Wonders of nanotechnology

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THERE'S an unprecedented multidisciplinary convergence of scientists dedicated to the study of a world so small, one can't see it - even with a light microscope. That world is the field of nanotechnology, the realm of atoms and nanostructures. Nanotechnology refers broadly to a technology whose unifying theme is the control of matter on the scale, generally 100 nanometers or smaller, and the fabrication of devices with critical dimensions that lie within that size range (Lakhtakia 2004). Materials reduced to the nanoscale can suddenly show very different properties compared to what they exhibit on a macroscale; for example, opaque substances become transparent (copper), inert materials become catalysts (platinum, gold), stable materials turn combustible (aluminum), solids turn into liquids at room temperature (gold), insulators become conductors (silicon) that means that the behavior of substances at the nanoscale can sometimes contradict common sense by behaving erratically.

The unusual behaviors enable unique applications of these nanomaterials. Nanotechnology today is growing very rapidly and has infinite applications in almost everything we do - the medicine we take, food we eat, chemicals we use, car we drive and much more.

Nanotechnology is an expected future manufacturing technology that will make most products lighter, stronger, cleaner and less expensive. Future nanotechnology is likely to change the way almost everything around our life.

One nanometer (nm) is one billionth, or 10-9 of a meter. Basically, it is about the width of 3 to 4 atoms. The comparative size of a nanometer to a meter is the same as that of a marble to the size of the earth.

WHY NANOPARTICLES BEHAVE THE WAY THEY DO?

- At nano scale, the properties of materials change tremendously because of the large surface-to-volume ratio and changes in the quantum mechanical behavior of materials.
- The enormous surface area of nanomaterials facilitates their interaction with other substances, giving the nanomaterials unique properties such as exceptional strength or greater chemical activity.

Nanotechnology is likely to change the way almost everything: like Medicine, Food, Agriculture, Environment, Energy, Computer, Car etc.

The somewhat speculative claims about the possibility of using nanorobots in medicine; researchers say, would totally change the world of medicine once it is realized.

Introduced into the body, to repair or detect damages and infections.

In the process of constant advancement in auto technology, car makers are pondering on manufacturing environment-friendly vehicles utilizing nanotechnology.

Nano Agriculture: Nanofertilizer, nano encapsulated pesticides, acceleration of photosynthesis, biosensor .

Tomato plants sprout earlier and grow faster. carbon nanotubes that increase the germination percentage and support and enhance the growth of seedlings. The carbon nanaotubes are able to penetrate the thick seed coat to support water uptake inside the seeds.

References

A Lakhtakia (ed) (2004) The Handbook of Nanotechnology. Nanometer Structures: Theory, Modeling, and Simulation. SPIE Press, Bellingham, WA, USA. ISBN 0-8194-5186-X.

