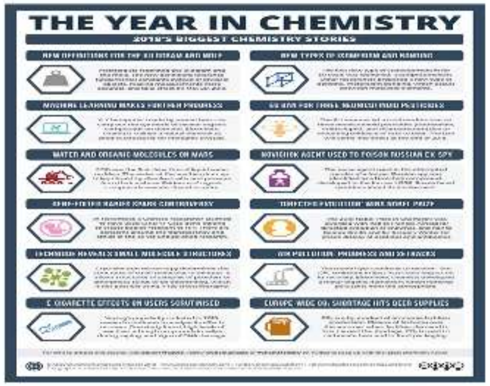
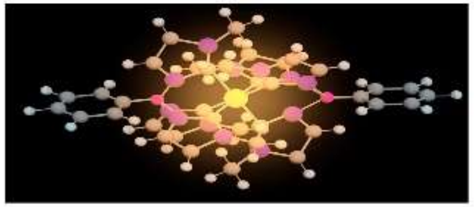


BRILLIANT IRON MOLECULE COULD PROVIDE CHEAPER SOLAR ENERGY



For the first time, researchers have succeeded in creating an iron molecule that can function both as a photocatalyst to produce fuel and in solar cells to produce electricity. The results indicate that the iron molecule could replace the more expensive and rarer metals used today. Solar cells are based on a technology that involves molecules containing metals, known as metal complexes. The task of the metal complexes in this context is to absorb solar rays and utilise their energy. The metals in these molecules pose a major problem, however, as they are rare and expensive metals, such as the noble metals ruthenium, osmium and iridium. Together with colleagues, Kenneth Wärnmark Chemistry Professor Lund University in Sweden worked for a long time to find alternatives to the expensive metals. Finally they showed that by using advanced molecule design, it is possible to replace the rare metals with iron, which is common in the Earth's crust and is therefore cheap. The researchers have produced their own iron-based molecules whose potential for use in solar energy applications has been proven in previous studies. In this new study, the researchers have moved one step further and developed a new iron-based molecule with the ability to capture and utilise the energy of solar light for a sufficiently long time for it to react with another molecule. The new iron molecule also has the ability to glow long enough to enable researchers to see iron-based light with the naked eye at room temperature for the first time. The good result depends on the fact that the researchers optimised the molecular structure around the iron atom.". The study is now published in the journal Science. According to the researchers, the iron molecule in question could be used in new types of photocatalysts for the production of solar fuel, either as hydrogen through water splitting or as methanol from carbon dioxide. Furthermore, the new findings open up other potential areas of application for iron molecules, e.g. as materials in light diodes (LEDs) What actually surprised is that they arrived at good results so quickly. In just over five years, they succeeded in making iron interesting for photochemical applications, with properties largely as good as those of the best noble metals. Besides the researchers from Lund University, colleagues from Uppsala University and the University of Copenhagen were also involved in the collaboration.

Sreelekshmi M S, II M.Sc Applied Chemistry

REPORT OF DEPARTMENTAL ACTIVITIES AND ACHIEVEMENTS

Post Graduate and Research Department of Chemistry organized so many activities in the year 2018. Being a research department under Kerala University, we got University research grant. The researchers and faculties of the department participated in various national and international conferences and presented papers. Mrs. Pinki Abraham, Research Scholar (FDP) got best poster award in the National seminar on recent trends and developments in chemistry (RRD 2018) 30-31st October at BJM College, Chavara.

Our M.Sc student, Mathu M secured 1st rank in M.Sc applied Chemistry in the year 2018.

Department of Chemistry successfully conducted a three day National seminar on Frontline Approaches in Material Science and Computational Chemistry (MATCOM-2018) during 14-16 March 2018. The seminar was Co-sponsored by Kerala State Council for Science, Technology and Environment (KSCSTE), supported by ANERT and in association with Academy of Chemistry Teachers (ACT).

The department is also encouraging the social liability by celebrating the World Students Day (15th October 2018 - Birthday of Former President Dr. A P J. Abdul Kalam) by distributing lunch packets to residents of Agathimandiram and share some time with them.

