announced. The nanocomposites being used in tires can be used in other consumer products as well, according to experts, including high performance footwear, exercise equipment, and car parts such as belts, wiper blades and seals.

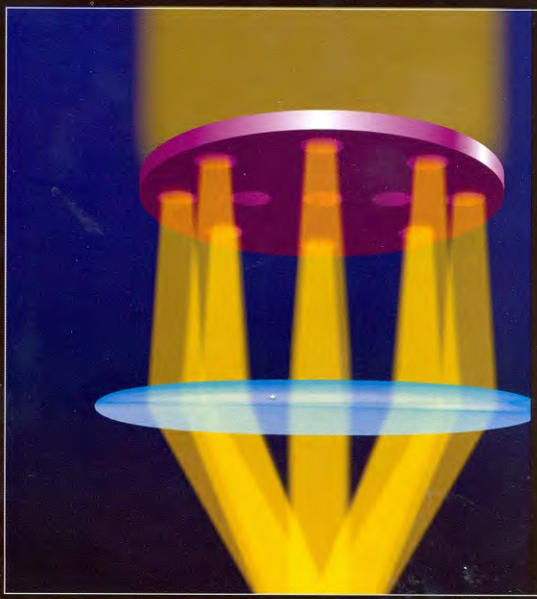
The pharmaceutical and chemical industries are being impacted greatly by nanotechnology, as well. New commercial applications of nanotechnology that are expected in two to five years in these industries include:

- advanced drug delivery systems, including implantable devices that automatically administer drugs and sensor drug levels and
- medical diagnostic tools, such as cancer tagging mechanisms.

What products will be available in the next 10-20 years?

It's hard to predict what products will move from the laboratory to the marketplace over such a long period, but today's predictions center on pervasive computing applications. It is believed that nanotechnology will facilitate the production of ever-smaller computers that store vastly greater amounts of information and process data much more quickly than those available today. Computing elements are expected to be so inexpensive that they can be in fabrics (for smoke detection, for instance) and other materials. Read about Moore's Law and continued advances in computing and electronics.

Advances in the field of defense are also expected through work in nanoscience. See the Institute for Soldier Nanotechnologies, which is housed at the Massachusetts Institute of Technology in Cambridge, Mass.



What are engineered nanoparticles?

Engineered nanoparticles refers to those that do not occur naturally but are created by people. People have been putting together different materials throughout time, and now are doing so on the nanoscale.

How can I get funding for my research in nanotechnology?

See Funding Opportunities.

How many researchers are working in nanotechnology today?

The current estimate is about 20,000 worldwide.

What are future workforce needs?

The National Science Foundation has estimated that 2 million workers will be needed to support nanotechnology industries worldwide within 15 years.

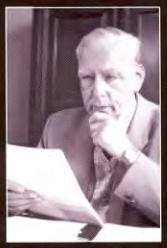
المرجع:

http://www.nano.gov/html/facts/home_facts.html

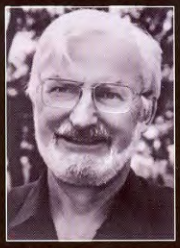
millionth of a millimeter. See The Scale of Things and Three Examples at the Nanoscale
A nanometer-sized particle also is smaller than a living cell and can be seen only with the most powerful microscopes available today.

Why fund nanotechnology?

Because of the promise of nanotechnology to improve lives and to contribute to economic growth, the Federal Government, through the guiding efforts of the U.S. National Nanotechnology Initiative (NNI), is supporting research in nanotechnology. As a result of the NNI research efforts, the United States is a global leader in nanotechnology development.



Ernst Ruska



Heinrich Rohrer

Gerd Binnig

How much money is the U.S. government spending on nanotechnology?

Federal funding for nanotechnology R&D has increased substantially since inception of the NNI, from $464 million in 2001 to an estimated $1,392 million in 2007. The 2008 budget request that President Bush has sent to Congress calls for a total NNI budget of $1,445 million.

How does this spending compare to other countries?

The United States is not the only country to recognize the tremendous economic potential of nanotechnology. While difficult to measure accurately, some have estimated that worldwide government funding has increased to about five times what it was in 1997, exceeding $2 billion in 2002. Asian countries, including Japan, China and Korea, as well as several European countries, have made leadership in nanotechnology national priorities.

What products available today have resulted from nanoscience?