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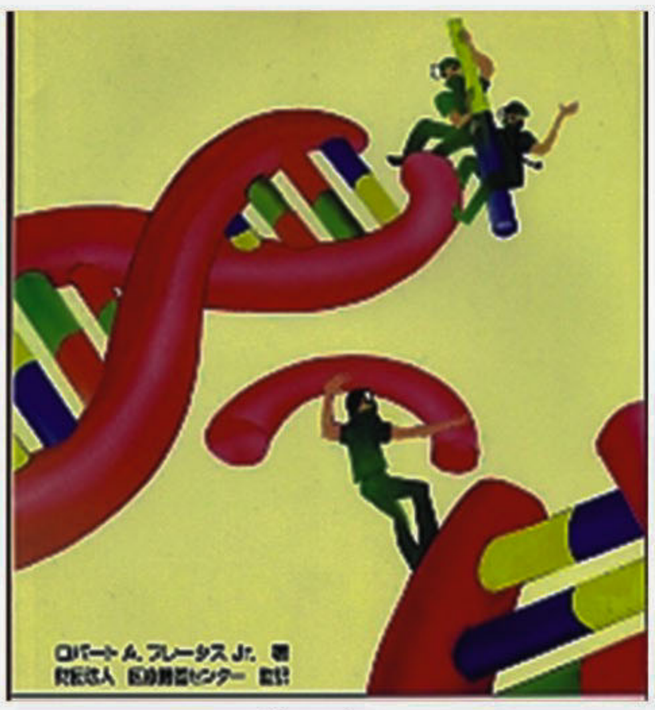
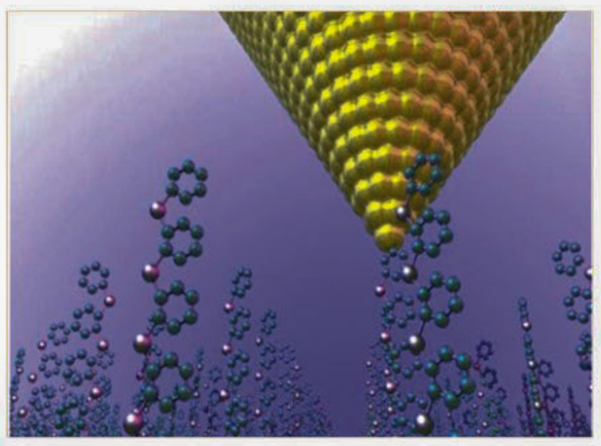
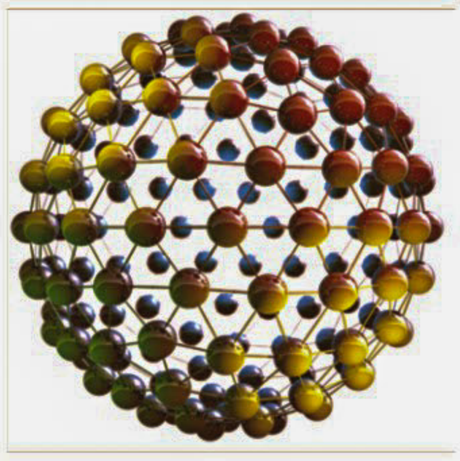


Nanorobots

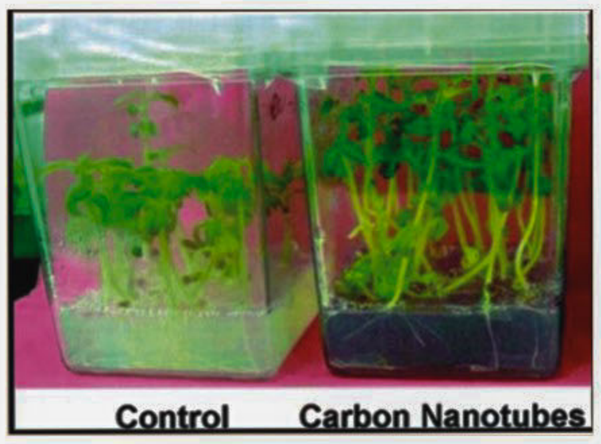


Turning waste heat into electricity

Nanotechnology in food

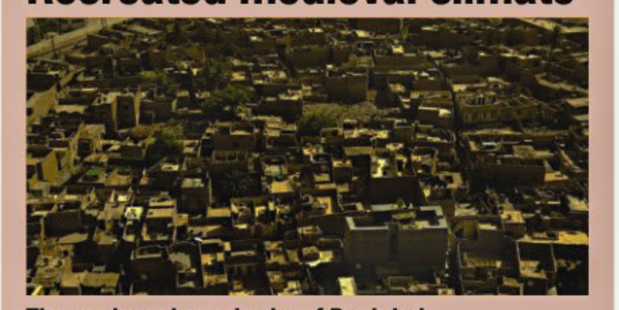


Nanomaterial



GHOST OF BAGH

Recreated medieval climate



The modern-day suburbs of Baghdad.

DIARIES and writings from ninth-century Baghdad provide a glimpse of the weird weather from the era, findings that could help researchers reconstruct past climate.

The surviving documents were written by historians and scholars during the Islamic Golden Age between A.D. 816 and A.D. 1009. They provide a new human record of climate, joining old ship's logs andWorld War II air force reports as one of the few sources for detailed information on historical weather.

"Climate information recovered from these ancient sources mainly refers to extreme events which impacted wider society, such as droughts and floods," study researcher Fernando Domínguez-Castro of the University of Extremadura in Spain said in a statement. "However, they also document conditions which were rarely experienced in ancient Baghdad such as hailstorms, the freezing of rivers or even cases of snow."

