Issue 2

JRCS

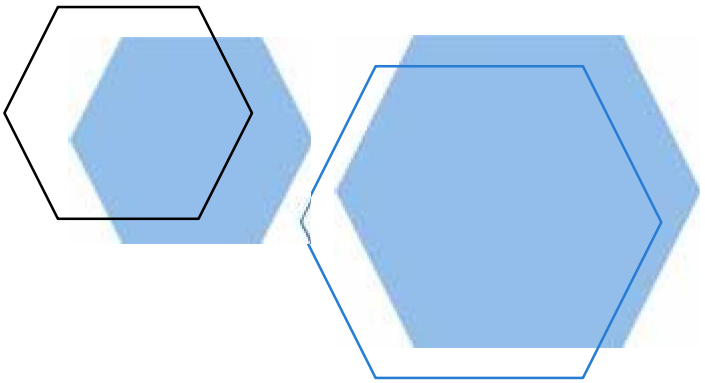
Journal of Rasayanatva - The Chemical Society of Hansraj College

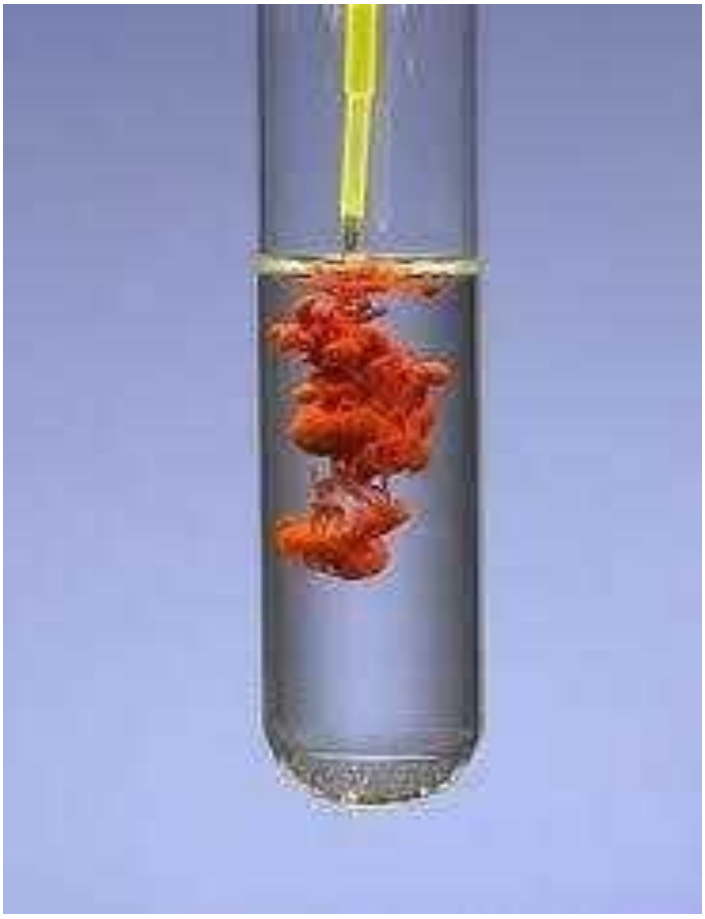
Department of Chemistry
Hansraj College
Delhi University

EDITORS' REMARK

Aloha Readers!

We are highly grateful for the affirmative responses bestowed on the first issue of JRCS- Journal of Rasayanatva, The Chemical Society of Hansraj College, an open access scientific journal. When one visualizes the evolving technology and advancements in the field of Chemistry through two facets, it could be assembled that while the brain stimulating discoveries has amazed everyone being updated to the information time to time could be challenging and exhausting. And when the latter side outweighs the former, the labelling of being 'slow-paced' could lead one to stoop to disappointment. It is thus necessary to be updated with the developments across the fields of science and technology especially when one is in the pursuit of becoming a scientist.





This is the second issue of JRCS covering an array of articles from the diverse topics of Chemistry. On reading the original research work of scientists through a simplified lens, articles in this journal have been written, featuring hot current topics of interest in the field of research.

We look forward to you views. You can mail your suggestions at- editorial.board.rasayanatva@gmail.com.

Happy reading!

Editors-in-chief

Kirti Kashyap 'Taijas'

Prashansa Mehta

JRCS

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COSMETICS IN FORENSICS

SARTHAK KAUSHIK (Department of Chemistry, Hansraj College)

ABSTRACT

"Cosmetics analysis is an emerging tool for forensic science".This statement gives the underlying status of use of a daily basis product in order to help in solving crimes.

INTRODUCTION

Readings say, in 1912, French forensic scientist found evidence in a murder suspect's fingernails that matched a cosmetic powder on his partner's neck, led to a conviction.