Department is also assisting the deserving students of final year degree by giving special training for IIT JAM exam 2019.

As a part of the syllabus, the Department arranged a Laboratory visit at IISER, Trivandrum for Final Year B.Sc Students and a Laboratory visit at NIIST, Trivandrum for M.Sc students.

MATHU. M
1st Rank in M.Sc Applied Chemistry

GLIMPSES OF DEPARTMENTAL ACTIVITIES

National Seminar MATCOM 2018 Inauguration by Dr.S M A Shibili,H O D,Dept of Chemistry Kariavattam

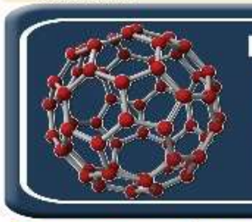
Releasing of Souvenir OF National Seminar MATCOM 2018 by Mr.M Shaneeth,Head,Fuel Cell Division,VSSC,TVM.

MSc students industrial visit at NIIST,Trivandrum

Agathimandiram visit one day meal programme on world students day

Final year BSC industrial visit - students visiting IISER Trivandrum

IIIT JAM entrance coaching for final year B.Sc students



THANMATHRA

News letter of the department of Chemistry

Sree Narayana College for Women, Kollam

Vol. XIII March 2019
Issue No. 13

EDITORIAL

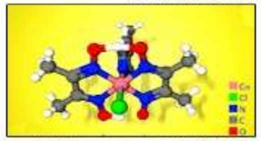
Let's revolutionize it!

Even in the ever highest glory of science education in our country, checking the knowledge to productivity ratio in the field of science and technology one may easily feel the "thing". "Thing" refers clearly to the ironical situation of low number of innovations and inventions from the amplified amount of research publications. In the field of chemistry, the optimistic perspective of this situation is that research community had made some promising advancements. As per Deepak Pental, former vice chancellor of Delhi University, the rising proportion of papers in chemistry is a good sign. "Most of the drug discovery today is a consequence of research in molecular chemistry and other applied disciplines in chemistry. We need to further strengthen our research capabilities in applied research in chemistry. Basic research is important but applied research is what leads to progress." He, however, adds that there's inadequate research in other fields like agricultural sciences in the country.

It is high time to act in the right way according to a right plan from the grass root level of science education. Pragmatic approach should be strictly implemented instead of forcing the youth to mug up the laws and theories. Let them taste the 'S A L T' instead of learning to write the word "SALT". Confining to our scenario, Chemistry education particularly at undergraduate level, should seek to innovatively combine the knowledge required for pursuing independent research and the ability to seek solutions to problems across disciplines. Certainly, the challenge today is larger than it was many decades ago. The plan to be adopted should be purely "science centred" and not student centred or teacher centred as we have to mould science craving innovative minds like Madam Curie or Nikolas Tesla. Irrespective of the level of learning from kinder garden to post graduation, the students should be provided with a sure environment for experimentally, practically or audio visually experience all the scientific facts they learn. There should be a concrete mechanism to ensure the same. There are certain flaws in the creamy layer also, that is at research level. We have to seriously think that why our journals do not reach up to the standards of journals from other countries. We must recognize our resources and develop the research suitable to that. Our research must concentrate more on the needs of our country. Research must not be a means for getting a degree but for developing our country. Also it is the responsibility of our universities and research institutions to provide outputs in industrial areas. As a responsible science community let us incarnate ourselves as self-proclaimed sincere wizards in our duties and work hand in hand for a better scientific tomorrow.

