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Sense N' Science

Nanotechnology

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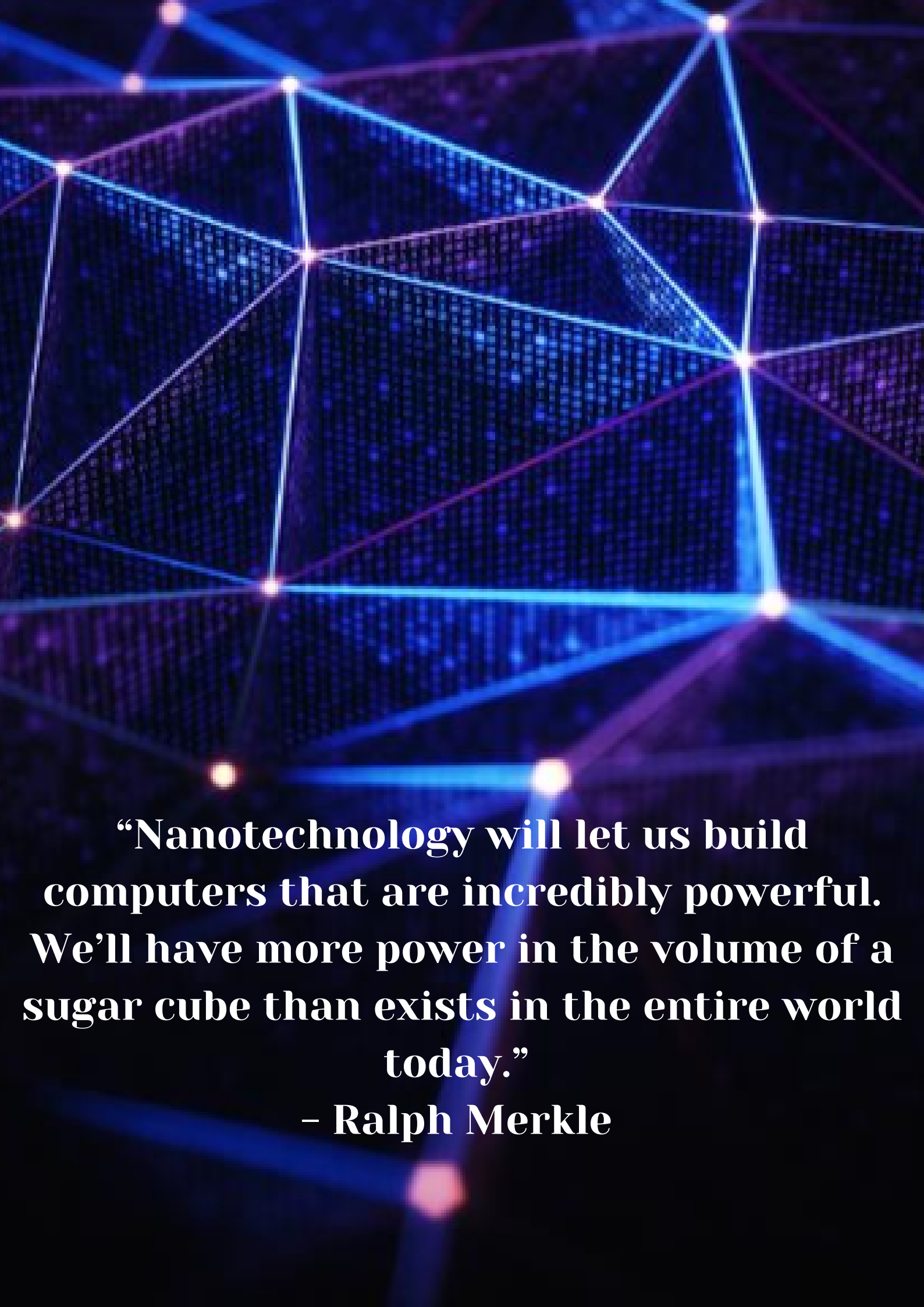

“Nanotechnology will let us build computers that are incredibly powerful. We’ll have more power in the volume of a sugar cube than exists in the entire world today.”

