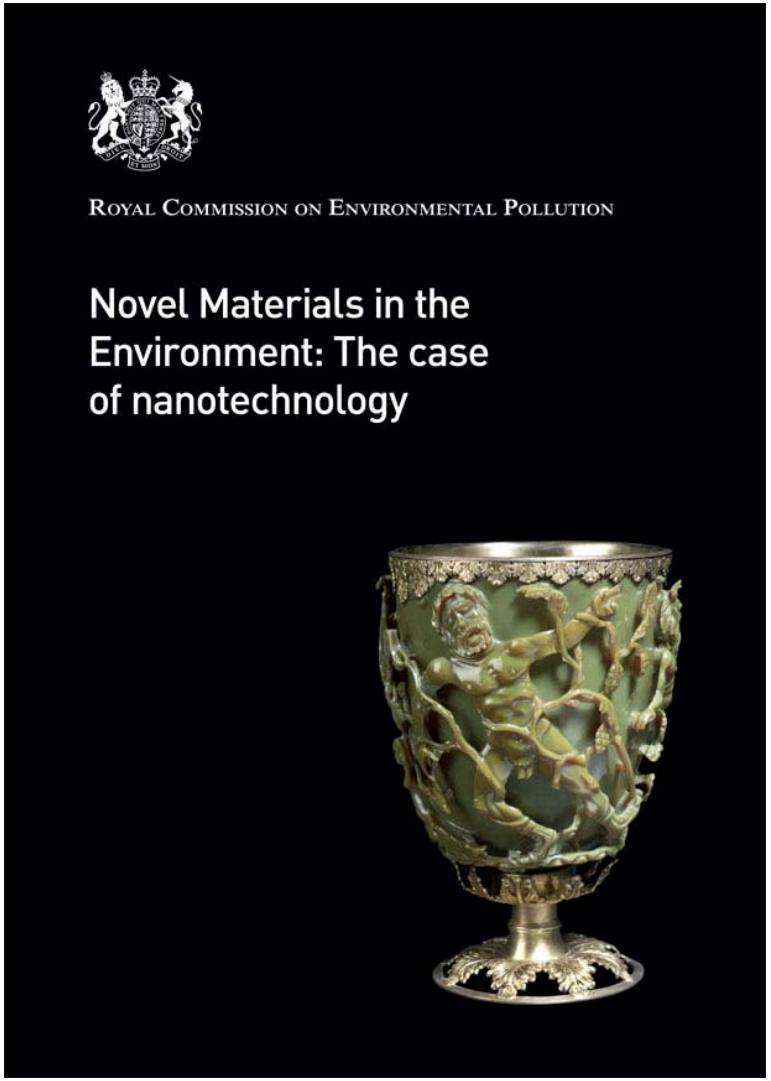
Member of the RCEP

25th February 2009



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About the Royal Commission

- The Commission was established by Royal Warrant in 1970;
- It is independent of Government;
- 14 members (currently 9), supported by a full-time secretariat;

Our Terms of Reference:

“To advise Government and Parliament on matters, both national and international, concerning pollution of the environment, the adequacy of research in this field, and future possibilities of danger to the environment.”

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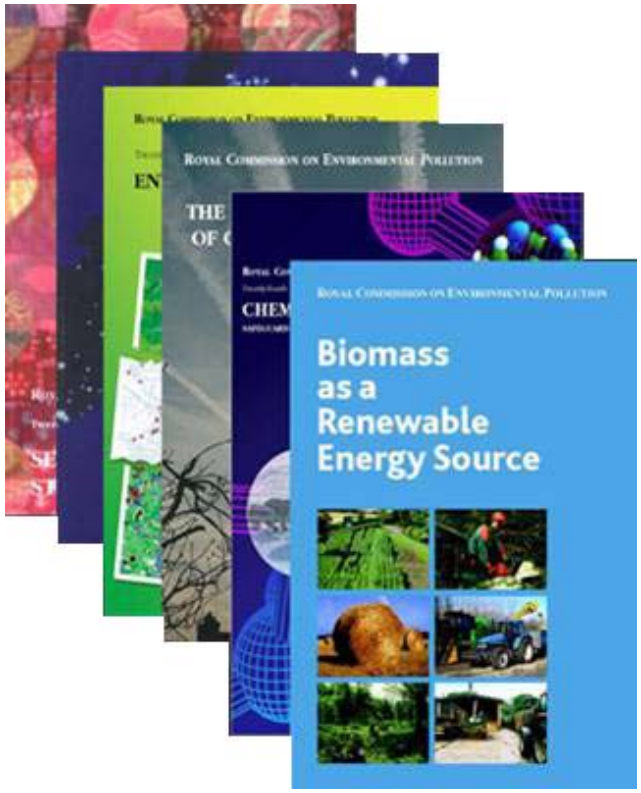
About the Royal Commission