WASTE VEG OIL TURNED INTO VALUABLE CHEMICALS FOR DRUGS AND PLASTICS

Fathima.S, III DC Chemistry



A new dual catalytic system can produce highly functionalised terminal alkenes from fatty acids. The technique could one day enable industrial production of valuable chemicals from a renewable source such as vegetable oils. Alkenes are one of the most useful classes of chemicals and can be turned into a range of products from polymers to pharmaceuticals. But most alkenes are derived from petroleum based materials. A new method developed by researchers at the Max Planck Institute for Coal research can produce terminal alkenes using waste vegetable oil as a starting material. The new process uses a dual catalytic system involving a cobalt-proton reduction catalyst and an iridium based photoredox catalyst to convert carboxylic acids into alkenes with the loss of carbondioxide and hydrogen. The process works for a range of different structurally complex carboxylic acids The technique is still in developmental long way from being practical for large scale synthesis First time it has shown by making alpha olefins that are really useful in large scale production of many materials from carboxylic acids.

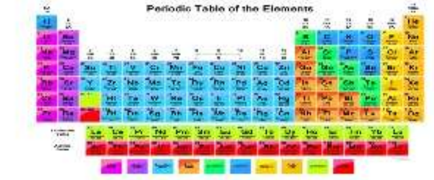
IYPT-2019

INTERNATIONAL YEAR OF PERIODIC TABLE OF CHEMICAL ELEMENTS

Kadambari.Chand, III DC Chemistry

The periodic table of chemical elements is more than just a guide or catalogue of the entire known atoms in the universe. It is essentially a window on the universe helping to expand our understanding of the world around us. 2019 will mark the 150th anniversary of it's creation by Russian scientist Dmitry Ivanovich Mendeleev. The International Year of Periodic table of Chemical Elements is an extension of the International Year of Chemistry in 2011 and the International Year of Crystallography in 2014. This year also provides an opportunity for UNESCO to promote the basic sciences for sustainable development ,including through UNESCO's International Basic Sciences Programme (IBSP).

Periodic Table of the Elements



TOO....Late, but Latest....

Further proof of the periodic table's continuing relevance to science will be a tribute during the year of the recently completed advanced discoveries of four super heavy elements of the periodic table of Mendeleev with atomic numbers are

- **113-Nihonium**
- **115-Moskovi**
- **117-Tennesin**
- **118-Oganesson**

Modern periodic table of elements

The modern periodic law states that physical and chemical properties of the elements are the periodic function of the atomic numbers. The various elements with the similar properties repeat after certain regular intervals. This repetition occurs when we arrange the elements in order of their increasing atomic numbers. Long form of periodic table is based upon the electronic configuration of the elements. It is the present form or the modern periodic table of elements. The modern periodic table of elements consists of 18 vertical columns and 7 horizontal rows. They are called groups and periods respectively.

Significance of modern periodic table

The periodic table of chemical elements is one of the most important and influential achievement in modern science reflecting the essence not only of chemistry, but also of physics, biology and other disciplines. It is a unique tool, giving scientists the opportunity to predict the appearance and

Artificial synapses made from Nanowires

Sruthi Premlal, I M.Sc Applied Chemistry

Scientists have produced a memristive element made from nanowires that functions in much the same way as a biological nerve cell. The component is able to both save and process information, as well as receive numerous signals in parallel. The resistive switching cell made from oxide crystal nanowires is thus proving to be the ideal candidate for use in building bioinspired 'neuromorphic' processors.

Scientists from Jülich together with colleagues from Aachen and Turin have produced a memristive element made from nanowires that functions in much the same way as a biological nerve cell. The component is able to both save and process information, as well as receive numerous signals in parallel. The resistive switching cell made from oxide crystal nanowires is thus proving to be the ideal candidate for use in building bioinspired "neuromorphic" processors, able to take over the diverse functions of biological synapses and neurons.

Computers have learned a lot in recent years. Thanks to rapid progress in artificial intelligence they are now able to drive cars, translate texts, defeat world champions at chess, and much more besides. In doing so, one of the greatest challenges lies in the attempt to artificially reproduce the signal processing in the human brain. In neural networks, data are stored and processed to a high degree in parallel. Traditional computers on the other hand rapidly work through tasks in succession and clearly distinguish between the storing and processing of information. As a rule, neural networks can only be simulated in a very cumbersome and inefficient way using conventional hardware.