Numerous products featuring the unique properties of nanoscale materials are available to consumers and industry today. Most computer hard drives, for instance, contain giant magnetoresistance (GMR) heads that, through nano-thin layers of magnetic materials, allow for a significant increase in storage capacity. Other electronic applications include non-volatile magnetic memory, automotive sensors, landmine detectors and solid-state compasses.
Some other current uses that are already in the marketplace include:

- Burn and wound dressings
- Water filtration
- Catalysis
- A dental-bonding agent
- Step assists on vans.
- Coatings for easier cleaning glass
- Bumpers and catalytic converters on cars
- Protective and glare-reducing coatings for eyeglasses and cars
- Sunscreens and cosmetics.
- Longer-lasting tennis balls.
- Light-weight, stronger tennis racquets.
- Stain-free clothing and mattresses.
- Ink.

See Applications and Products.

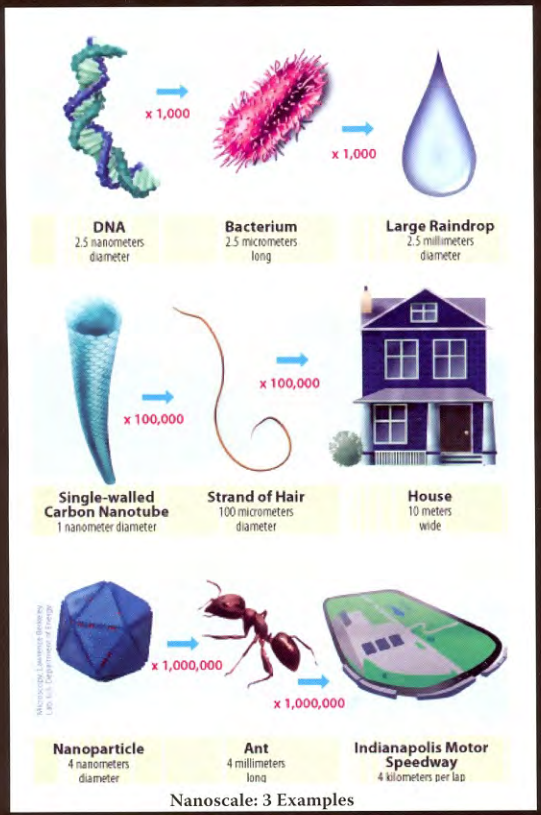
What products will be available in the next few years?

Watch for solar cells in roofing tiles and siding that provide electricity for homes and facilities. The vision of researchers working in this field is a much cleaner environment due to greater use of solar energy (and less burning of fossil fuels) and a higher standard of living for the many parts of the world that do not have access to efficient, reliable energy.
Prototype tires exist today that provide improved skid resistance, reduced abrasion and resulting longer wear, although a date for market introduction has yet to be

development of a revolutionary, low-cost technology for cleaning arsenic from drinking water. The technology holds promise for millions of people in India, Bangladesh and other developing countries where thousands of cases of arsenic poisoning each year are linked to poisoned wells. The new technique is described in the Nov. 10 issue of Science magazine. Read more about Rice University's research

Microscopes and Nanoscale Science:

Nanoscale science was enabled by advances in microscopy, most notably the electron, scanning tunneling and atomic force microscopes, among others. The 1986 Nobel Prize for Physics honored three of the inventors of the electron and scanning tunnel microscopes, Ernst Ruska, Gerd Binnig and Heinrich Rohrer.



Nanoscale: 3 Examples

Exploring the World through Microscopes

The scanning tunneling microscope (STM) is one of a number of instruments that allows scientists to view and manipulate nanoscale particles, atoms and small molecules. The STM, which was first used in the mid-1980s, allowed scientists not only to see details of atomic structures, but also to manipulate those structures. STMs have opened the door to images of what happens out of sight of the naked eye.

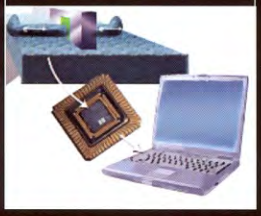
A precursor instrument, the topografiner, was invented by Russell Young and colleagues between 1965 and 1971 at the National Bureau of Standards (NBS) [currently the National Institute of Standards and Technology (NIST)].

Frequently Asked Questions

What is a nanometer?

It's defined as one billionth of a meter. How small is that? Some ways to think about just how small a nanometer is:

- A sheet of paper is about 100,000 nanometers thick.
- Blond hair is probably 15,000 to 50,000 nanometers in diameter, but black hair is likely to be between 50,000 and 180,000 nanometers.
- There are 25,400,000 nanometers in an inch.
- A nanometer is a



Electronic properties of CNTs have made them a candidate for flat panel displays in TVs, batteries, and other electronics. Nanotubes for various uses can be made of materials other than carbon.