These types of evidences are rarely discussed outside of specialist groups, compared to DNA and fingerprint evidence. It is explained that the significance of cosmetic analysis is now rising due to the development of new, more sensitive, faster and non-destructive technologies day by day.

Traces of cosmetics such as lipstick, eyeliner, eye shadow etc. are left behind on many objects, including clothing, cups, glasses and cigarette butts, as evidence of events and locations in everyday life. They are also often transferred between the victims and perpetrators or illegal aspects of crime. Resulting in the increase of use of modern analytical techniques that bring cosmetic evidence into the courtroom. But the techniques are highly sensitive and have limited accuracy, many forms of analysis also destroy abundant portions of the evidence, raising problems for checking and later further investigation. Under the studies it is found that stains play a significant role for identification of criminals in different type of cases such as rape, murder, theft, burglary. Stains i.e. blood, semen, saliva, lipstick are the foremost common evidence found at the crime scene.

Lipstick is one of the important types of evidence, which is mostly found on clothing, papers, tissue-papers, cigarette-buts, skin or any other surface or thing. Questioned lipstick stains are often matched with the suspected one for the criminal identification. In the present study an attempt has been made to analyse the Lipstick stains by different processes like Thin Layer Chromatography(TLC). With the help of such processes lipstick stains are processed in such ways that they can be beneficial in decrypting many evidential mysteries. It has been emphasized that a priority for future research perspective will be to generate a global database of cosmetic products around the globe, allowing reliable identification of different types. Knowing the diversity of cosmetic products available worldwide that is a vast undertaking, but it is felt that, it could make a significant contribution to solving many crimes. This may be especially relevant to assist investigations involving travellers who may become involved in crimes far from the countries in which the cosmetics were involved.

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HYDROGEN FUEL CELL VS LITHIUM ION CELL

SHASHANK SAHU (Department of Chemistry, Hansraj College)

It will not be out of place if it is said that world is growing at a faster rate and non-renuable resources are exausting rapidly. So it is the high time to for us to move towards renuable resource which are not only enviromental friendly but also very efficient.

(i) HYDROGEN FUEL CELL

A fuel cell is an electrochemical which converts chemical energy contained in readily available fuel oxidant system into electrical energy.

PRINCIPLE: The fuel cell operates like a galvanic cell. The only difference is that the fuel and the oxidant are stored outside the cell. Fuel and oxidant are supplied continuously and separately to the electrodes at which they undergo redox reaction. Fuel cells are capable of supplying current as long as reactants are replenished.

Fuel + Oxidant → Oxidation products + Electric Energy

APPLICATIONS:

1. The most important application of a fuel cell is its use in space vehicles, submarine or military vehicles.

2. The product H2O is valuable source of fresh water by the astronauts.

3. Fuel cell batteries for automotive will be a great boom for the future.

ADVANTAGES:

1. The energy conversion is very high (75-82%).

2. Fuel cell minimizes expensive transmission lines and transmission losses.

3. It has high reliability in electricity generation.

4. The byproducts are environmentally acceptable.

6. They save fossil fuels.

7. Noise and thermal pollution are very low.

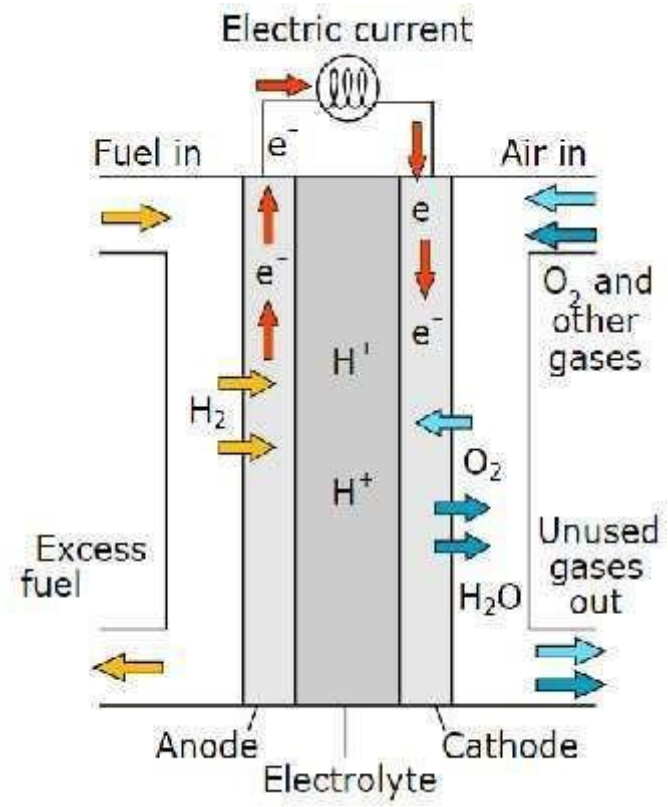


Fig: *H2-O2 fuel cell*

DISADVANTAGES:

1. The major disadvantage of the fuel cell is the high cost and the problems ofdurability and storage of large amount of hydrogen.