– Ralph Merkle

Editor's note

Although nanotechnology made its advent in 1959, when Richard Feynman introduced the concept at Caltech, it is relatively new and has thoroughly fascinated us humans. It truly makes us ponder on how something so minute can have the ability to make such a widespread impact on various industries. We are proud to present the 7th edition of the Sense N' Science magazine and showcase exactly that.

We rely on science to provide an explanation for the mysteries of mankind and our own creations. Read ahead to discover more about nanotechnology and its widespread impact. We thank all the students and teachers who helped us with the newest issue of Sense N' Science.

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Contents

Debunking vaccines and nanotechnology

Moksha Betai
IBDP-1

An Instagram post went viral, and the caption read: “Realistic portrayal of what's going on in (a vaccinated person’s) body as we speak " and claimed that recipients “are technically not human.” They are hybrids. I’ll give you a hint. Nanotechnology. Nanotechnology is the study of extremely small things and can be used across many fields of science. The realistic portrayal in question was a stock image of how mRNA enters our body. And humans turning into hybrids is amusing. A genetic modification would require the insertion of foreign DNA into the nucleus of the cell, a vaccine can't do that. According to World Health Organization(WHO), the vaccine involves a direct introduction to the plasmid containing the DNA that encodes for the antigens, this is different from the conventional method, where an entire fragment or pathogen is used. mRNA is injected to stimulate a small immune response in the patient without any infection. This process cannot genetically modify any organism.

One video posted on Facebook claimed that Covid-19 vaccines have “nanoparticles”, well truth be told nanoparticles just indicate the size of a particle. But it doesn't stop there, the narrator explains “The vaccine and the nanoparticles mixed in the syringe. The vaccine and the nanoparticles are then injected simultaneously into your body. From that moment on, your mobile phone will locate you immediately. And by the magic of the 5G network, your location is no longer a secret to the authorities.” With Facebook flagging the post to combat misinformation, this viral video was based on nanoparticles being small robots or computers. The vaccines contain lipid nanoparticles that primarily work to protect the mRNA and transport it to the correct cell. Nanoparticles are not microchip technology or have 5G connections to track humans or alter them.

When the pandemic hit, consumption of social media was at an all-time high. Misinformation started spreading like wildfire. So much so that half the Indian population was convinced cow dung and urine were included in our vaccines. In times like these before reading conspiracy theories and believing that it’s true, a simple fact check might lead you to the truth.

https://www.who.int/teams/health-product-policy-and-standards/standards-and-specifications/vaccines-quality/dna

Moore's law and nanotechnology

Adhya Brahmakshatriya
IBPP- 1

In 1965, Gordon Moore made the prediction that the number of transistors on a typical circuit would double every 18-24 months, implying an exponential rise in computer power over time. His prediction was little more than an offhand observation to begin with, but soon it was found to be amazingly accurate, and today is essentially the gospel of the microelectronics industry. It is by assuming that computer power will double every year and a half that the investors are able to justify the enormous sums of money required to build modern microprocessor fabs.

Moore's Law, as it is called, drives the industry today. Another tenet of Moore's Law asserts that this growth is exponential. Coined in 1965 by Gordon Moore, future chairman and chief executive of Intel, it started at the time that the number of transistors packed into an integrated circuit had doubled every year since the technology's inception four years earlier. In 1975 he revised this to every two years, and most people quote 18 months. The trend cannot continue indefinitely with current lithographic techniques, and a limit is seen in ten to fifteen years. However, the baton could be passed to nanoelectronics, to continue the trend (though the smoothness of the curve will very likely be disrupted if a completely new technology is introduced).

