ANNALS of the ORADEA UNIVERSITY.
Fascicle of Management and Technological Engineering

NON-CONVENTIONAL NANO-TECHNOLOGIES

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Abstract:
In general, the mechanic non-conventional technologies are characterized by manufacturing capacity with a thin tool a strong material. Nanotechnologies are the technologies of the future, which have the ability to create and control objects on the scale of ~ 1 – 100 nm, with the goal of preparing novel materials that have specific properties and functions. This paper shows some cases with specific non-conventional technologies properties in nano- domain.

1. INTRODUCTION

The nanotechnologies are results after the progress in scientifically and technological research in molecular direction, with specific tools and machine. The development of nanotechnologies began together with nanoscience.

Interest in nanoscience is burgeoning, largely due to its enormous practical potential. Yet it is very clear that nanoscience has provided a new way of thinking that has the potential to promote truly exciting developments in fundamental science as well. Long-standing questions in condensed matter physics and chemistry, in biological science, in materials science, and in mechanical engineering will receive renewed attention as a result of the exciting developments in nanotechnology.

2. NANOSTRUCTURES AND NANOTECHNOLOGIES

Nanostructures are the entry into a new realm in physical and biological science. They are intermediate in size between molecular and microscopic (micron-size) structures. They contain a countable number of atoms, and are, as a result, uniquely suited for detailed atomic-level engineering. They are chameleons: viewed as molecules, they are so large that they provide access to realms of quantum behaviour that are not otherwise accessible; viewed as materials, they are so small that they exhibit characteristics that are not observed in larger (even 0.1 µm) structures. They combine small size, complex organizational patterns, potential for very high packing densities and strong lateral interactions, and high ratios of surface area to volume. Nanostructures are the natural home of engineered quantum effects. Microstructures have formed the basis for the technologies that support current microelectronics.

Although microstructures are small on the scale of direct human experience, their physics is largely that of macroscopic systems. Nanostructures are fundamentally different: their characteristics - specially their electronic and magnetic characteristics -are often dominated by quantum behaviour. They have the potential to be key components in information technology devices that have unprecedented functions. They can be fabricated in materials that are central to electronics, magnetic, and optics. Exploring the science of nanostructures has become, in just a few years, a new theme common to many established disciplines.

2. TECHNOLOGICAL ADVANCEMENTS IN NANOSCIENCE

Nanoscience has exploded in the last decade, primarily as the result of the development of new tools that have made the characterization and manipulation of nanostructures practical, and also as a result of new methods for preparation of these structures.

Such fundamental properties as the melting temperature of a metal, the remanence of a magnet, and the band gap of a semiconductor depend strongly upon the size of the component crystals, provided they are in the nanometer regime. Almost any property in a solid is associated with a particular length scale, and below this length, the property will vary. For instance, the exciton diameter in a semiconductor may be tens or hundreds of nanometers, the distance between domain walls in a magnet may be hundreds of nanometers, etc. This opens the prospect for creating a new generation of non-conventional materials with designed properties, not just by changing the chemical composition of the components, as has been done in the past, but by controlling the size and shape of the components. This creates great opportunities for fundamental science in condensed matter physics, solid state chemistry, materials science, electrical engineering, biology, and other disciplines. Scanning probe microscopies have revolutionized characterization of nanostructures, and development of new variants of scanning probe devices continues apace. Older tools, especially electron microscopy, continue to play essential roles. In biological nanoscience, the combination of X-ray crystallography and NMR spectroscopy offers atomicresolution structural information about structures as complex as entire virus particles. These advances are currently occurring in the synthesis and fabrication of isolated nanostructures. These activities range from colloidal synthesis of nanocrystals to the growth of epitaxial quantum dots by strained layer growth. Related activities include the preparation of fullerenes, buckytubes, and other one-dimensional nanostructures, as well as the growth of mesoporous inorganics. Increased activity in the nanoscale design of polymers is also occurring, including the development of dendrimers and complex block copolymers. The techniques of molecular biology have made a very wide range of biological nanostructures readily available through cloning and overexpression in bacterial production systems. While much has been accomplished in the growth of isolated nanostructures, work has only just begun in the use of self-assembly techniques to prepare complex and designed spatial arrangements of nanostructures. A parallel line of current activity in fabrication of patterned nanostructures rests on the extension of techniques highly developed in the field of microelectronics: photolithography, X-ray lithography, and e-beam lithography.

3. ABOUT NANOMANUFACTURING

Developing techniques for fabricating nanostructures inexpensively in very large numbers - that is, manufacturing them - is an area that requires substantial effort: nanoscience will not be fully successful until it has provided the base for manufacturing technologies that are economically viable. It is probable that methods developed for microfabrication in the >100 nm size range will not work in the 20 nm range. It will thus probably be necessary to develop an entire new suite of manufacturing methods for nanostructures. There is reason to believe that self-assembly and soft lithography will be able to make substantial contributions to this important problem, but other fundamentally new methods will also be needed.