Many of the writings from the Islamic Golden Age have been lost in wars and upheaval. But some works survive, including those of Sunni scholar al-Tabari (A.D. 913), Kurdish historian Ibn al-Athir (A.D. 1233) and Egyptian scholar al-Suyuti (A.D. 1505).

Domínguez-Castro and his colleagues collected and analyzed these documents and found that they revealed a pattern of increasing frequency of cold-weather events in the early 10th century. July A.D. 920 was unusually cold, perhaps because of a volcanic eruption, Domínguez-Castro said. It snowed in Baghdad in 908, 944 and 1007. The only snow in living memory in the city was in 2008.

Source: **Live Science**

METATRONIC

Light to replace electricity?

THE technological world of the 21st century owes a tremendous amount to advances in electrical engineering, specifically, the ability to finely control the flow of electrical charges using increasingly small and complicated circuits. And while those electrical advances continue to race ahead, researchers at the University of Pennsylvania are pushing circuitry forward in a different way, by replacing electricity with light.

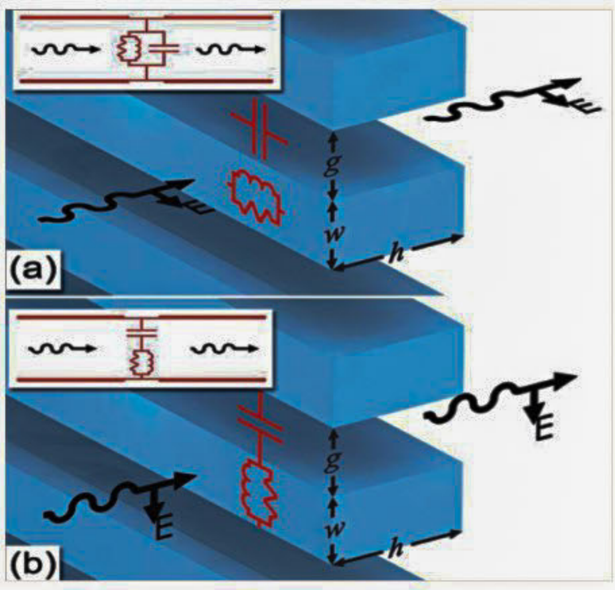
"Looking at the success of electronics over the last century, I have always wondered why we should be limited to electric current in making circuits," said Nader Engheta, professor in the electrical and systems engineering department of Penn's School of Engineering and Applied Science. "If we moved to shorter wavelengths in the electromagnetic spectrum -- like light -- we could make things smaller, faster and more efficient."

Different arrangements and combinations of electronic circuits have different functions, ranging from simple light switches to complex supercomputers. These circuits are in turn built of different arrangements of circuit elements, like resistors, inductors and capacitors, which manipulate the flow of electrons in a circuit in mathematically precise ways. And because both electric circuits and optics follow Maxwell's equations -- the fundamental formulas that describe the behavior of electromagnetic fields -- Engheta's dream of building circuits with light wasn't just the stuff of imagination. In 2005, he and his students published a theoretical paper outlining how optical circuit elements could work.

Now, he and his group at Penn have made this dream a reality, creating the first physical demonstration of "lumped" optical circuit elements. This represents a milestone in a nascent field of science and engineering Engheta has dubbed "metatronics."

Engheta's research, which was conducted with members of his group in the electrical and systems engineering department, Yong Sun, Brian Edwards and Andrea Alù, was published in the journal Nature Materials.

In electronics, the "lumped" designation refers to elements that can be treated as a black box, something that turns a given input to a perfectly predictable output without an engineer having to worry about what exactly is going on inside the element every time he or she is designing a circuit.



A. When the plane of the electric field is in line with the nanorods the circuit is wired in parallel. B. When it crosses both the nanorods and the gaps the circuit is wired in series.

"Optics has always had its own analogs of elements, things like lenses, waveguides and gratings," Engheta said, "but they were never lumped. Those elements are all much larger than the wavelength of light because that's all that could be easily built in the old days. For electronics, the lumped circuit elements were always much smaller than the wavelength of operation, which is in the radio or microwave frequency range."

Source: **Science Daily**

Steamy exotic planet

A new class of planet has emerged from the buzzing masses of celestial spinners, a type unlike the rocky, gassy and icy worlds shuffling around the solar system.

