seeing nano.

Memory Game

SeeingNano is a European Union supported project creating new visualisation tools that provide the public with an understanding and awareness for the breadth of nanoscience and nanotechnologies, including the benefits, uncertainties and potential risks connected to them. Our materials are created in collaboration with visualisation professionals and experts in the nanotechnology, risk communications, and nanotoxicology to provide users with scientifically accurate and engaging ways to 'see' technologies at the nanoscale.

For more information about these principles and ongoing nanotechnologies research, please see www.seeingnano.eu.

Game rules

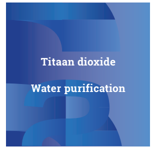
The object of the game is to collect matching cards. All cards are placed face down on a table. Shuffle the cards well and position them next to one another in neat rows. The youngest player starts and chooses two cards and turns them face up. If the two form a pair, then that player keeps the pair and plays again. If the cards do not match, they are turned face down in the same spot and play passes to the player on the left. The game ends when the last pair has been picked up. The player with most pairs wins the game.

The game is first played with the cards that show the nanoscale image and the application together on one card. The second game is a little more difficult, since the cards are not the same: one displays the nanoscale image, and the other shows the related application. Players have to remember from the first game which of the images form a pair (use the descriptions on the flip side of the card to see if you've remembered correctly).

NB. If you want to shorten the game, take some pairs out.

Game 1
one pair


Game 2
one pair



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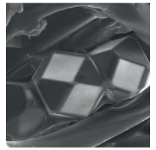
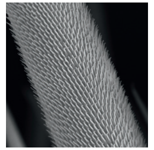


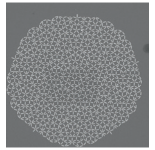

Diamond-like Carbon
Hard, wear-resistant coating
20.000 nm

Diamond-like carbon is used in engineering as a hard coating on metal components to reduce wear. Different forms exist which can be combined to give specific properties to a coating.



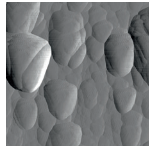

Spider leg
Hairs function as ears
10.000 nm

Spiders hear through hairs on their legs, each acting as an individual ear. The (nano size) hairs are capable of very sensitively monitoring air movements around the spider's body. Spiders' hairs can also help them to walk up vertical surfaces and across water.



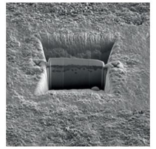

Magnetic copper/nickel alloy nanowire
Higher density memory
2.000 nm

Nanowires are used in the read heads in computer hard drives, giving higher density memory, allowing greater storage space.
© Alan Brown



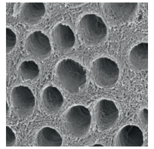

Zinc dithiophosphate layer
Low friction anti-wear
1.000 nm

Coatings and lubricant additives help to reduce friction and wear of engine components. A zinc dithiophosphate tribolayer (ZDDP) forms a soft, deformable layer on the moving surfaces of a car engine (piston or camshaft) which allow parts to slide over one another more easily, reducing wear.



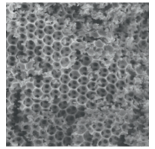

Titanium dioxide
Water purification
20.000 nm

Titanium dioxide acts as a photocatalyst and can be used to purify water, enhancing the effect of UV light to destroy dangerous micro-organisms and convert pollutants to less harmful products.



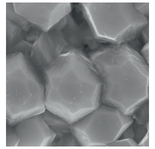

Dentine
Repair of enamel
10.000 nm

Natural tubules in dental tissue allow ion transport for growth of enamel. When exposed, they can make teeth highly sensitive to pain . Nanotechnology has been used to repair dental tissue, for example in filling cavities with nanoparticles or preparing a scaffold structure to grow mineral. In both cases the mineral used is the natural main component of teeth and bones.



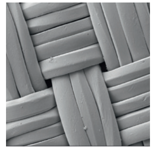

Photonic crystal
Trap light or provide colour
1.000 nm

The regular porous nanoscale structure of photonic crystals can be used to trap light or to provide colour (as in a butterfly's wing). The regular hole structure acts like a diffraction grating - certain wavelengths of light are trapped and absorbed - the light remaining results in exact colours.