Nanoscale transistors

Transistors are electronic switching devices where a small amount of electricity is used like a gate to control the flow of larger amounts of electricity. In computers, the more transistors, the greater the power. Transistor sizes have been decreasing, so computers have become more powerful. Now, the industry's best commercial technology produces computer chips with features as small as 45 nanometers

Solar Plastics

Thin, flexible, lightweight rolls of plastics containing nanoscale materials are being developed that some people believe could replace traditional solar energy technologies. The nanoscale materials absorb sunlight and, in some cases, indoor light, which is converted into electrical energy. Thin-film solar cells paired with a new kind of rechargeable battery also are the subject of research today. This technology will be more widely used when researchers learn how to capture solar energy more efficiently.

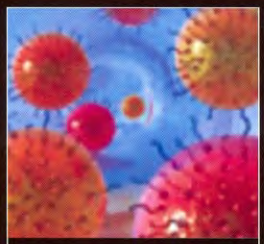
Water-Filtration Techniques

Researchers are experimenting with carbon nanotube-based membranes for water desalination and nanoscale sensors to identify contaminants in water systems. Other nanoscale materials that have great potential to filter and purify water include nanoscale titanium dioxide, which is used

in sunscreens and which has been shown to neutralize bacteria, including E. coli, in water.

Benefits of Nanotech

Nanorust Cleans Arsenic from



Drinking Water. Image courtesy of CBEN/Rice University

Nanotechnology for Clean Water: New Research Funding Brings Hope

Interest in clean water research is flowing. And much of it is focused on nanotechnology, which many believe will be a major contributor to new industrial and public water purification systems. With the World Health Organization estimating that as many as 35 percent of the deaths worldwide are due to contaminated drinking water supplies, research focused on various forms of purification and filtration is critically important.

Among the NNI agencies, the Environmental Protection Agency (EPA) recently issued research grants for the development of new methods of insuring clean drinking water. EPA's 10 research grants to nine universities are for developing better methods for detecting harmful organisms in drinking water, including viruses, bacteria and protozoa. The grants, totaling $5 million, were awarded through the EPA National Center for Environmental Research Program's Science to Achieve Results (STAR) research grants.

With funding from the National Science Foundation, Rice University researchers recently discovered unexpected magnetic interactions between ultra small specks of rust, which can help to remove arsenic from drinking water. Rice University's Center for Biological and Environmental Nanotechnology (CBEN) says its research could lead to the

metal in a car! Carbon nanotubes also conduct both heat and electricity better than any metal, so they could be used to protect airplanes from lightning strikes and to cool computer circuits.

Applications and Products: Putting Technology to Use

Over the past two decades, scientists and engineers have been mastering the intricacies of working with nanoscale materials.

Now researchers have a mucher clearer picture of how to create

nanoscale materials with properties never envisioned before.

Products using nanoscale materials now available:

- anti-bacterial wound dressings use nanoscale silver.
- A nanoscale dry powder can neutralize gas and liquid toxins in chemical spills and elsewhere.
- Batteries for tools are being manufactured with nanoscale materials in order to deliver more power more quickly with less heat.

Cosmetics and food producers are "nano-sizing" some ingredients, claiming that improves their effectiveness. Sunscreens containing nanoscale titanium dioxide or zinc oxide are transparent and reflect ultraviolet (UV) light to prevent sunburns. Scratch- and glare-resistant coatings are being applied to eye glasses, windows, and car mirrors.

Entirely new products could result from nanotechnology too. Research in nanomedicine, for instance, is focused on finding new ways for diagnosing and treating disease.

Looking farther into the future, some researchers are working toward nanomanufacturing and a "bottom-up" approach to making things. The idea is that if you can put certain molecules together, they will self-assemble into ordered structures. This approach could reduce the waste of current "topdown" manufacturing processes that start with large pieces of materials and end with the disposal of excess material.

Drug-Delivery Techniques

Dendrimers are a type of nanostructure that can be precisely designed and manufactured for a wide variety of applications, including treatment of cancer and other diseases. Dendrimers carrying different materials on their branches can do several things at one time, such as recognizing diseased cells, diagnosing disease states (including cell death), drug delivery, reporting location , and reporting outcomes of therapy.