Computers and electronics are still seeing the benefits of Moore's Law. As transistors in integrated circuits become more efficient, computers become smaller and faster. The cost of higher-powered computers has been dropping annually, partly because of lower labor costs and reduced semiconductor prices. Every facet of a high-tech society benefits from Moore's Law in action. Mobile devices, such as smartphones and computer tablets would not work without tiny processors; neither would video games, spreadsheets, accurate weather forecasts, and GPS.

The fact that Moore's Law may be approaching its natural death is perhaps most painfully present at the chip manufacturers themselves; as these companies are saddled with the task of building ever-more-powerful chips against the reality of physical odds. Shrinking transistors have powered advances in computing for more than half a century, but soon engineers and scientists must find other ways to make computers more capable. Thus we can most definitely infer that the vision of an endlessly empowered and interconnected future brings us both challenges and benefits.

https://www.investopedia.com/terms/m/mooreslaw.asp#:~:text=the%20long%20run.-,What%20Is%20Moore's%20Law%3F,and%20more%20efficient%20over%20time.

Life changing nanomedicine

Aansh Bhatt
9GB

The convergence of nanotechnology and medicine has led to the interdisciplinary field of nanomedicine. Advances in genetics, proteomics, molecular and cellular biology, material science, and bioengineering have all contributed to this developing field, which deals with physiological processes on the nanoscale level.

Over the last years, nanotechnology has been introduced in our daily routine. This revolutionary technology has been applied in multiple fields through an integrated approach. An increasing number of applications and products containing nanomaterials or at least with nano-based claims have become available.

The application of nanotechnology for medical purposes has been termed nanomedicine and is defined as the use of nanomaterials for diagnosis, monitoring, control, prevention and treatment of diseases. However, the definition of nanomaterial has been controversial among the various scientific and international regulatory corporations. Some efforts have been made in order to find a consensual definition due to the fact that nanomaterials possess novel physicochemical properties, different from those of their conventional bulk chemical equivalents, due to their small size.

The most important feature to take into account is size, because it is applicable to a huge range of materials. The conventional range is from 1 to 100 nm. However, there is no bright line to set this limit. The maximum size that a material can have to be considered nanomaterial is an arbitrary value because the psychochemical and biological characteristics of the materials do not change abruptly at 100 nm. To this extent, it is assumed that other properties should be taken into account.

https://www.oecd.org/science/nanosafety/44108334.pdf

Nanotechnology in fiction

Aditya Saini
8B

Nanotechnology is the use of matter on an atomic supramolecular scale for industrial purposes. Nanotechnology includes the manipulation of atoms and particles for various purposes. All research and technology which involves molecules with a size of 1 to 100 nanometres come under nanotechnology. Unsurprisingly, this interesting field has attracted the attention of fiction writers over the ages.

The use of science in fictional media hasn't been known for being realistic. Concepts such as quantum technology are often used to justify outrageous and over-the-top technology in movies and Sci-Fi books all the time. Rather than explaining such concepts, writers would rather treat it as some sort of mystical magic that can justify the whims of the author. Nanotechnology is one such concept, almost always used in imaginative if not realistic ways.

The short story The Next Tenants, by Arthur. C Clarke is one of the first uses of nanotechnology as used in modern-day fiction. It describes tiny machines on the micrometre scale. Nanotechnology has been used creatively by various authors such as Robert Silver's How It Was when the Past Went Away, where nanotechnology is used in the construction of loudspeakers or Blood Music by Clark Bear where nanotechnology is used to create genetically engineered white blood cells that eventually learn to manipulate matter on an atomic scale.

Nanotechnology is quite prominent in movies as well. In Star Trek: The Next Generation, the Borg use nanomachines. In Cowboy Bebop: The Movie, a criminal is a tanker releasing a Nano virus that kills thousands instantaneously.

https://en.wikipedia.org/wiki/Nanotechnology_in_fiction

Nanotechnology in agriculture

Dhyana Pujara
9 GB

Agriculture is always the most important and stable sector because it produces and provides raw materials for food and feed industries. The limit of natural resources (production land, water, soil, etc.) and the growth of population in the world claim the agricultural development to be economically further, viable, environmentally and efficiently.