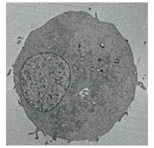

Zinc oxide crystallite
Gas detection
500 nm

Currently, photoelectric smoke sensors detect larger smoke particles found in dense smoke, but are not as sensitive to small particles of smoke from rapidly burning fires. Gas sensors convert the concentration of a gas into an electronic signal. Zinc oxide is a semiconductor material capable of gas sensing. When it is prepared as nanocrystals it presents a much greater detection surface and is much more sensitive to gas molecules. © Matthew Murray



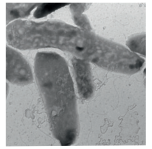

NanoWeaving
Stop water ingress
10.000 nm

Stops water from passing through the fabric without compromising the fabric quality. Nanomaterials can be used to improve fabric properties without a significant increase in stiffness, weight or thickness. The material could be made more water and stain repellent or antimicrobial action, depending on the nanomaterials included.



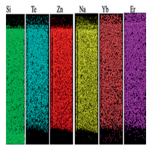

Human Cell
Natural nanomachine
5.000 nm

A human cell is a biological example of a naturally occuring nanomachine. The outer and inner membranes are made of phospholipid bilayers - two layers of phospholipids with their water repelling (hydrophobic) parts pointing inwards and water attracting (hydrophilic) parts facing outwards.




Nano Silver
Antimicrobial activity
1.000 nm

Nanosilver is used in countless consumer products as an antimicrobial agent. It offers the potential benefit of killing dangerous bacteria, but its toxicity to organisms could impact the environment negatively and give human health concerns.




Rare earth element-doped glass
Glucose sensing
500 nm

Erbium is a rare earth element which has specific light absorbing properties. When Erbium absorbs light of particular wavelengths, it then radiates light at specific wavelengths. This wavelength can be precisely controlled to detect glucose molecules, even through skin and blood veins, enabling non-invasive glucose sensing in diabetes patients.
© Jayakrishnan Chandrappan, Jacobs School of Engineering/UC San Diego

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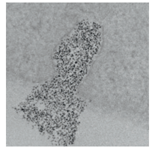
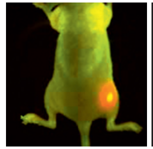
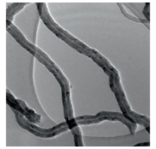
Description (from biggest size to smallest size)

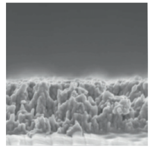
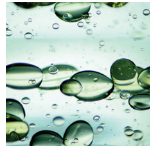
Quantum dots – cadmium telluride
Uptake of nanomedicines
200 nm

Quantum dots are used as fluorescent markers to track the uptake of nanomedicines within human cells. In the nanoscale, the colour of quantum dots varies with their size: larger dots are red or orange and smaller dots are green or blue.. © Nicole Hondow



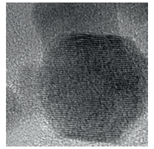

Carbon nanotubes
Strong and light material
100 nm

Carbon nanotubes are used to strengthen plastics and alter their electrical properties. The type of chemical bonding within nanotubes make them extremely strong. Numerous structures are possible which give different electronic properties and can be electrical conductors or semiconductors.

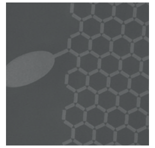
Titanium dioxide layer superhydrophobic coating
100 nm

The layer is extremely repellent to water droplets, causing them to remain as droplets and falling off the surface rather than forming a film. The droplets carry dirt particles with them, leaving a cleaner surface.



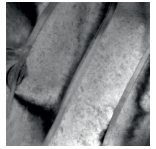

Ferrofluids
Medical imaging
5 nm

Ferrofluids contain nanoparticles suspended in a carrier liquid with surfactant to prevent the particles from joining together. They become strongly magnetised within a magnetic field. They are used for lubrication and sealing bearings, in medical imaging (MRI scanner) and for treating cancer through magnetic hyperthermia.