The poster-planet for this new order is GJ 1214b, first discovered in 2009 and now shown to be a steamy, water-rich sphere. But it's not a water-world in the sense of splashing oceans and Kevin Costner: Scientists suspect that the planet's interior is filled with some exotic, high-pressure form of solid H2O unlike anything seen on Earth.

The planet is just 6.5 times more massive than Earth and about 2.7 times bigger in diameter. It circles a small star about 42 light-years away.

"It's an exciting thing that we don't have in our solar system," says Lisa Kaltenegger, an astronomer who divides her time between Germany's Max Planck Institute for Astronomy in Heidelberg and the Harvard-Smithsonian Center for Astrophysics in Cambridge. "And it's a fun puzzle trying to figure out what the atmosphere of that planet is really made of."

Astronomers sniffed out the latest details using the Wide Field Camera 3 aboard the Hubble Space Telescope. It's not the first time GJ 1214b has been peered at, but the new study both confirms and sharpens previous observations.

As the planet passed in front of its star, the team could study its atmosphere at a range of infrared wavelengths, and from there could estimate the planet's composition a mystery because of its low density. The atmosphere is at least half water and is probably clustered near the planet's surface, says Zachory Berta, a graduate student at the Harvard-Smithsonian Center for Astrophysics and coauthor of the study describing the planet's properties, which will appear in the March 1 issue of The Astrophysical Journal.

The interior, Berta says, is probably largely water molecules instead of primarily something like rock. But it's not water in familiar frozen or liquid forms.

"We're not talking about either a frozen core of normal ice or a liquid water ocean," Berta says. "You're getting into weird states of matter when you're describing this."

Source: **Science News**

SCALED DOWN

DID YOU KNOW?

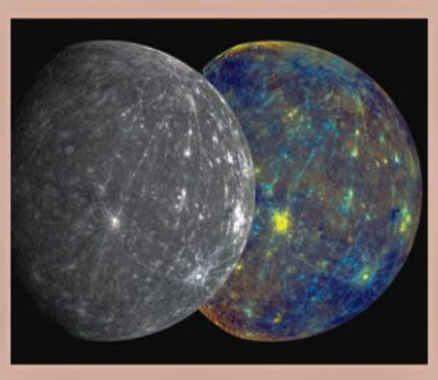
Ancient warming shrunk horses

The earliest-known horse Sifrhippus, dwarfed next to a modern domestic horse.

During the Paleocene-Eocene Thermal Maximum, or PETM, about 56 million years ago, a massive release of carbon into the atmosphere and oceans boosted average global temperatures by about 10 degrees Fahrenheit (5.5 degrees Celsius) over 175,000 years. Mammals responded to this climate change by shrinking, with about one-third of species getting smaller.

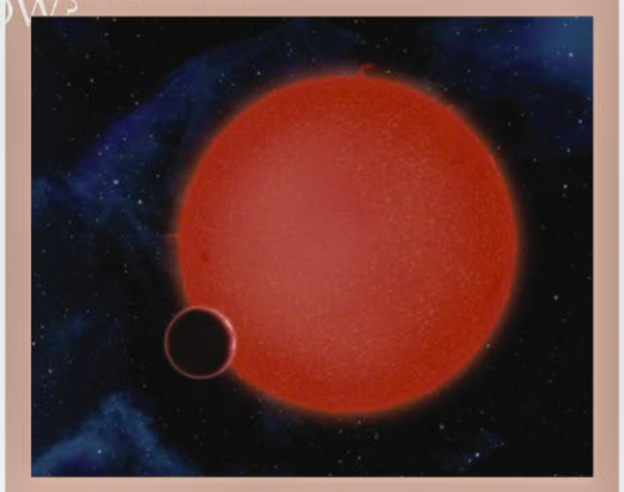
Source: **Live Science**

How hot is Mercury?



Despite being closest to the sun, Mercury is not the hottest planet. The hottest planet isVenus (at 462 Celsius).

The temperature on Mercury may reach 450 degrees C (840 degrees F) during the day. But at night, the temperature may drop as low as -170 degrees C (-275 degrees F). The sunlight on Mercury's surface is 6.5 times as intense as it is on Earth due its closeness to the sun.



New observations from the Hubble Space Telescope reveal that the planet GJ 1214b, shown orbiting its star in this artist's conception, is 6.5 times the size of Earth and composed mostly of water.

WATER WORI