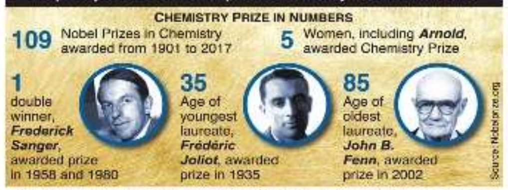
Systems with neuromorphic chips that imitate the way the human brain works offer significant advantages. Experts in the field describe this type of bioinspired computer as being able to work in a decentralised way, having at its disposal a multitude of processors, which, like neurons in the brain, are connected to each other by networks. If a processor breaks down, another can take over its function. What is more, just like in the brain, where practice leads to improved signal transfer, a bioinspired processor should have the capacity to learn.

"With today's semiconductor technology, these functions are to some extent already achievable. These systems are however suitable for particular applications and require a lot of space and energy," says Dr. Ilia Valov from Forschungszentrum Jülich. "Our nanowire devices made from zinc oxide crystals can inherently process and even store information, as well as being extremely small and energy efficient," explains the researcher from Jülich's Peter Grünberg Institute. For years memristive cells have been ascribed the best chances of being capable of taking over the function of neurons and synapses in bioinspired computers. They alter their electrical resistance depending on the intensity and direction of the electric current flowing through them. In contrast to conventional transistors, their last resistance value remains intact even when the electric current is switched off. Memristors are thus fundamentally capable of learning. In order to create these properties, scientists at Forschungszentrum Jülich and RWTH Aachen University used a single zinc oxide nanowire, produced by their colleagues from the polytechnic university in Turin. Measuring approximately one ten thousandth of a millimeter in size, this type of nanowire is over a thousand times thinner than a human hair. The resulting memristive component not only takes up a tiny amount of space, but also is able to switch much faster than flash memory.

Nanowires offer promising novel physical properties compared to other solids and are used among other things in the development of new types of solar cells, sensors, batteries and computer chips. Their manufacture is comparatively simple. Nanowires result from the evaporation deposition of specified materials onto a suitable substrate, where they practically grow of their own accord. In order to create a functioning cell, both ends of the nanowire must be attached to suitable metals, in this case platinum and silver. The metals function as electrodes, and in addition, release ions triggered by an appropriate electric current. The metal ions are able to spread over the surface of the wire and build a bridge to alter its conductivity. Components made from single nanowires are, however, still too isolated to be of practical use in chips. Consequently, the next step being planned by the Jülich and Turin researchers is to produce and study a memristive element, composed of a larger, relatively easy to generate group of several hundred nanowires offering more exciting functionalities.

CHEMISTRY NOBEL PRIZE WINNERS 2018

Frances H Arnold (USA), George P Smith (USA), and Sir Gregory Winter (GBR) have won the 2018 Nobel Prize in Chemistry for using the principles of evolution to produce new enzymes and antibodies



The Royal Swedish Academy of Sciences said at the October 10 ceremony of Nobel Prizes that the three researchers who were awarded this year's Nobel Prize in chemistry "harnessed the power of evolution" to develop enzymes and antibodies that have led to new pharmaceuticals and biofuels.

One half of this year's Nobel Prize in Chemistry is awarded to Frances H. Arnold. In 1993, she conducted the first directed evolution of enzymes, which are proteins that catalyse chemical reactions. Since then, she has refined the methods that are now routinely used to develop new catalysts. The uses of Frances Arnold's enzymes include more environmentally friendly manufacturing of chemical substances, such as pharmaceuticals, and the production of renewable fuels for a greener transport sector.

The other half of this year's Nobel Prize in Chemistry is shared by George P. Smith and Sir Gregory P. Winter. In 1985, George Smith developed an elegant method known as phage display, where a bacteriophage – a virus that infects bacteria – can be used to evolve new proteins. Gregory Winter used phage display for the directed evolution of antibodies, with the aim of producing new pharmaceuticals. The first one based on this method, adalimumab, was approved in 2002 and is used for rheumatoid arthritis, psoriasis and inflammatory bowel diseases. Since then, phage display has produced anti-bodies that can neutralise toxins, counteract autoimmune diseases and cure metastatic cancer.