- Published 26 reports and 3 special reports to date
- ‘Committee of experts’ rather than an ‘expert committee’
- Members have backgrounds in the natural sciences, law, social sciences, industry & business, medicine and economics



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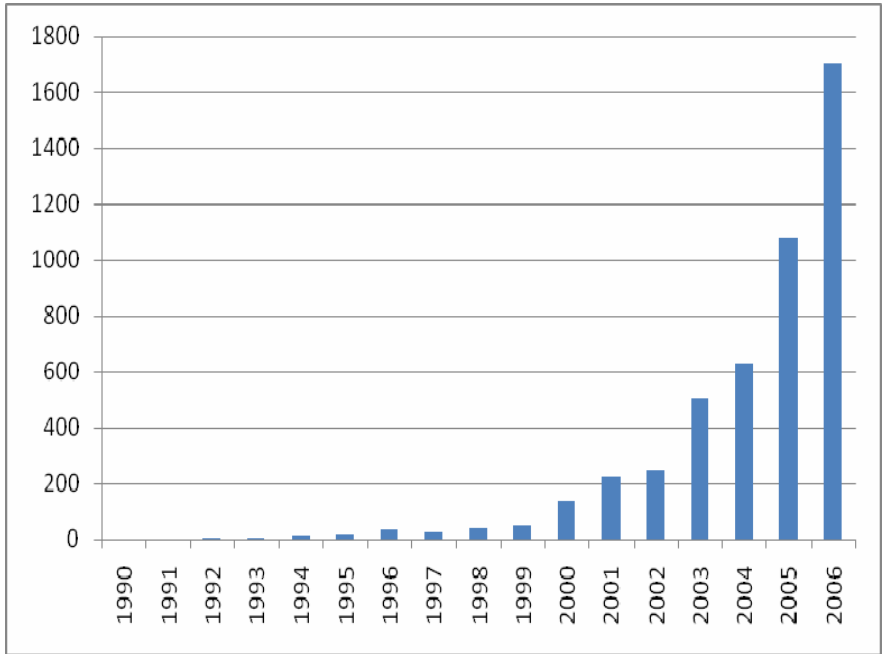
Novel Materials: Nanomaterials as the exemplar

- Innovation in the materials sector and the introduction of novel materials into the environment
- The challenge of regulating a rapidly moving area of innovation – using nanomaterials as the exemplar



Trends of patents on nanomaterials (1990-2006)