The development of agriculture is a compulsory phenomenon for the purge of poverty and hunger which must be gotten rid of from the present situation. Therefore, we have to take one bold step for agriculture development. Sustainable agricultural strengthening is the practical opportunity to get rid of poverty and hunger of the people which depends on new and innovative techniques like nanotechnology.

Nanotechnology monitors a leading agricultural controlling process, especially by its miniature dimension. Additionally, many potential benefits such as enhancement of food quality and safety, reduction of agricultural inputs, enrichment of absorbing nanoscale nutrients from the soil, etc. allow the application of nanotechnology to be a resonant encumbrance. Nanotechnology has the prospective to improve the agriculture and food industry with novel nanotools for the controlling of rapid disease diagnosis, enhancing the capacity of plants to absorb nutrients among others.

The significant interest of using nanotechnology in agriculture includes specific applications like Nano fertilizers and Nano pesticides to trail products and nutrient levels to increase productivity without decontamination of soils, waters, and protection against several insect pests and microbial diseases. Nanotechnology is applied in various aspects of agriculture, for example: Nano-pesticide delivery, slow and controlled release of nanoparticles containing biofertilizers, transport of genetic materials for crop development, application of Nano biosensors for rapid detection of phytopathogen and other biotic and abiotic stresses.

Several nanoparticles are commercially used in agriculture instead of chemical pesticides. Nanomaterials with specific antimicrobial properties help prevent microbial infestations. Nano fertilizers increase crop productivity by enhancing the availability of essential nutrients to the plant. India started a National Nanotechnology Mission more than a decade ago and the technology has found applications in the agriculture sector, the backbone of the Indian economy. Nanotechnology promises a breakthrough in improving our presently abysmal nutrient use efficiency. Nanotechnology requires a thorough understanding of science, as well as fabrication and material technology, in conjunction with knowledge of the agricultural production system.

https://www.researchgate.net/publication/318217365_Nanotechnology_in_Sustainable_Agriculture_Recent_Developments_Challenges_and_Perspectives

Nanomites – a promising cure for cancer ?

Dhyana Shah
9 GB

Cancer is a leading cause of death worldwide, it includes the transformation of normal cells into tumour cells. It usually is cured by chemotherapy, radiotherapy or surgery but these are not very promising cancer treatments. Chemotherapy has the risk of killing normal cells also along with tumour cells so the question arises ?

Then what is the real complete & secure cure of cancer?

There is a new emerging treatment for cancer using Nanometers. They are a billionth of a meter. Imagine a strand of your hair and the tip of it, a Nanometer is smaller than that. Nanomites are filled with a cancer drug after which the Nanomite is injected into the bloodstream. All cancer cells have a receptor-ligand and they are surrounded by leaky blood vessels which allow the Nanomyte to reach the cancer cell and attach its targeting ligand to the receptor-ligand and then bind, eventually killing the cell with the cancer drug it has been filled with. These Nanomites are engineered so that they only attach themselves to cancer cells and not the healthy cells of the body. Their small size helps them locate and kill cancer more precisely than current cancer treatments.

Nanoparticles also help in identifying cancer at its earliest stages when it is not visible in MRI scans. Nanoparticles made from iron oxide bind to cancer cells and send off a strong signal that lights up cancer on MRI scans. This method reduces the number of healthy cells being attacked and increases the probability to kill the cancer cells.

Nowadays Nanomites such as Abraxane and Doxil help chemotherapy treatment work better. They both stop cancer cells from dividing and are used to cure breast and pancreatic cancers.

Science has come this far that hopefully shortly cancer would be a curable disease, and the generations to come shall be freed from this chronic disease which has millions of lives around the world.

https://www.cancer.gov/nano/cancer-nanotechnology/detection-diagnosis

Nanotechnology facts

A nanometer is about the width of a strand of DNA; if you design, build, or use functional systems smaller than 100 of these, you're a nanotechnologist.