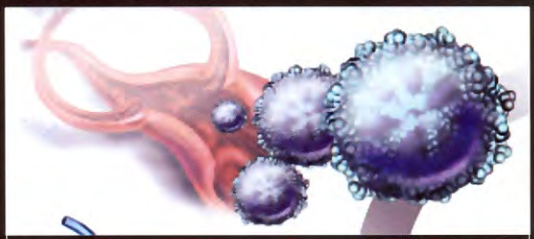
Nanofilms

Different nanoscale materials can be used in thin films to make them water-repellent, anti-reflective, self-cleaning, ultraviolet or infrared-resistant, antifog, anti-microbial, scratch-resistant, or electrically conductive. Nanofilms are used now on eyeglasses,

computer displays, and cameras to protect or treat the surfaces.

Nanotubes

Carbon nanotubes (CNTs) are used in baseball bats, tennis racquets, and some car parts because of their greater mechanical strength at less weight per unit volume than that of conventional materials.



Dimensions between approximately 1 and 100 nanometers are known as the nanoscale. Unusual physical, chemical, and biological properties can emerge in materials at the nanoscale. These properties may differ in important ways from the properties of bulk materials and single atoms or molecules.

What is special about the nanoscale?

Unusual physical, chemical, and biological properties can emerge in materials at the nanoscale. These properties may differ in important ways from the properties of bulk materials and single atoms or molecules: some are better at conducting electricity or heat, some are stronger, some have different magnetic properties, and some reflect light better or change colors as their size is changed.

Surface area

Nanoscale materials also have far larger surface areas than similar volumes of larger scale materials, meaning that more surface is available for interactions with other materials around them.

How small is a nanometer?

It's defined as one billionth of a meter. How small is that? Some ways to think about just how small a nanometer is:

- A sheet of paper is about 100,000 nanometers thick.
- Blond hair is probably 15,000 to 50,000 nanometers in diameter, but black hair is likely to be between 50,000 and 180,000 nanometers.
- There are 25,400,000 nanometers in an inch.
- A nanometer is a millionth of a millimeter.

Where are nanoscale materials found?

If scientists can create artificial spider silk economically, the superstrong, lightweight materials could be used in sports helmets, armor, tethers and other products. **Nanoscale materials and effects are found in nature all around us.** Nature's secrets for building from the nanoscale create processes and machinery that scientists hope to imitate. Researchers already have copied the nanostructure of lotus leaves to create water repellent surfaces used today to make stain-proof clothing, other fabrics, and materials. Others are trying to imitate the strength and flexibility of spider silk, which is naturally reinforced by nanoscale crystals. Many important functions of living organisms take place at the nanoscale. Our bodies and those of all animals use natural nanoscale materials, such as proteins and other molecules, to control our bodies' many systems and processes. A typical protein such as hemoglobin, which carries oxygen through the bloodstream, is 5 nanometers, or 5 billionths of a meter, in diameter.

Nanoscale materials are all around us, in smoke from fire, volcanic ash, sea spray, as well as products resulting from burning or combustion processes. Some have been put to use for centuries. One material, nanoscale gold, was used in stained glass and ceramics as far back as the 10th Century. But it took 10 more centuries before high-powered microscopes and precision equipment were developed to allow nanoscale materials to be imaged and moved around.

What is nanoscale behavior?

At the nanoscale, objects behave quite differently from those at larger scales. Gold at the bulk scale, for instance, is an excellent conductor of heat and electricity, but not of light. Properly structured gold nanoparticles, however, start absorbing light and can turn that light into heat, enough heat, in fact, to act like miniature thermal scalpels that can kill unwanted cells in the body, such as cancer cells.

Other materials can become remarkably strong when built at the nanoscale. For example, nanoscale tubes of carbon, 1/100,000 the diameter of a human hair, are incredibly strong. They are already being used to make bicycles, baseball bats, and some car parts today. Some scientists think they can combine carbon nanotubes with plastics to make composites that are far lighter, yet stronger than steel. Imagine the fuel savings if such a material could replace all the

