Exploration of the tiny world opens huge prospects

"The nano-world that we are now starting to discover challenges us to explore it, understand the physical laws that govern it, and develop know-how for making it work for us"

The new discipline of nanoscience investigates the mechanisms of events that happen at the scale of a nanometre, or one-billionth of a metre. At this tiny scale the classical laws of physics 'break down' and research is necessary to develop new knowledge and understanding of processes occurring. The exploration of the nano-world, in turn, can lead to new processes in miniaturised manufacturing, information handling and diagnostics. Because of its great economic potential, leading industrial countries have started nanoscience research programmes. Twelve leading national funding bodies plan to speed up progress in nanoscience with the NanoSci-ERA Coordination Action funded by the EU, and to lay the foundations for future growth.

Nanoscience – its name comes from *nanos*, Greek for dwarf – looks at the behaviour of very small objects, such as a single semiconductor 'nanocrystal', a single molecule, atom or even electron. This behaviour is governed not by the classical laws of our macroscopic world, but by quantum mechanics. Manipulations on this scale could produce tiny reagents or tiny transistors that would revolutionise many branches of industrial design – developments known collectively as nanotechnology. Nanoscience provides the theoretical basis for the development of nano-products.

The semi-conductor industry offers a model for the kind of change that nanoscience could bring about. The understanding of semi-conductor physics developed since the 1930s led to the introduction and increasing miniaturisation of all the applications of electronics, from computers to mobile phones. The continuous advance of miniaturisation over the last half century has increased the performance of electronics exponentially; at this rate it will reach the nano-scale in a couple of decades. Nanoscience lets us envisage single electron transistors, with a further exponential increase of performance. Through similar developments in single molecule reactions or single photon emissions, nanotechnology will make a major input to Europe's economic growth in the 21st century.

Major investments in nanoscience research

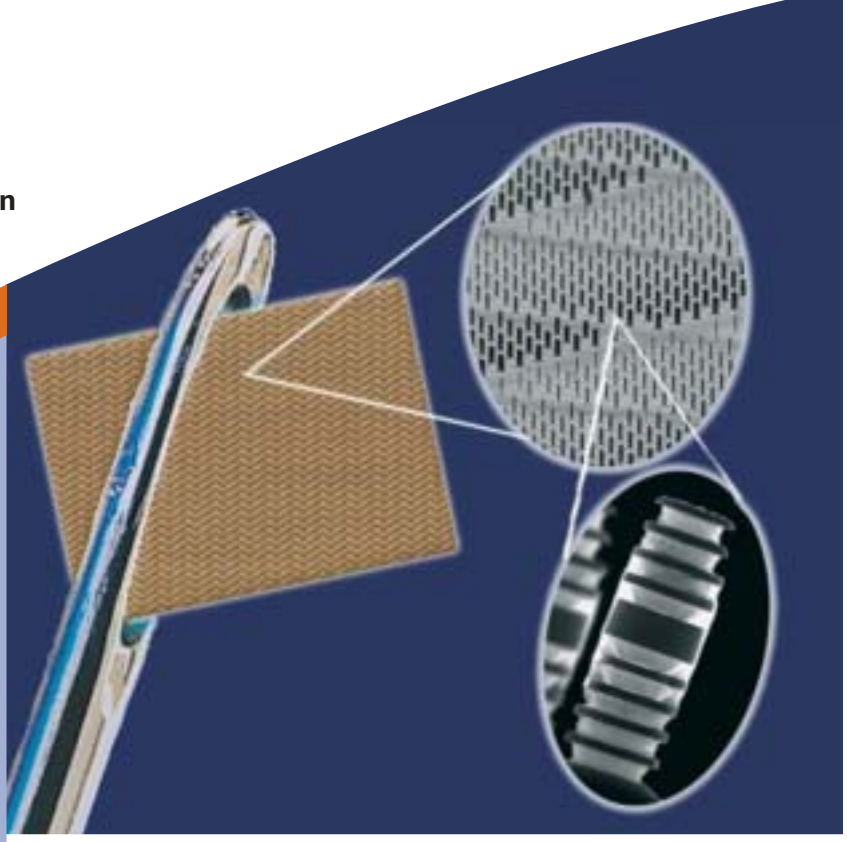
The great potential of nanoscience has encouraged many nations to invest heavily in it. While not yet matching the US and Japan, European nations and the European Commission together spend close to a billion euros each year on nanoscience. But this effort is fragmented. Any given programme tends to reflect national capabilities and needs and each has developed independently of the others. Collaboration between national programmes has so far been very limited to a few specific applications.

The new ERA-NET NanoSci-ERA aims to establish collaboration and help integrate these separate programmes. It will put nanoscience on a European footing for the first time, laying a firmer foundation for continuing European prosperity.

Nanoscience networking

The NanoSci-ERA three-year Coordination Action aims to set up an effective sustainable network of the major national organisations in Europe that fund nanoscience research. In the long term it will encourage continued co-operation and the convergence of research policies. The first stage is to set up the actual network between national partners with systematic exchange of information and best practice, creating the basis for open collaboration. Mapping of research programmes and capabilities will give an

Coordination Action
Nanosci-ERA



Full title:
Nanoscience in the European Research Area

Research field:
Nanoscience

Co-ordinator:
France: Centre Nationale de la Recherche Scientifique

Partners:
- Austria: Fonds zur Förderung der Wissenschaftlichen Forschung
- Finland: Academy of Finland
- France: Commissariat à l'Energie Atomique
- France: Ministère Délégué à la Recherche
- Germany: Deutsche Forschungsgemeinschaft
- Israel: Israel Science Foundation
- Italy: Istituto Nazionale per la Fisica della Materia
- The Netherlands: Stichting FOM
- The Netherlands: Technologiestichting STW
- Spain: Ministerio de Educación y Ciencia
- UK: Engineering and Physical Sciences Research Council

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"This grand challenge requires competences from all traditional scientific disciplines, biology, chemistry, physics… and calls for a concerted effort throughout Europe"

overview of the current state of nanoscience in Europe.

This review will enable possible joint transnational research proposals to be developed, to capitalise on joint strengths or fill obvious gaps in knowledge. A further aim is to help to consolidate the European nanoscience research community, through conferences, exchange schemes and training programmes. The result will be to give Europe an increasing presence in international nanoscience, promoting excellence in the topic and in the research community. This objective will be supported by expanding the consortium to include emerging partners and associates, which will help to spread capability in this new multi-disciplinary branch of science more widely in Europe.

Finally, NanoSci-ERA will reach out to the rest of society, keeping policy-makers, academics and public opinion, including young people, in touch with this emerging field and its vast potential.

Links with nanotechnology

The rapid advance of all the facets of nanoscience encouraged by NanoSci-ERA will hasten the evolution of nanotechnology products and processes. This will add value to the considerable national investments in nanoscience. Other ERA-NETs, such as ERA-Chemistry, MNT (Micro-Nano-Technology) and MATERA (Materials), have nano-technology elements, and NanoSci-ERA will maintain close contact with them so that mutual benefits can be easily realised. These networks will play their part in ensuring that the opening decades of this century see developments in nanotechnology that match those of recent years in electronics.