2. The accurate life time is also not known.

LIMITATIONS:

1. The life time of fuel cells is not accurately known

2. It cannot store electricity

3. Electrodes are expensive ad short lived.

4. Storage and handling of H2 gas is dangerous because it is inflammable

(ii) LITHIUM ION CELL

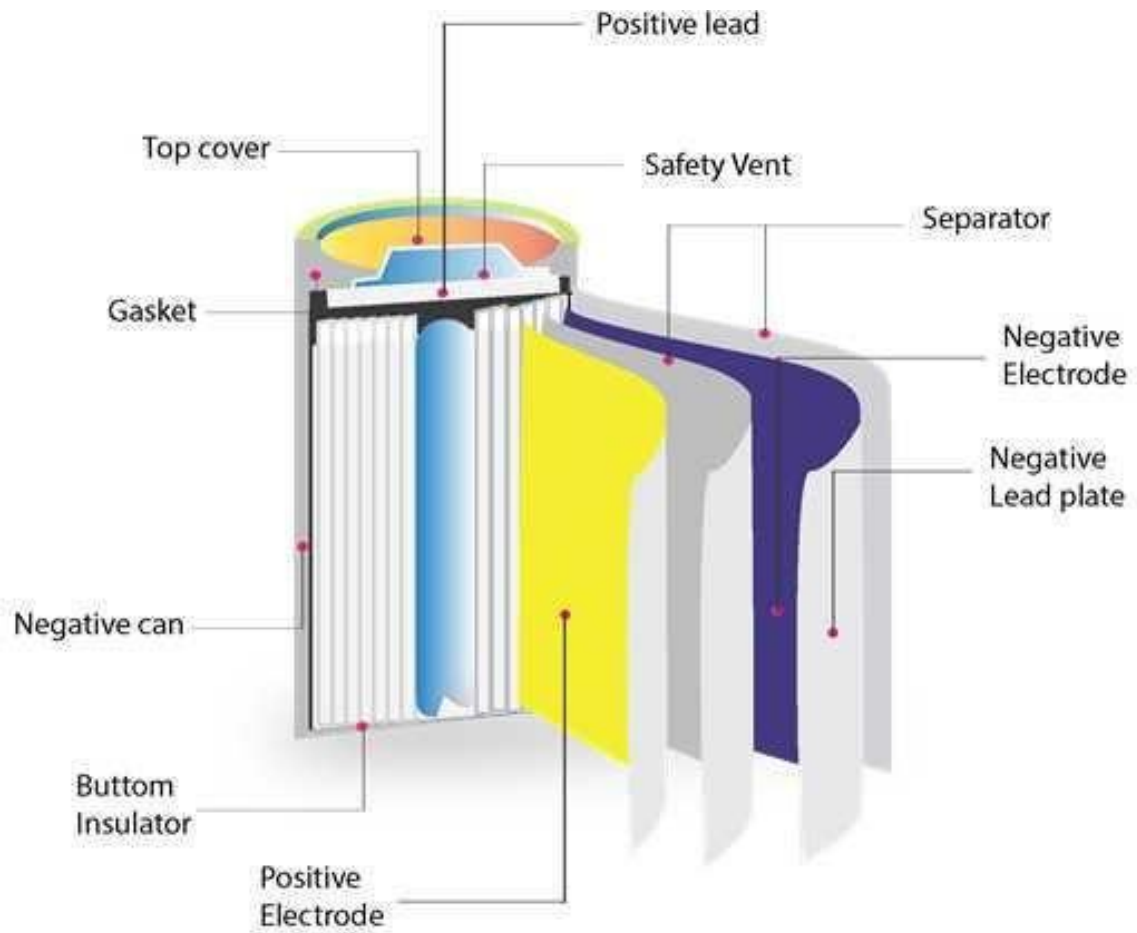
Lithium-ion battery is a secondary battery. As in lithium cell, it does not contain metallic lithium as anode. As the name suggests, the movement of lithium ions are responsible for charging & discharging. Lithium-ion cell has the following three components.

1. A positive electrode (Layers of lithium-metal oxide) (cathode).

2. A negative electrode (Layers of porous carbon) (anode).

3. An electrolyte (Polymer gel) (separator).

APPLICATIONS: Cell phone, PC, Portable LCD TV, Semiconductor driven audio, etc.