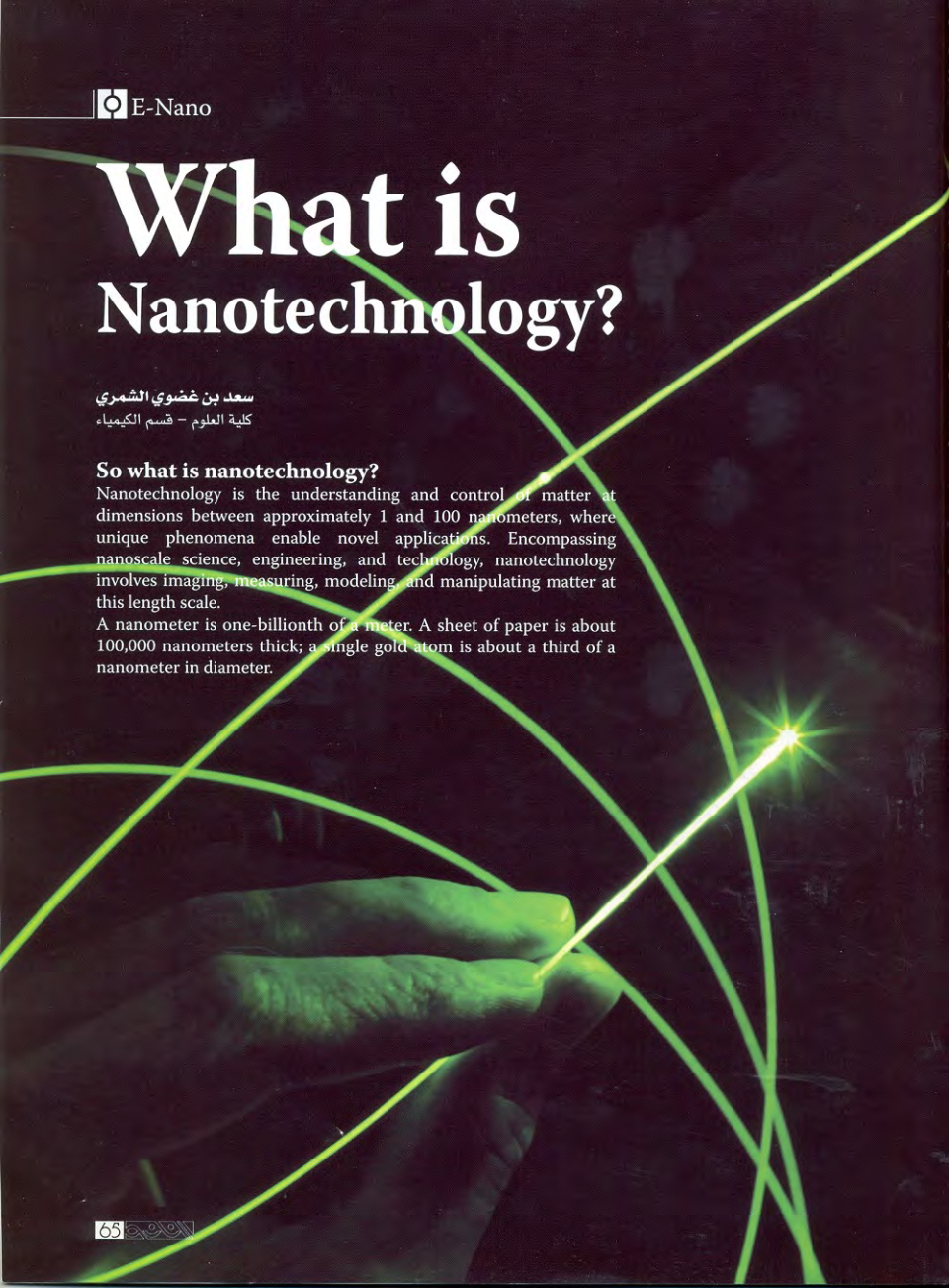
What is Nanotechnology?

سعد بن غضوي الشمري
كلية العلوم – قسم الكيمياء

So what is nanotechnology?

Nanotechnology is the understanding and control of matter at dimensions between approximately 1 and 100 nanometers, where unique phenomena enable novel applications. Encompassing nanoscale science, engineering, and technology, nanotechnology involves imaging, measuring, modeling, and manipulating matter at this length scale.

A nanometer is one-billionth of a meter. A sheet of paper is about 100,000 nanometers thick; a single gold atom is about a third of a nanometer in diameter.



د.ضيف الله بن محمد الضعيان
قسم الكيمياء - جامعة الملك سعود

هل تُصلح النانو... ما أفسده (دهر) الأزمة المالية العالمية؟!