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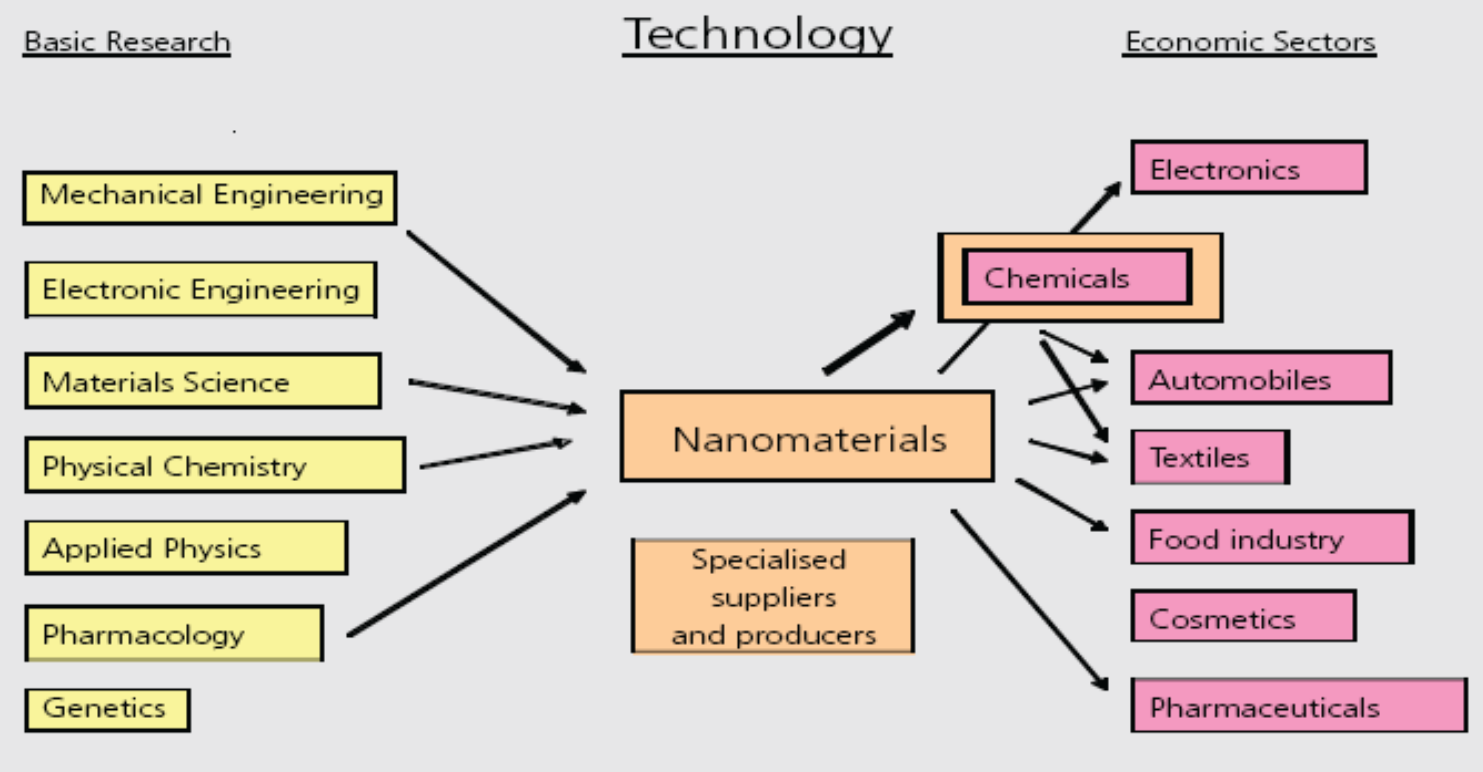
About the nanomaterials sector



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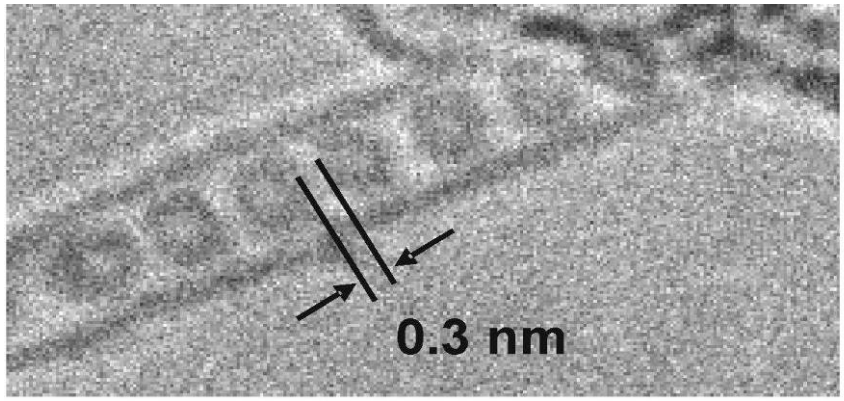
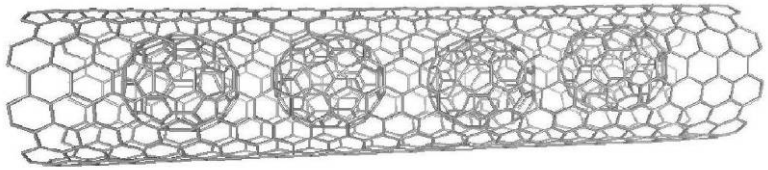
It is the functionality that is important

- Materials in the nanoscale can have enhanced and radically different physico-chemical properties
- New functionality means nanomaterials can be used in novel ways
- Makes their behaviour in the environment or human body hard to predict – some behaviours are predictable, others will be unexpected





Carbon nanotubes

Image © Dr Andrei Khlobystov

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No evidence of harm

- The Royal Commission conducted an extensive review of the published scientific literature
- The Commission found **no evidence of nanomaterials causing harm to human health or to the environment**

Suggestions of possible risk

However:

- There is very limited or no toxicological information on many new nanomaterials now being produced, for example C_{60}, nanosilver, and carbon nanotubes
- The properties these nanomaterials are quite different to those of the bulk form (graphite or metallic silver, for example)
- Managing nanomaterials in the face of this ignorance poses an enormous challenge