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DEVELOPMENT OF METHODS OF GENOME EDITING AND ITS IMPACT ON THE SOCIETY

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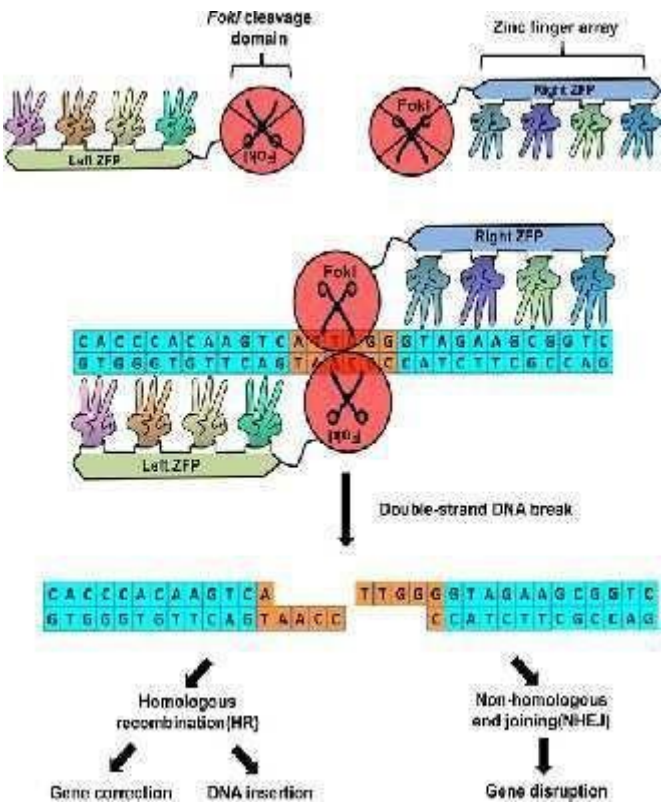
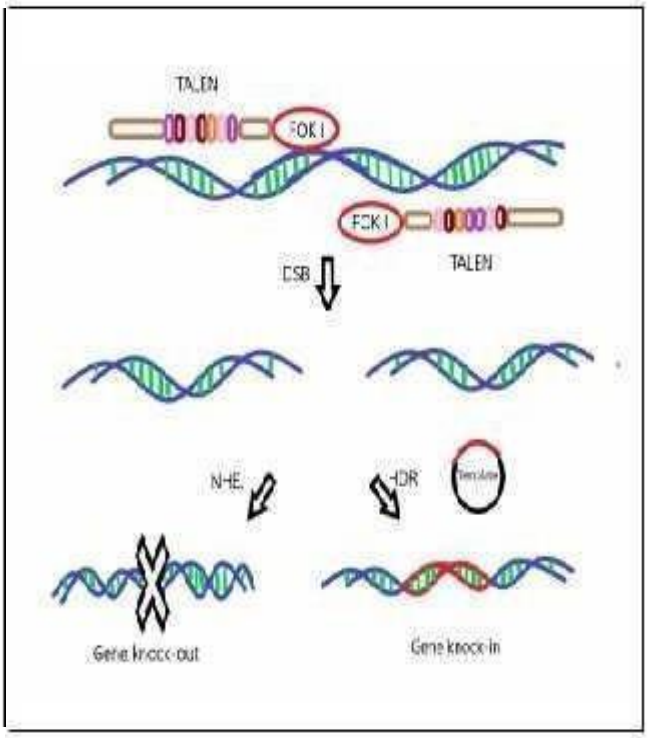
ABSTRACT

For several years, scientists have developed various technologies to study the effects of changes in DNA. Genome editing or gene editing is one such method that allows scientists to perform highly specific changes in the DNA of a living organism, including bacteria, plants, and animals. The development of the first genome engineering technology dates back to the 1900s. Since then, a myriad of techniques have come into the picture, but the most recent one CRISPR-Cas9 has caught everyone's attention and has proved to be the most versatile and efficient one. This article reviews the development of various strategies that have paved the way for the success of genome editing, and then briefly discusses its impact on the society as a whole.





DEVELOPMENT OF METHODS OF GENOME EDITING

Howsoever simple the process of gene editing may seem,the reality is quite far-fetched. There are four main gene editing techniques which define the history of genome engineering.

RESTRICTION ENZYMES:

Their discovery in the 1970s enabled the scientists to edit genes. These enzymes recognize specific DNA sequences and cut at that site, allowing the insertion of a new DNA material at that location. Restriction enzymes are not used these days

ZINC FINGER NUCLEASES:

The loopholesin the restriction enzymes technique were addressed with the discovery of zinc finger nucleases(ZFN) in the 1980s. ZFNs consist of two sub-units: one DNA binding domain (zinc finger) and one DNA cleavage element. Each zinc finger recognizes a characteristic pattern of three base pairs.