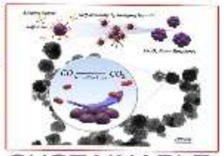
Future's MEATing

GREESHMA RAJEEVAN
II DC B.Sc Chemistry

Imagine biting a juicy non veg burger that was produced without killing animals, with the same taste, same smell, same texture as that of conventional meat! Meat grown in a laboratory from cultured cell is turning that vision into a reality. Cultured meat is the meat produced by invitro cultivation of animal cells, instead of from slaughtered animals. Cultured meat is produced using tissue engineering techniques. The lab grown meat also called clean meat, cultured meat, invitro meat could eliminate much of the cruel, unethical treatment of animals that are raised for food.

In late 1931, Winston Churchill wrote in an essay, "Fifty years hence, we shall escape the absurdity of growing a whole chicken in order to eat the breast or wing by growing these parts separately under a suitable medium. Lab grown meat can be prepared by taking stem cells painlessly from live animals via biopsy. Thus the initial stage of growing cultured meat is to collect cells that have a rapid rate of proliferation. Such cells include embryonic stem cells, adult stem cells or myoblasts. Stem cells proliferate the quickest. The cells are then treated by applying a protein that promotes tissue growth, which is known as a growth medium. Meat can then be grown on the culture medium in a bioreactor where it differentiates and grows faster.

The global meat consumption is going to double by 2050 with increase in population and in order to prevent the associated greenhouse gas emissions, deforestations and ensure disease free food, invitro meat is going to gain importance. A study by researchers at the Oxford University found that cultured meat was "potentially much more efficient and environmentally friendly" generating only 4% greenhouse gas emissions reducing the energy needs of meat generation by up to 45% and requiring only 2% of the land that the global livestock industry does. Hanna Tuomisto, a PhD student of Wild Life Conservation Research Unit of the Oxford University strongly says that it has less environmental impact. This is in contrast to cattle farming responsible for 18% of greenhouse gases and causing more damage to the environment than the combined effects of the world's transportation systems. Thus lab grown meat may very well be the path forward



Co_3O_4 *Nano-Raspberry*

Nivethabharathan I MSc Chemistry

SUSTAINABLE 'NANO-RASPBERRY' TO NEUTRALIZE POISONOUS CARBON MONOXIDE

Scientists from the Nagoya Institute of Technology (NITech) in Japan have developed a sustainable method to neutralize carbon monoxide, the odorless poison produced by cars and home boilers. Their results were featured on the cover of the September issue of the journal, Nanomaterials. Traditionally, carbon monoxide needs a noble metal – a rare and expensive ingredient – to convert into carbon dioxide and readily dissipate into the atmosphere. Although the noble metal ensures structural stability at a variety of temperatures, it's a cost-prohibitive and finite resource and researchers have been anxious to find an alternative. Now, a team led by Dr. Teruaki Fuchigami at the NITech has developed a raspberry-shaped nanoparticle capable of the same oxidation process that makes carbon monoxide gain an extra oxygen atom and lose its most potent toxicity.

"We found that the raspberry shaped particles achieve both high structural stability and high reactivity even in a single nanoscale surface structure," said Dr. Fuchigami, an assistant professor in the Department of Life Science and Applied Chemistry at the NITech and first author on the paper. The key, according to Dr. Fuchigami, is ensuring the particles are highly complex but organized. A single, simple particle can oxidize carbon monoxide, but it will naturally join with other simple particles. Those simple particles compact together and lose their oxidation abilities, especially as temperatures rise in an engine or boiler. Catalytic nanoparticles with single nano-scale and complex three-dimensional (3D) structures can achieve both high structural stability and high catalytic activity, however, such nanoparticles are difficult to produce using conventional methods. Dr. Fuchigami and his team worked to control not only the size of the particles, but also how they assembled together. They used cobalt oxide nanoparticles, a noble metal alternative that can oxidize well but eventually presses together and becomes inactive. The researchers applied sulfate ions to formation process of the cobalt oxide particle. The sulfate ions grasp the particles, creating a chemically bonded bridge. Called a ligand, this bridge holds the nanoparticles together while also inhibiting the clumping growth that would lead to a loss of catalytic activity.