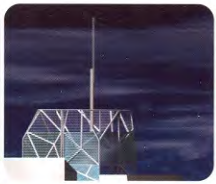
في هذه الأيام التي تعلن فيها الشركات العالمية الكبرى عن قوائمها المالية للعام المنصرم (٢٠٠٨)، تحمل لنا وسائل الإعلام كل صباح أخباراً عن خسائر ببلايين الدولارات، وعن إغلاق مصانع، وإلغاء مشاريع، وتسريح آلاف العمال والموظفين، كنتيجة طبيعية لآثار الزلزال المدمر الذي ضرب الاقتصاد الأمريكي في نهاية (العصر البوشي) سَيِّئ الذكر، وامتدت آثاره إلى جميع الاقتصاديات العالمية، مذكراً "بأمواج تسونامي" نهاية العام ٢٠٠٤ التي أحدثت دماراً هائلاً وقتلت مئات الآلاف من البشر نتيجة الزلزال الضخم الذي ضرب منطقة المحيط الهندي، وتتابعت أمواجه حتى وصلت شواطئ إفريقيا.

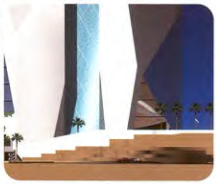
هذه الأزمة المالية العالمية التي أطاحت بعدد من رموز الاقتصاد الرأسمالي من بنوك وبورصات وشركات تأمين، جاءت نتيجة التوسع المحموم من قبل البنوك الأمريكية في الإقراض العقاري الربوي لمحدودي الدخل من الأمريكيين، الذين استغلوا ارتفاع أسعار هذه العقارات في رهنها لدى البنوك مقابل قروض أخرى، مما أنعش الإنفاق الاستهلاكي وبالتالي استمرار النمو الخادع في الاقتصاد الأمريكي، الذي لم يكن نتاج اقتصاد حقيقي، بل كان قائماً على سلسلة من الديون المتضخمة التي لم يكن لها أي ناتج في الاقتصاد الفعلي، حيث كانت عبارة عن أوراق من السندات والمشتقات والخيارات والرهون العقارية، تم تبادلها والمضاربة عليها في البورصات؛ وتقاذفتها البنوك وشركات العقار وشركات التأمين في عمليات خداع كبيرة لمستثمرين عالميين. وحين انهار السوق العقاري الأمريكي نتيجة عجز المقترضين عن السداد انهارت هذه السلسلة من الشركات والمؤسسات المالية الكبرى. ويرى المراقبون أن إدارة بوش سهلت ورخصت لمثل هذه الإجراءات رغم تحذيرات بعض المتخصصين والمهتمين بالشؤون الاقتصادية، في محاولة منها للتغطية على إخفاقاتها في العراق وأفغانستان، والاستنزاف المالي الكبير الذي كان يثقل كاهل دافع الضرائب الأمريكي نتيجة لهذه الحروب العبثية.

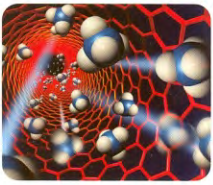
والسؤال المطروح أعلاه، هل تستطيع تقنية النانو إنقاذ الاقتصاد العالمي من هذا الانهيار المدمر من خلال المجالات الرحبة التي فتحها ما بات يعرف «بالاقتصاد المعرفي»؟

إن حجم الإنفاق العالمي على الأبحاث المتعلقة بهذه التقنية ومحاولات توظيفها في إنتاج مواد جديدة، أو تحسين خواص المواد الموجودة ضخم بكافة المقاييس، والمنتظر من نتائج هذه الأبحاث هو دعم الاقتصاد العالمي بتريليونات الدولارات، عبر مختلف الصناعات الطبية والصيدلانية والمنتجات الحيوية والزراعية والغذائية، إلى جانب الصناعات البترولية والبتروكيميائية، وكافة المجالات الحياتية كصناعة السيارات والإلكترونيات والاتصالات ودراسات الفضاء وعلوم البيئة...إلخ.

وباختصار: هل تنقذ تقنية $(1\text{-}100) \times 10^{-9}$ m الشركات العالمية التي بلغت خسائرها أكثر من $(1\text{-}100) \times 10^{9}$ $؟



معهد الملك عبدالله لتقنية النانو

يسر المعهد دعوة جميع الباحثين والمهتمين بتقنية النانو للتسجيل في قاعدة بيانات معهد الملك عبدالله عن طريق الصفحة الالكترونية للمعهد .

أهم أنشطة المعهد:

» الطاقة.
» معالجة المياه.
» الاتصالات.
» الطب والصيدلة.
» الغذاء والبيئة.
» تصنيع خصائص مواد النانو ودراستها.

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King Abdullah Institute For Nanotechnology - Issue 2 - February 2009

What is Nanotechnology?