No case for a blanket ban or moratorium on nanomaterials

- On balance, we see **no reason for there to be a blanket ban or moratorium** on nanomaterials

- **Prioritised testing** should begin with those nanomaterials with functionality which suggests they might pose the greatest risk to the environment or to human health

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Research gaps and long lead times

- Lack of data on toxicity and exposure, and no consensus about how to address this
- Virtually no data on long term effects on people, other organisms, or the environment
- Little evidence of identification of the most critical characteristics that are likely to cause harm; or information relating to how the properties interact
- Environment monitoring for many kinds of nanomaterials (e.g. nanosilver or carbon nanotubes) is currently impossible or extremely difficult
- Increased testing is necessary and urgent

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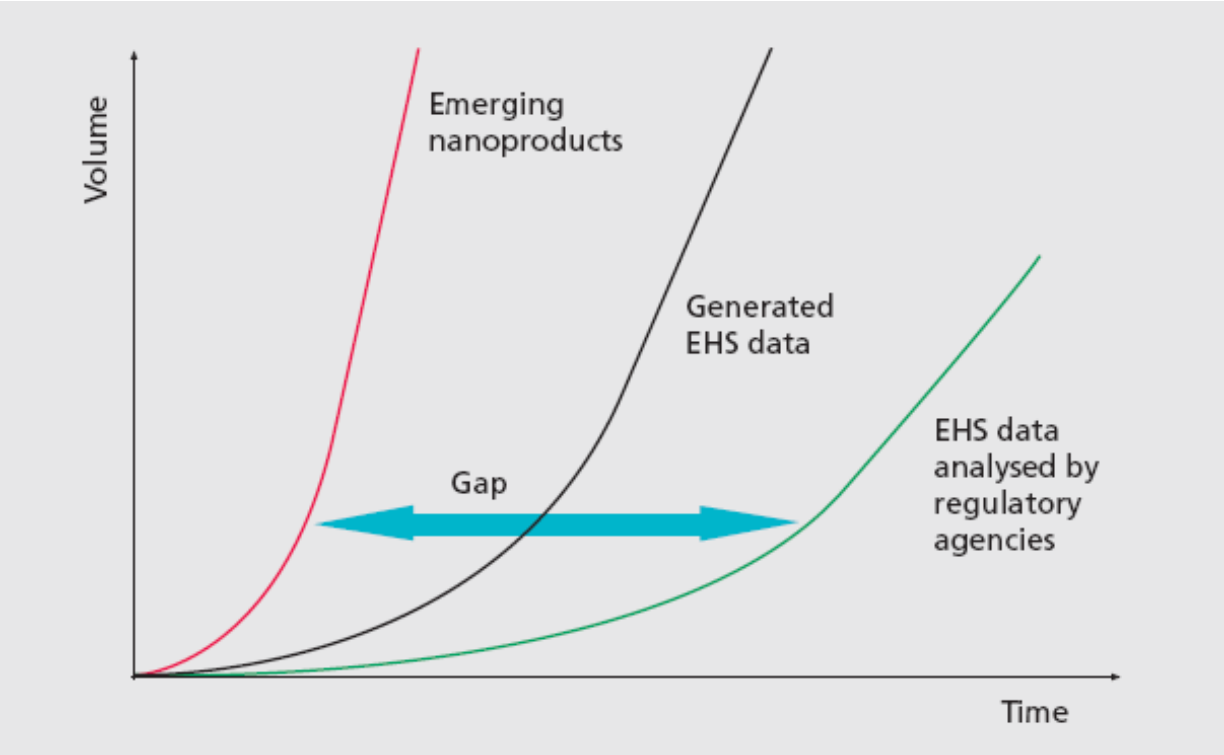
Obtaining information on risk is going to take a very long time



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Do we need special regulations for nanomaterials?