CRISPR- CAS9:

The introduction of CRISPR- Cas9 in 2012 completely revolutionized the genome engineering technology. Clustered Regularly Interspaced Short Palindrome Repeats (CRISPR- Cas9) is a system that has long existed in the genomes of prokaryotic organisms like bacteria. CRISPR- Cas9 system consists of two key molecules: a guide RNA (gRNA) and a Cas9 nuclease. The Cas9 nuclease cuts the two DNA strands at specific sites within a nucleotide region defined by the guide RNA. The CRISPR- Cas9 technique has proved to be cost effective and budget-friendly and stands out as the most reliable system for genome editing.

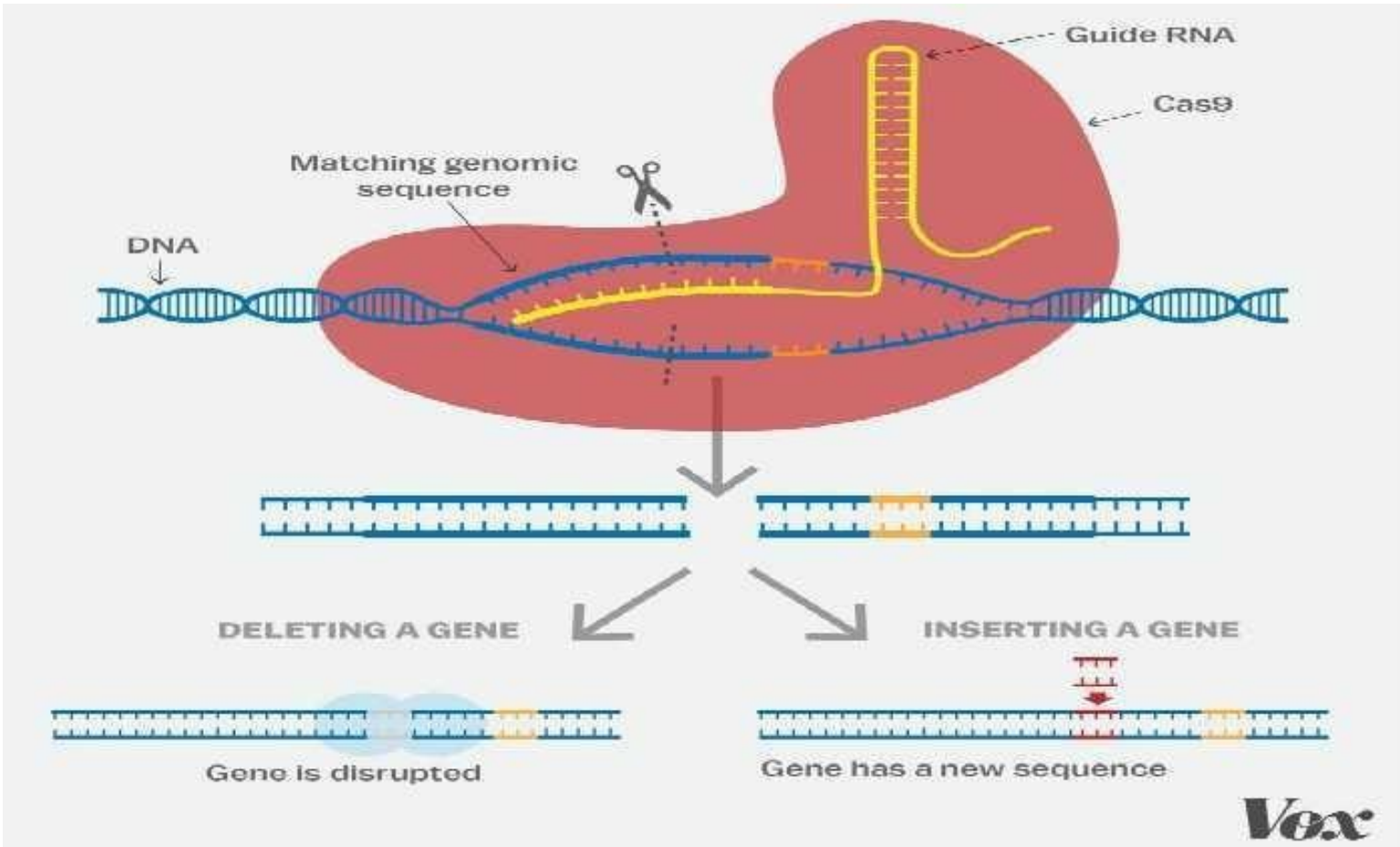
IMPACT ON THE SOCIETY

The Modifying the structure of DNA of a living organism has profound implications, which have been vividly reflected through the wondrous changes brought in by the genome technology.