In 1989, using an atomic force microscope, IBM engineer Don Eigler became the first person to move and control a single atom.

Nanoscale bits of metal oxide, carbon fiber, or metal blends can detoxify hazardous waste: Their extreme solubility and chemical reactivity help them zero in on the nasty stuff.

Yale researchers have created plastic nanospheres that encapsulate proteins called cytokines, which stimulate the immune system's killer T-cells. An injection of those spheres could help fight disease and infection.

For the rodent who has everything. Georgia Tech scientists made piezoelectric generators out of nanowires and attached them to tiny hamster jackets. When the critters ran, the generators created electricity.

Zhong Lin Wang, co-inventor of the jacket, envisions a shirt that charges your cell phone as you stroll, or an implanted device for measuring blood pressure that's powered by your own heartbeat.

– Vama Shah, Armaan Somani

https://www.discovermagazine.com/the-sciences/20-things-you-didnt-know-about-nanotechnology

Mini-nukes and mosquito-like robot weapons being primed for future warfare

Dhruv Pathak
8B

Several countries are developing nano weapons that could unleash attacks using mini-nuclear bombs and insect-like lethal robots.

While it may be the stuff of science fiction today, the advancement of nanotechnology in the coming years will make it a bigger threat to humanity than conventional nuclear weapons, according to an expert. The U.S, Russia and China are believed to be investing billions on nano weapons research. “Nanobots are the real concern about wiping out humanity because they can be weapons of mass destruction,” said Louis Del Monte, a Minnesota-based physicist and futurist.

While nanotechnology has produced major benefits for medicine, electronics and industrial applications, federal research is currently underway that could ultimately produce nanobots. For one, the Defense Advanced Research Projects Agency, or DARPA, has a program called the Fast Lightweight Autonomy program for the purpose to allow autonomous drones to enter a building and avoid hitting walls or objects. DARPA announced a breakthrough last year after tests in a hangar in Massachusetts. Previously, the Army Research Laboratory announced it created an advanced drone the size of a fly complete with a set of tiny robotic legs— a major achievement since it presumably might be capable of entering a building undetected to perform surveillance, or used for more nefarious actions.

A Cambridge University conference on global catastrophic risk found a 5 percent risk of nanotech weapons causing human extinction before the year 2100. As for the mini-nukes, Del Monte expects they represent “the most horrific near-term nano weapons. Nanotechnology opens up the possibility to manufacture mini-nuke components so small that they are difficult to screen and detect.”

https://www.cnbc.com/2017/03/17/mini-nukes-and-inspect-bot-weapons-being-primed-for-future-warfare.html

Nanorobotics

Maanil Parikh
9 GB

Nanorobotics is an emerging technological field creating machines or robots whose components are at or near the scale of a nanometer (10−9 meters). Nanorobotics refers to the designing and development of robots made of nanoscale or molecular components. The first person to ever mention nanorobots was Richard Feynman in 1959. Since nanorobots would be microscopic in size, large numbers of them would be required to be put at microscopic or macroscopic work.

Robotics is the designing and building and programming of robots while nano-robotics is the same thing but at nanoscale. Nanorobotics makes things practical which are impractical for normal robots to do. When the components of a robot are made at molecular size, new properties emerge for that particular component which are unlike the normal properties for the structure. . For example, carbon nanotubes are 100 times stronger than steel and are 1/6th its weight, conduct electricity better than copper and are semiconductors like silicon.

Various challenges are faced while making the nano robots. A few of them are friction, energy dissipation, thermal noise and an implementation path. The most difficult part about creating nanobots is building them at nanoscale. Another challenge is to build a motor with low density.

The application of nanorobotics is everywhere. Nanorobotics is being used in all branches of science i.e. physics, biology and chemistry. It is also used to make robots that can be implemented in space programs. The nanorobots have many more advantages.