- The manufacture, use and disposal of nanomaterials is covered by REACH
- The Commission **recommends that REACH is adapted** to meet the challenges posed specifically by nanomaterials
- Specifically, the **weight threshold should be lowered for nanomaterials, and focus should be given to properties and functionality** rather than to size per se

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Flexible management and early warning systems

- The Commission proposes a **compulsory checklist as part of an early warning system** for nanomaterials
- Government should impose a **legal duty on companies** to report suspicions of possible risk (to humans or the environment)
- **Environmental monitoring** to detect manufactured nanoparticles
- Move from **one-off public engagement projects to continual 'social intelligence' gathering**

The checklist and compulsory reporting

- The checklist should be developed and defined further by Government (involving the wider materials community) and **should not be onerous** to complete
- **All importers or manufacturers of nanomaterials not currently covered by REACH** should complete this
- Reporting should elaborate the **special properties** of the nanomaterial including why they are being used, and consider pathways of environmental or human exposure
- Defra should make nanomaterials reporting mandatory

The urgent need for monitoring

- The Commission believes that monitoring is an essential part of an early warning system
- We recommend that **environmental monitoring to detect manufactured nanomaterials should be the responsibility of the Environment Agency in England and Wales, SEPA in Scotland and the Northern Ireland Environment Agency** to ensure that robust processes are used

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Recommendations to the research councils

- The Commission call for a more **directed, more co-ordinated and larger response led by the Research Councils to address the critical research needs** raised by this report
- Linked to this is a recommendation directed to the Department for Innovation, Universities and Skills, calling for an **investment in training of medical and eco-toxicologists**

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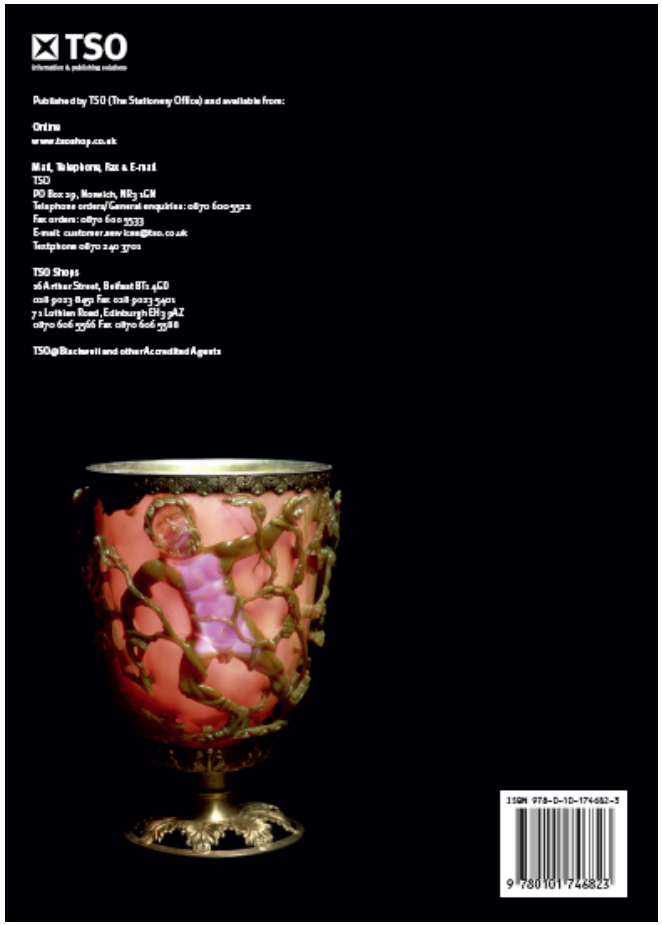

The need for ongoing dialogue

- More sophisticated later generation nanoproducts are likely to raise issues which cannot be captured by treating them as chemicals or mixtures of chemicals
- We have therefore **recommended the move from one-off public engagement projects to continued social intelligence gathering** – by this, we mean ongoing opportunities for public (and expert) reflection and debate on novel materials.

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Press coverage

- 12th November 2008: The Guardian, The Independent, The Daily Mail, The Daily Telegraph, The Times and The Financial Times. There were over 40 references to the report on the web.
- The Chairman, Sir John Lawton, was interviewed on the BBC Radio 4 Today programme and appeared on the Channel 4 lunchtime news, both on 12th November 2008.

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Thousands of starlings turn the sky black as they roost near Gretna Green on the England-Scotland border. Many starlings from Scandinavia and eastern Europe winter in the UK Photograph: Owen Humphreys/PA

Attack of the Tiny Particles – be very afraid

Report calls for more tests on 'wonder ingredient'

Proliferation of nano materials could pose risk

Ian Sample Science correspondent

The government must begin a "major and urgent" effort to assess the safety of nanomaterials, the tiny particles commonly used in products as varied as sun creams, sports clothing and medicine, leading experts warn today.

Hundreds of consumer products made with nanoparticles, which can be 100 times smaller than a virus, are already on the market, despite an almost complete lack of knowledge of the dangers they may pose to human health and the environment, according to a report by the royal commission on environmental pollution.