Gene editing techniques have showed real promise in the field of medicine and in acting as a diagnostic and therapeutic tool.

- ZFNs have been used to edit tumor- infiltrating lymphocytes as a method of treatment for metastatic melanoma.
- CRISPR- Cas9 as an editing tool has been in use since a long time to treat cancer, hepatitis-B, and even high cholesterol.

Although the practice of gene editing has proved greatly beneficial to the society, there have been umpteen controversies related to editing of the germline (reproductive) cells owning to their ethical implications and impact on the future generations.



CONCLUSION

The remarkable headways in genome editing techniques have opened up new horizons in the fields of medicine and agriculture. Undoubtedly, gene editing technologies are bound to create a substantial impact on our lives in the years to come. This is merely the beginning!

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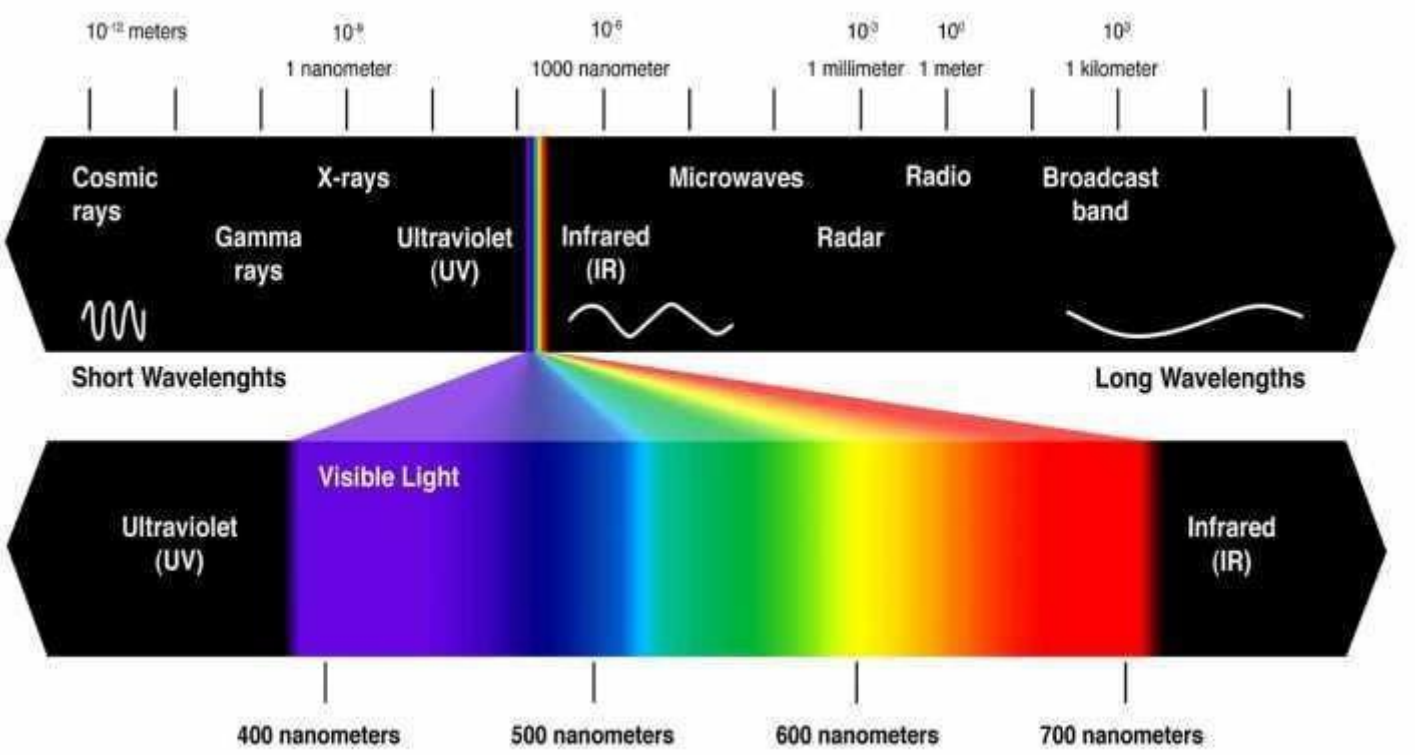


NANOPHOTONICS AND ITS APPLICATIONS

TRIPTI YADAV (Department of Chemistry, Hansraj College)

WHAT IS NANOPHOTONICS ?