The resulting particle looked like a raspberry: small cells bound together into something greater than the sum of its parts. "The phenomenon of crosslinking two substances has been formulated in the field of metal-organic framework research, but, as far as we can tell, this is the first report in oxide nanoparticles. The effects of bridging ligands on the formation of oxide nanoparticles, which will be helpful to establish a synthesis theory for complex 3D nanostructures," Dr. Fuchigami said of the raspberry-shaped nanostructure. The unique surface nanostructure of the raspberry-shaped particles remained stable even under the harsh catalytic reaction process, improving the low-temperature CO oxidation activity. Dr. Fuchigami and his team will continue to study the bridging ligands with the goal of precisely controlling the design aspect of nanomaterials, such as the size and morphology. Ultimately, they plan to discover the most stable and active configuration for chemical catalysis and other applications.. Synthesis of cobalt oxide particles with complex, three-dimensional, raspberry-shaped nanostructures via hydrothermal treatment. Sodium sulfates functioned as bridging ligands to promote self-assembly and suppress particle growth. The highly ordered and complex surface nanostructure with < 5 nm in diameter shows good structural stability and high activity in CO oxidation reaction.

CHEMISTRY IN OUR DAILY LIFE

Dr. Chithra .P. G, Associate Professor

Have you ever wondered about the importance of Chemistry in everyday life? Everything on the earth is made of chemicals. Chemistry as a subject has a significant importance in our daily lives. You are made of chemicals. So is your dog. So is your son etc. Chemistry sometimes called central science because it connects other sciences such as biology, Physics, geology and environmental science. Human life is inseparable from Chemistry. Everything whether living or non-living is made up of basic building blocks called chemical elements. All of the materials used by technologists are made by chemical reactions and we all experience chemical reactions continuously, whether it be breathing or baking a cake or driving a car. Chemistry is a worthwhile discipline because it prepares us for the real world.

Dr.E.C.G. SUDARSHAN

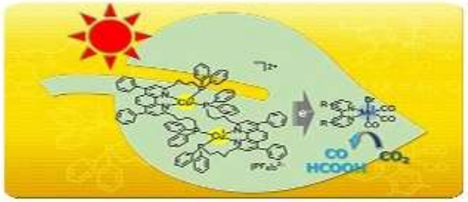
Passing of an Era

Outspoken, opinionated, candid and combative Ennackal Chandy George Sudarshan (1931 – 2018) was one of the most brilliant scientific minds ever to emerge from South Asia. When the last echo of the controversies surrounding him has died away, the world will still remember him for his deep insights and outstanding contributions to fundamental science. Born in Kerala, Sudarshan graduated from the Madras Christian College in 1951 and got his Master's degree from the University of Madras a year later. He then spent three years (1952 – 55) working in Homi Bhabha's cosmic ray group at TIFR, before moving to the University of Rochester in the USA, where he did his Ph.D. He discovered the V - A theory of weak interactions while working on his PhD thesis under the late Robert E. Marshak. He has made remarkable discoveries in many fields of physics, including quantum optics, tachyons, quantum Zeno effect, non-invariance groups, positive maps of density matrices, quantum computation, etc. His contributions include also relations between east and west science, philosophy and religion. This unfortunate incident embittered Sudarshan for life, but it did not inhibit his scientific creativity. He founded the Centre for Theoretical Studies (CTS) inside the Indian Institute of Science (IISc) at Bengaluru in 1972. He accepted the Directorship of the Institute of Mathematical Sciences (IMSc) at Chennai in 1986, where he would spend half the year, the other half being at Austin. During his Directorship, the IMSc expanded greatly in budget and personnel, but his idiosyncratic style of management led to a succession of controversies which lasted during the whole of his tenure. In his lifetime, Sudarshan was showered with many awards, including the Dirac medal of the ICTP, the TWAS prize and the Majorana prize. In India, he was awarded the C.V. Raman prize in addition to the Padma Bhushan and the Padma Vibhushan. The renowned physicist was even recommended for the Nobel Prize nine times but never awarded. He lived into a feisty old age, despite the frustration of having been passed over for the Nobel prize and of seeing others awarded for work that was his. But that transient pain of the frail human psyche is now over, and it is only the outstanding scientific legacy of E.C.G. Sudarshan which will last for future generations to study and admire.