Nanoparticles have been embraced as a wonder ingredient across manufacturing industry. Cosmetic companies add titanium dioxide nanoparticles to sun creams to make them transparent instead of white. Sports clothing firms have introduced odour-free garments containing nanosilver particles that are twice as toxic to bacteria as bleach. The motor industry has added carbon nanofibres to car tyres and body panels to strengthen them. Many nanomaterials are so poorly understood that scientists are unable to predict how they will behave, and are unclear even how to check their safety, the report says.

Sir John Lawton, who chairs the commission, said the lack of tests and environmental monitoring for nanoparticles meant it was impossible to know if the materials were already a cause for concern. "Would we know if nanomaterials were causing harm? The answer is, no we wouldn't. We have no evidence that they cause harm, but a lot of that is because of a lack of evidence," he said.

Industry figures estimate at least 600 products are already available globally that contain nanomaterials of some form, but that figure is expected to rise steeply.

The report warns that the proliferation of nanoparticles will see more of them released into the environment where they could be inhaled, discharged into water courses, and potentially introduced into the food chain with unknown consequences.

Lawton acknowledged nanoparticles were "exceedingly useful", but said there was "a major gap between the pace at which new nanomaterials are being developed and the generation of environmental health and safety data". Some scientists who gave evidence to the commission said it could be 20 years before sufficient safety measures were in place to monitor nanotechnology. "We don't want to be alarmist, but experience says the more we find out about this the better," said Lawton. "We're saying [to the government] get your finger out and get on and do something. This is really urgent."

Last week, the Royal Society expressed its dismay at the government's lack of action following its own report on nanotechnology in 2004, which also called for more stringent safety checks.

Nanoparticles lend their success to the extraordinary, and sometimes highly unusual, properties they have. For example, carbon nanotubes are incredibly strong, while pieces of graphite easily sheer apart. Nanoparticles of silver are significantly more toxic than lumps of the metal because the tiny particles have a huge surface area. The medical industry is investing heavily in nanoparticles to create precision drugs that can target specific tissues, such as cancer cells.

The report calls on government departments to back immediate research into toxicity tests for nanoparticles and the impact of nanomaterials in the environment.

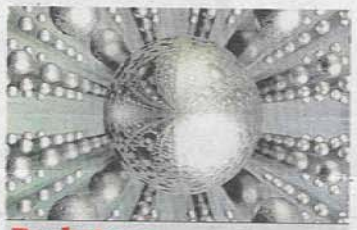
The commission picks out three types of nanoparticle it says are of particular concern. Highly toxic nanosilver will inevitably get into the water supply when sports garments incorporating silver nanoparticles are washed. These could cause problems at sewage treatment works, which rely on beds of bacteria to purify water. Carbon nanofibres, which can be added to car tyres or woven into clothing to produce different colours without using dyes, are likely to be shed into the environment where they could be inhaled.

Finally, "buckyballs" – microscopic football-shaped cages of carbon – can be absorbed by simple organisms, according to the report, raising concerns that they could contaminate the food chain.

A spokesperson for Defra said: "As the commission states, it has found no evidence of harm to health or the environment from nanomaterials, but the government remains committed to researching their health and environmental impact."

guardian.co.uk

» **In today's Guardian Daily podcast** Professor Sir John Lawton discusses nanotechnology
guardian.co.uk/guardiandaily



Backstory

Eric Drexler, an American engineer sketched the **scenario** whereby nanomachines no bigger than molecules **run amok**, consuming the planet's resources and leaving nothing but **grey goo**, in his 1986 book **Engines of Creation**. He has now dismissed that view, but more realistic concerns remain. **Nanotechnology** encompasses any material suited to measurement in **billionths of a metre**, or **nanometres**: connections in a chip, fibres in a tennis racket, or particles absorbing UV light in suntan lotion. **Nanoparticles** behave unlike lumps of the same material – stronger, more toxic, and with radically different electrical properties. What makes them **so useful** also makes their safety **so uncertain**.

The Guardian, p.3, 12/11/2008

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Progress since the publication of the RCEP report

- The Chairman of RCEP, Sir John Lawton, met with the **Government Chief Scientific Advisers** in the UK in December 2008
- **RCEP met with the European Commission** in Brussels on 12th January to discuss the report's recommendations
- On 30th February, the UK's Department for Innovation, University and Skills published a press release announcing:
  - The **Government's intention to respond the RCEP report** in Spring 2009. This will be led by Defra;
  - Other **pledges to ensure the responsible development of the field** of nanotechnology