Nanophotonics is a branch of engineering which deals with study of light at extremely small scale known as a nanometer scale. Human brains are not good at conceptualizing how small a nanometer is. A nanometer is about 1/200 millionth of an average human head.Nanophotonics is also considered a branch of electrical engineering, optics, optical engineering and nanotechnology.Ever since **Richard Feynman's** announced lecture in 1959, researchers and scientists have been studying how once light is squeezed down into a nanometer scale, odd behaviors can occur and completely challenge the way we perceive our physical world. By demystifying these odd behaviors, we can have the power to break the limits of current technology and create superior photonics devices.In 2013, one group of researchers introduced IPKISS as a simple software framework used for the design of nanophotonic components. A few subcomponents of a nanophotonic circuit are displayed in Fig. 3.1. The resulting device consisted of submicrometer-wide silicon lines on top of a thick glass layer.

PRINCIPLE

It is based on the principle that it is possible to squeeze light into a nanometer scale using other techniques like surface plasmons, metal optics, field optics and metamaterials.

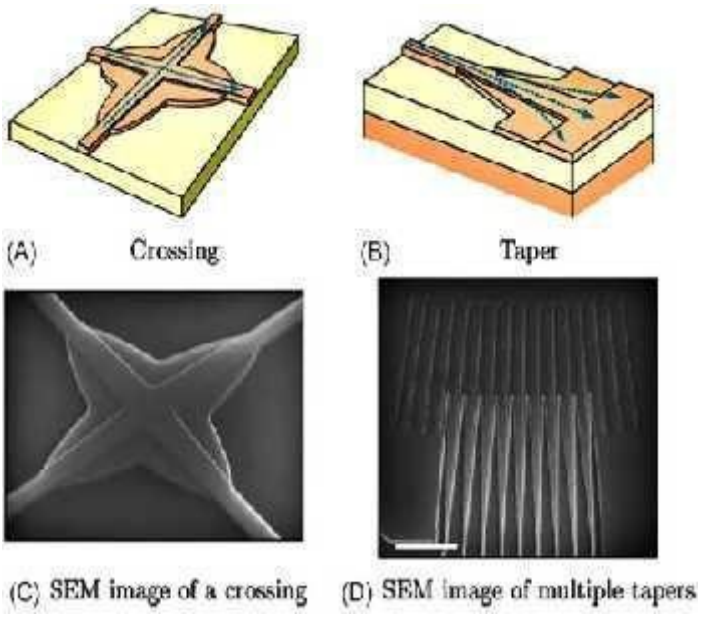
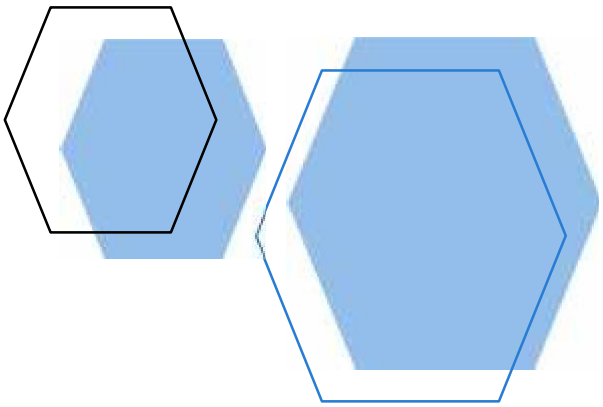


Fig. 3.1. Some examples of the Nanophotonics subcomponents used for designing small integrated optical circuits.



APPLICATIONS

1. SOLAR CELLS

Establishing the fundamental limit of nanophotonic light-trapping schemes is of paramount importance and is becoming increasingly urgent for current solar cell research. The standard theory of light trapping demonstrated that absorption enhancement in a medium cannot exceed a factor of $4n^2/\sin^2\theta$, where n is the refractive index of the active layer, and θ is the angle of the emission cone in the medium surrounding the cell. Here we develop a statistical temporal coupled-mode theory of light trapping based on a rigorous electromagnetic approach.

2. AS BAND GAP MATERIALS

Photonic band-gap (PBGs) materials or photonic crystals are materials with a periodic dielectric profile, which can prevent light of certain frequencies or wavelengths from propagating in one, two or any number of polarisation directions within the materials. This range of frequencies is similar to an electronic band-gap; thus, it is often called a photonic band-gap. Bragg grating structure is the best known one-dimensional PBG. The PBG is caused by a lattice or a crystal structure. The lattice scale of PBG is in the order of the wavelength of light, rather than in the order of atoms.