Nanorobotics also has a wide application in the field of biology due to its size. They are tiny compared to biological cells. They are used by doctors to supply medicines or drugs to the specific infected cells and heal them. Since nanorobotics have an application in biology, the components of the nanobots are made biodegradable.

https://www.nanowerk.com/what-are-nanobots.php

Nanofabrication

Tithi Lakhani
8A

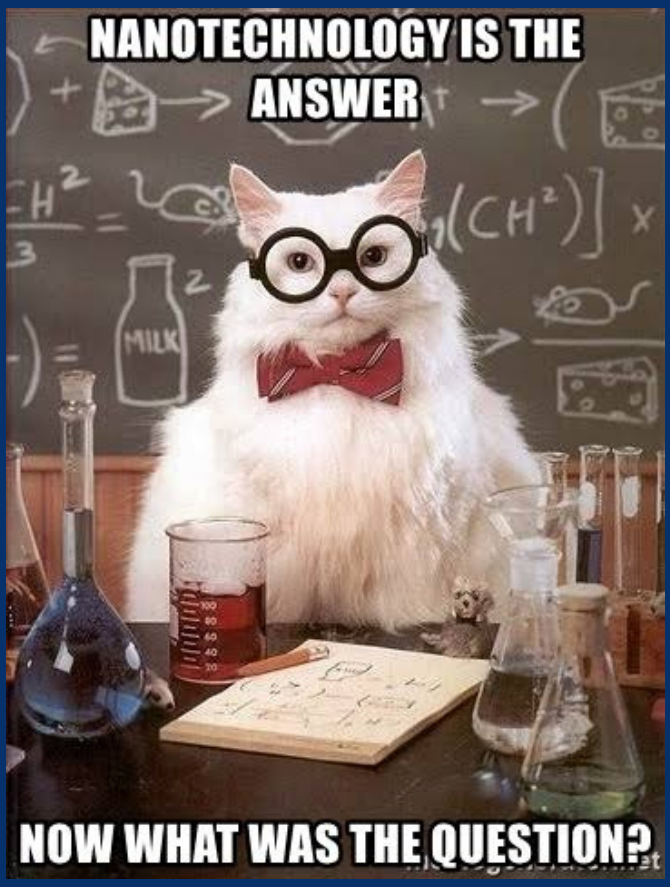
Nanofabrication is the design and manufacture of devices with dimensions measured in nanometers. One nanometer is 10^-9meter, or a millionth of a millimeter.

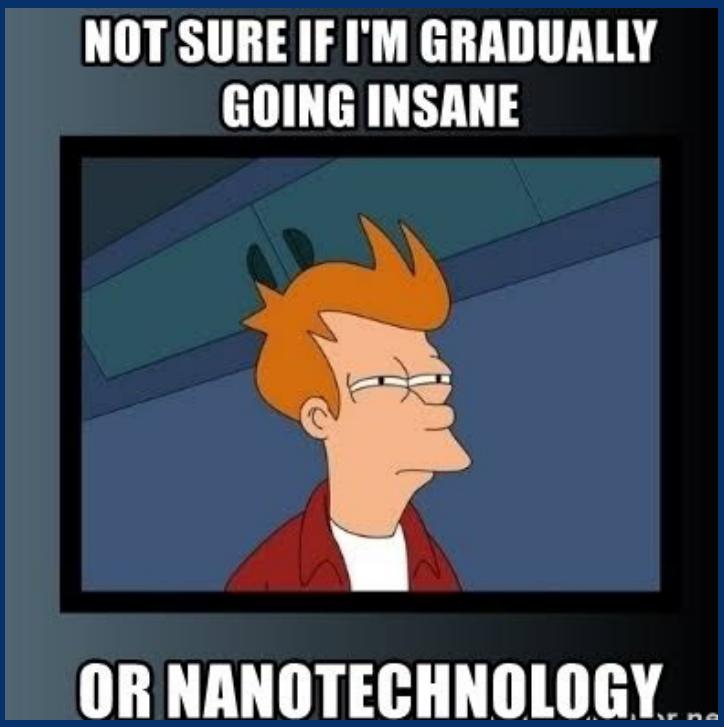
Nanofabrication is of interest to computer engineers because it opens the door to super-high-density microprocessors and memory chips. It has been suggested that each data bit could be stored in a single atom . Carrying this further, a single atom might even be able to represent a byte or word of data. Nanofabrication has also caught the attention of the medical industry, the military, and the aerospace industry.