Lekshmi J B, 1st D.C.

GREAT STRIDES FOR CARBON CAPTURE USING EARTH-ABUNDANT ELEMENTS AS PHOTOCATALYTIC

Anjali G Kumar, II MSc Chemistry



Researchers at Tokyo Institute of Technology have designed a CO2 reduction method based only on commonly occurring elements. Achieving a 57% overall quantum yield of CO2 reduction products, it is the highest performing system of its kind reported to date, raising prospects for cost-effective carbon capture solutions. As global warming presents one of the biggest challenges to humanity in the 21st century, the quest to curb mounting CO2emissions is more pressing than ever. In a study published in the Journal of the American Chemical Society, Osamu Ishitani and colleagues at Tokyo Institute of Technology (Tokyo Tech) and Japan's National Institute of Advanced Industrial Science and Technology report a photocatalytic system that brings scientists closer to achieving artificial photosynthesis – the goal of creating a sustainable system similar to the way that plants convert CO2 to useful energy by using earth abundant metals. Although metal complex photocatalytic systems have been reported for CO2 reduction, many of them used noble and/or rare metal complexes. Compared to these approaches that utilize rare metals (such as ruthenium and rhenium), the use of earth abundant metals is "greener" and inexpensive, and has thus attracted much interest. Their new process is made up of two components: 1) a copper complex (CuPS) that behaves as a redox photosensitizer[2] and 2) a manganese-based catalyst, Mn(4OMe). The team reported that the total quantum yield of CO2 reduction products was 57%, the turnover number based on the manganese catalyst was over 1300 and the selectivity of CO2 reduction was 95%. In particular, the figure of 57% is remarkable, as the researchers comment: "To the best of our knowledge, this is the highest quantum yield for CO2 reduction using abundant elements and the yield would be comparable to that obtained with rare metals." The study highlights the way that incremental advances in chemistry may have a large impact on the wider goal of working towards a fossil-fuel-free future. The research was supported by the Japan Science and Technology Agency's CREST program aimed at accelerating strategic innovation.

OBITUARIES IN CHEMISTRY WORLD IN 2018

Uma Devi,m II DC Chemistry

Aaron Klug

Who received the chemistry Nobel prize in 1982, has died aged 92. Klug won the prize for developing crystallographic electron microscopy – a technique that can produce detailed three-dimensional images of biological structures by combining several 2D images of crystals taken from different angles – as well as for working out the structure of RNA– and DNA–protein complexes such as chromatin, the tightly packaged genetic material found in cell nuclei.

Osamu Shimomura

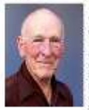
who shared the 2008 chemistry Nobel prize with Martin Chalfie and Roger Tsien for the discovery of green fluorescent protein (GFP) has died of natural causes at his home in Nagasaki, Japan, aged 90. In the 1960s he isolated GFP from the luminous jellyfish Aequorea victoria and showed that it glowed green under UV light. Others then went on to show how the gene for GFP can be incorporated into other organisms' DNA and used to fluorescently label other proteins so that they can be seen under a microscope.

Thomas Steitz

Is joint recipient of the 2009 Nobel prize in chemistry, has died aged 78. Steitz published a landmark study detailing the atomic arrangement of the large 50S ribosomal subunit in 2000, using data obtained by x-ray crystallography

Jens Christian Skou

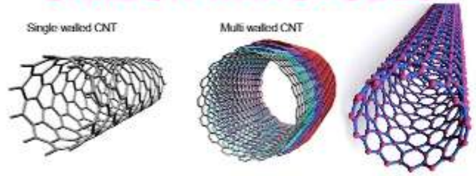
A joint recipient of the chemistry Nobel prize in 1997, has died aged 99. Skou was awarded a half share of the Nobel for discoveringthe sodium–potassium pump, an enzyme that transports sodium and potassium ions across the membranes of cells and is crucial for the normal functioning of nerves and muscles. The other half was divided between Paul Boyer and John Walker for their work on the synthesis of adenosine triphosphate (ATP).