One of the opportunities in basic science is to search for synergies between nanoscience in biology and nanoscience as developed in the contexts of computation and information science and solid-state physics and chemistry. There is no question that understanding the structure and function of biological nanostructures will stimulate fabrication of nonbiological materials; it is possible that biologically derived structures may also be useful in assembly of systems of nanodevices. In return, nanofabrication can provide analytical tools for investigating biomolecules (in genomics, proteomics, and highthroughput screening for drug leads) as well as for exploring the interior structure and function of cells. One objective of nanoscience should be to build robust intellectual bridges between its currently scattered disciplinary components, but especially between nanoelectronics and molecular biology. The conversion of energy into controlled motion plays an important role in several biological systems such as muscle fibers, flagella and cilia, for example. The confluence of scientific developments in molecular biology, materials science and nano-fabrication now offers the potential to engineer functional hybrid nano-mechanical systems. A particular goal is thus to integrate biological motors with nano-mechanical systems as might be found. A wide range of experimental techniques that qualify for the title biosensor are developed and used at iNANO. With these techniques it is possible to detect, measure mass and determine structure of biomolecular species. A biosensor can also be defined as any biological component that can be used to sense the chemical or physical environment. A geneticaly engineered organism that for example emits light when exposed to some variable is thus often named a biosensor.

4. HYDROGEN TECHNOLOGY

Modern society is based on energy produced mainly by burning fossil fuels. Besides having unacceptable effects on climate, this resource will eventually be exhausted. Thus there is a need for alternative sources of energy, and as hydrogen is available in large quantities, hydrogen as a fuel represents a prime candidate for this role. To exploit the energy stored in hydrogen, it is necessary to find non-polluting ways to manufacture hydrogen and to develop fuel cells, which transform H2 and O2 into H2O. Seen as an entity the fuel cell essentially works as a battery, the only difference being, that the fuel cell is designed for continuous replenishment of the reactants consumed, whereas the battery will eventually be exhausted. When hydrogen is fed into a fuel cell, a catalyst on the anode surface converts the gas into negatively charged electrons (e-) and positively charged ions (H+). The electrons (e-) flow through an external electrical circuit to the cathode, while the hydrogen ions (H+) migrate through the electrolyte to the cathode where they combine with oxygen and the electrons (e-) to produce water.

The most critical obstacle in developing hydrogen technology is the storage of hydrogen. The problem is easily seen by comparing the energy to volume ratio for gaseous hydrogen (3.0MJ/L) to that of conventional gasoline (32.0MJ/L). So how could we store hydrogen for use in e.g. cars? Some possible solutions are to use liquid hydrogen (8.5MJ/L), to use compressed hydrogen or to store hydrogen in solid metallic hydrides (e.g. MgH_2, $LaNi_5H_6$ or $TiFeH_2$).

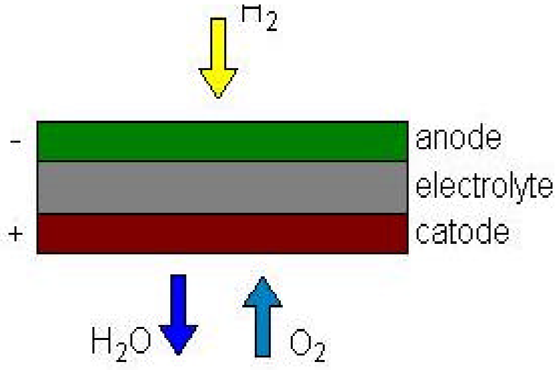

Figure 1. *- Schematic of one type of fuel cell.*

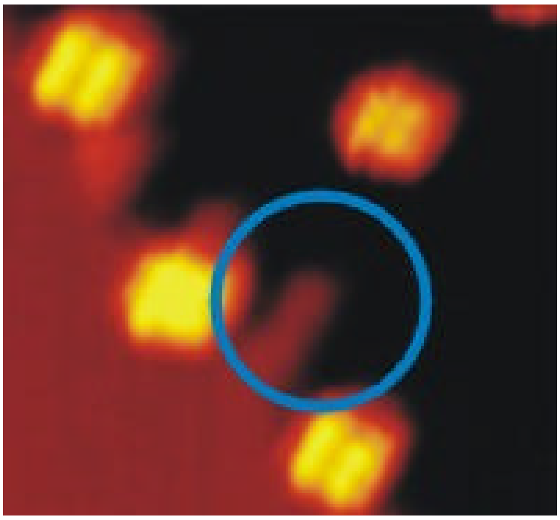

Figure 2*. Image showing a nanoscopic feature molded into a monoatomically high step-edge on a copper surface.*

5. CONCLUSIONS

In general the nanotechnologies are destined for nanomaterials. Those are cornerstones in all attempts to develop and exploit nanotechnology. Already today there are successful examples of nanomaterials on the market and potential applications include thermoelectrics, electronics, sensors, coatings, superconductors, optical fibres, optical barriers, magnetic materials, shape changing alloys, polymers, ceramics, membranes, catalysts, paints, lubricants, pesticides, food additives, anti-microbials, sunscreens, fuel cells, solar cells, cosmetics etc.

To fully exploit the potential of nanotechnology and transform it to applications that have a strong impact on individuals and the society as a whole, focus is needed on continued development of nano-characterization tools as well as on new processing schemes, which allow for improved control of the properties and scale-up to industrial scale manufacturing in a cost effective and sustainable way

The manufacturing methods are very crude at the molecular level. Casting, grinding, milling and even lithography move atoms in great thundering statistical herds. It will be essential if it are to continue the revolution in computer hardware beyond about the next decade, and will also let fabricate an entire new generation of products that are cleaner, stronger, lighter, and more precise.

For this period the many of the nanotechnologies are at the limits between conventional and non-conventional domain.

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