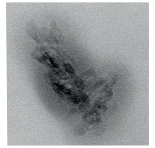

Cobalt-Iron-Boron Alloys
High density data storage
200 nm

Cobalt iron boron alloys are of research interest because the north and south poles of nanorods are fixed in close proximity when normally they would repel each other. This unusual property might in the future be applied in data storage.
© S. Morely C. Marrows, M. C. Rosamond, E. H. Linfield



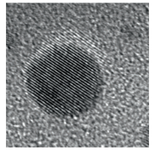

Iron/Carbon Alloy
High mechanical strength
100 nm

The structure of iron and carbon in steel gives high mechanical strength. Nanoparticle additives are used to improve the properties of steel, for example to increase its strength and reduce fatigue.



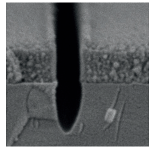

Alumium oxide
Clean and polish teeth
20 nm

This picture shows nano aluminium oxide particles in toothpastes. The crystal form of aluminium oxide at the nanoscale is softer than that formed at higher size ranges, so it polishes teeth to remove plaque but is less abrasive towards tooth enamel. © BFR



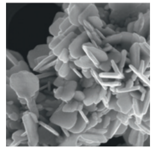

Gold/palladium alloy on titanium dioxide
Speed up chemical reactions
2 nm

Gold nanoparticles are used as catalysts in a number of chemical reactions. They are being developed for fuel cell applications. These technologies are expected to become useful in the automotive and display industry. © Mike Ward



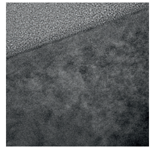
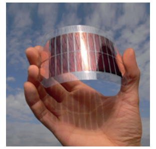

Nano trench
Crystallisation control for pharmaceutics
200 nm

A nano trench can be used to control the formation of drug crystals. Minute crystals form in a controlled way in the trench. From these 'seed' crystals, larger crystals can be formed which make up the active ingredient. © A. Bejarano-Villafuerte, F. Meldrum, M. C. Rosamond, E. H. Linfield EPSRC Publication: EP/M003027/1



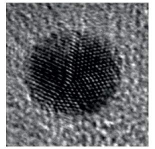

Zinc Oxide
UV protection
100 nm

Sunblocks are one of the most common applications of nanotechnology. Nanoscale particles offer UV protection. They're so small that they don't reflect visible light, making the sunblock transparent.

Tellurium-doped glass
Convert light photons in solar cells
10 nm

The very uniform structure (bottom layer) is intentionally , featureless to allow unhindered conversion of photons to electrons and 'electron holes' - so generating electric current and giving a more efficient electricity generation. © Matthew Murray




Gold nanoparticle
Quantum effects
2 nm

Particles of nanoscale gold were the accidental ingredient in red stained glass in the middle ages. The glass makers benefited from this effect without understanding the science behind it. Today, now that we can see at the nanoscale, we harness this colour changing property of gold for use in many different medical and biological applications.

Some general remarks on the potential health risks of nanomaterials

Beyond the achievements of nanotechnology in the areas of consumer convenience, medicine and economics, the investigation of potential health risks is a relevant part of nano science. That is because nano particles can have completely different properties than the material they were made of originally. Because of their small size, shape and high reactivity nano particles might feature distinct toxic intensities and make their way into other organs. Scientists are not (yet) able to simply deduce such possible toxic effects from the original materials' properties. But rather, each nanomaterial has to be risk-assessed seperately.

Yet, even in case specific nanoparticles are assessed to have potentially harmful effects, they only pose an actual health risk if humans are exposed and able to absorb these particles. In general, humans are not exposed to solid nanomaterials when the particles are bound in a tight matrix and cannot be released to enter the body. By contrast, unbound nanoparticles (in liquid or gaseous materials) in a size smaller than 100 nm are able to enter the human organism either via inhalation or via ingestion. Scientists believe that nanomaterials' greatest risks stem from the inhalation of nanoparticles. Whether the intake of nanoparticles via the gastrointestinal tract involves any risks is currently being investigated (see e.g. description to picture Alumium oxide in toothpaste). The possibility of nanoparticles penetrating healthy human skin has been largely ruled out by the latest scientific findings.

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