Paul Boyer

Who won the chemistry Nobel prize in 1997 for his work on the synthesis of the cellular energy source adenosine triphosphate (ATP), has died aged 99. In the 1970s Boyer put forward a theory of how the enzyme ATP synthase can turn adenosine diphosphate and inorganic phosphate into molecules of ATP, which are used to store and transport energy within biological cells. His model of how the enzyme's different subunits work together to create a rotating molecular motor powered by a hydrogen ion gradient was shown to be correct in 1994 when John Walker, with whom Boyer shared the Nobel, determined the structure of ATP synthase using x-ray crystallography.

CARBON NANOTUBES



Carbon Nanotubes, long, thin cylinders of carbon, were discovered in 1991 by Sumio Iijima. These are large macromolecules that are unique for their size, shape, and remarkable physical properties. They can be thought of as a sheet of graphite (a hexagonal lattice of carbon) rolled into a cylinder. Nanotubes have a very broad range of electronic, thermal, and structural properties that change depending on the different kinds of nanotube (defined by its diameter, length, and chirality, or twist). To make things more interesting, besides having a single cylindrical wall (SWNTs), Nanotubes can have multiple walls (MWNTs)--cylinders inside the other cylinders. Carbon nanotubes are large molecules of pure carbon that are long and thin and shaped like tubes, about 1-3 nanometers (1 nm = 1 billionth of a meter) in diameter, and hundreds to thousands of nanometers long. As individual molecules, nanotubes are 100 times stronger than steel and one sixth its weight. Some carbon nanotubes can be extremely efficient conductors of electricity and heat; depending on their configuration, some act as semiconductors. They open an incredible range of applications in materials science, electronics, chemical processing, energy management, and many other fields. Carbon nanotubes are capable of storing up to 80 percent of their weight in hydrogen - a capacity that could someday make hydrogen fuel cells a cheap and efficient alternative to fossil fuels. Scientists at Rice University are developing a new type of wire made of carbon nanotubes that conducts electricity much better than copper, and could transform the electrical power grid. Nanotubes are members of the fullerene structural family, which also includes the spherical buckyballs and the ends of a nanotube may be capped with a hemisphere of the buckyball structure. Their name is derived from their long, hollow structure with the walls formed by one-atom-thick sheets of carbon, called graphene. The future for carbon nanotubes looks bright due to the fact that they are extremely versatile. There appears to be no other material that is as strong, conducting, inert, and so forth at the same time. The rapid progress with nanotubes is largely driven by its unique combination of properties. A very important property of carbon nanotube is very high surface area which increases the amount of charge that can be stored. Carbon nanotubes are another possible material for use in an ultracapacitor. Ultracapacitors have high density interior, compact size, reliability, and high capacitance. This decrease in size makes them increasingly possible to develop much smaller circuits and computers. Gene therapy is an approach to correct a defective gene which is the cause of some chronic or hereditary disease by introducing DNA molecule into the cell nucleus. By using DNA, doped graphene and magnetic nanoparticles, researchers have synthesized a hybrid material that is potentially useful for delivering genes and anticancer drugs to cancer cells. DNA-based hybrid materials are promising for their potential applications in molecular sensing, intelligent drug delivery, programmable chemical synthesis, bioanalysis and biomedicine. Hybrid materials made of carbon nanotubes and DNA are promising for gene therapy, but few studies have investigated hybrids consisting of graphene and DNA. The hybrid material was non-toxic to cultured mammalian cells and did not inhibit their growth, indicating that it is biocompatible and may be useful for fabricating extremely tiny drug carriers.