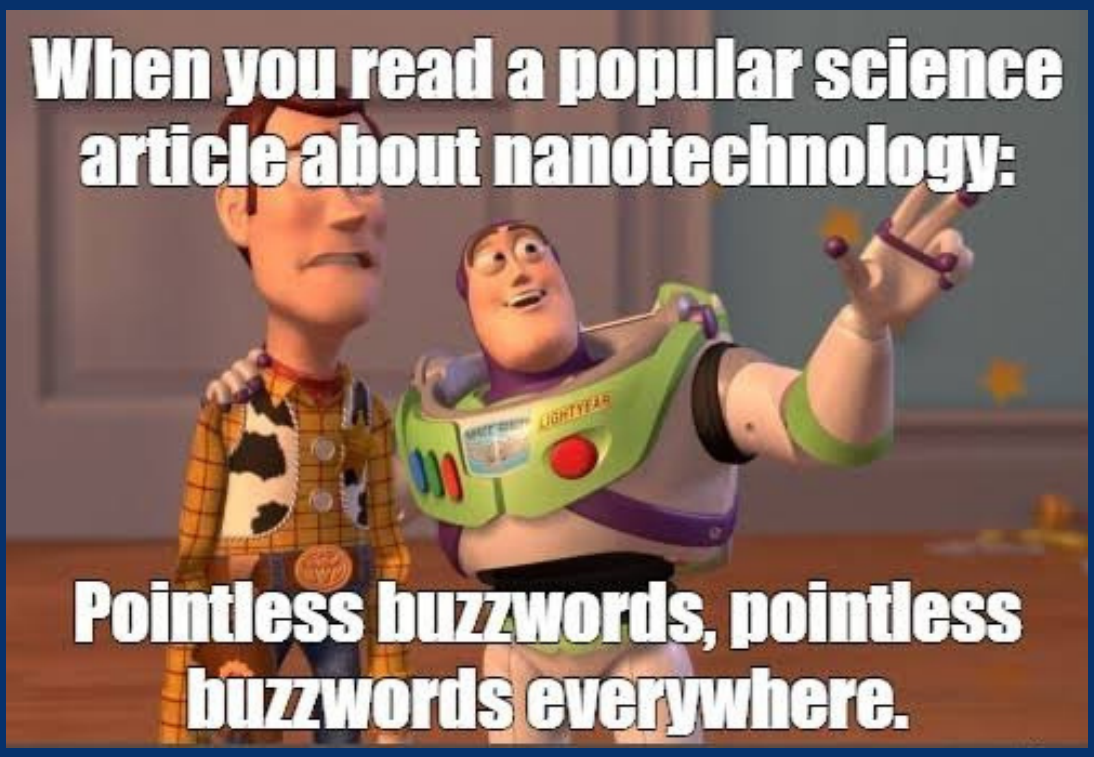
There are several ways that nanofabrication might be done. One method involves scaling down integrated-circuit (IC) fabrication that has been standard since the 1970s, removing one atom at a time until the desired structure emerges. A more sophisticated hypothetical scheme involves the assembly of a chip atom-by- atom; this would resemble bricklaying.

https://www.sciencedirect.com/topics/chemistry/nanofabrication-process

Nanotechnology jokes







– Vama Shah, Armaan Somani

https://www.cartoonstock.com/directory/n/nanotechnology.asp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