3. NANOPHOTONIC BIOSENSERS

Photonic biosensors exploit light's unique properties to realize some of the more sensitive, robust and reliable sensing platforms currently available. The paramount example is the surface Plasmon resonance biosensor. Most common optical biosensors are based on the so-called evanescent-field principle; the objective of point-of-care diagnostic biosensors is fully operational, portable devices that can be readily employed by end-users. Biosensors in clinical settings must analyze human samples like blood or urine directly, without pretreatment, providing unambiguous responses about the levels of specific molecules with an exquisite accuracy, selectivity and reproducibility.

4. MICROSCOPY

Photonic force microscopy (PFM) is an optical tweezers based microscopy technique. A small dielectric particle is held by a strongly focused laser beam. The forward scattered light, i.e. the light whose orientation is slightly permit the detection of the bead's position in three dimensions. The precision is very good and the recording speed is very high. Brownian motion deflects the bead from the resting position. A time sequence of measured positions allows one to derive the optical potential in which the particle is held. The PFM is sensitive to the environment of the particle and has been used in a variety of different experiments that e.g. monitor space that can be filled by particles inside agars or the fate of small latex beads captured by macrophages.

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SILICONE AND ITS VERSATILITY

RITUL SHARMA (Department of Chemistry, Hansraj College)

ABSTRACT

Silicone (polydimethylsiloxane) is an organic polymer and is made up of smaller units of silicon and oxygen skeleton ($R_2Si\text{-}O\text{-}SiR_2$-, where R= organic group) called monomers. It is synthesized as liquid, gel or rubber but in solid form, it is like plastic. The physical properties of silicon can be modified by creating cross-linking or changing the length of primary chain. In addition, this can be useful in surgical aids and have many other applications which are listed in the following content.

INTRODUCTION

Earth's crust is a very rich source of many naturally occurring minerals such as silicon, aluminum, quartz etc. which are found abundantly in earth's crust. Among these, the 2nd most prolific element and most prolific metalloid present is silicon. It is a hard, brittle crystalline solid with a blue-grey metallic lustre, and is a tetravalent metalloid and semiconductor. It is used as a base component for many semiconducting devices as well as used in the fabrication of glass, ceramics and silicones.

Silicone had a wide range of applications from kitchenware products (due to high resistant property) to the medical purpose (due to non-toxicity and biocompatibility of the semi-metal). The biocompatibility of an element refers to its ability to perform its intended function without creating any undesirable local or generalized effects. Silicone is a material of great utility because of its biodurable and biocompatible qualities that make it perfect for medical devices that have contact with the human body. A silicone polymer fulfills its role well and well combined with the wide availability and low cost of its base material. Moreover, even when carbon and silicon are closely related in distinct compounds, it does not harm its neighbor by its electronic composition.

They are extensively used as smoothening agents, conditioning agents, pacifying agents (that makes the solution opaque), shining agent, de-foaming agent and occlusive agents. In fact, it is used in 50% of items for skin, hair and underarms and a variety of other cosmetic products. Some people also undergo cosmetic surgery, in order to enhance the appearance by rectifying or modifying any physical imperfection of the body parts, which uses silicone as a major facilitator.

Silicone is used as a filler material in cosmetic industry. The physical properties are altered by adding fatty acids, glycerol, amino group and some other organic additives in order to get the long lasting results irrespective of temporary results. It can be easily molded and shaped into any shape and size due to its versatility in hardness.

Many cosmetic surgeries like lip augmentation, scars treatment, Rhinoplasty or to smoothen wrinkled frown etc. utilize medical grade silicone gel and oils. Polydimethylsiloxane (PDMS) is used for augmentation of the chin, malar and nasal bones. In ear surgery, the thin sheet of silicone rubber is placed over perforation of eardrum, middle ear covering and temporal canal lining in eardrum repair. It is used in homeostasis which provides strength and elasticity to scars tissue. It acts as a hydrating agent and regulates oxygen level in worn out tissue maintaining the moisture content in the area. The main use of silicone gel is for breast augmentation. Silicone is used as outer shell and it just feels like the characteristics of breast tissue. It is done by inserting the silicone shell just behind the breast tissue or under the chest muscles.

As the demand in the market for different cosmetic surgery and beauty products increases rapidly, new cosmetic silicones such as cetyaldimethicones and pegmethicones are introduced.

CONCLUSION

Despite being very helpful, silicone may cause several health issues. It is suggested that injected silicone fillers may go into the body which can result into death in the long term. The research over the effect of silicone with the body tissue is in the nascent age. There is a constant debate going on over the acceptance and restriction of cosmetic surgery through silicones sheet/gel/ oil with the human body. Recent research shows that silicone gel can go into different parts of body like heart, lungs leading to several health issues. Its presence in tissue provokes an inflammatory reaction with foreign body giant cells.

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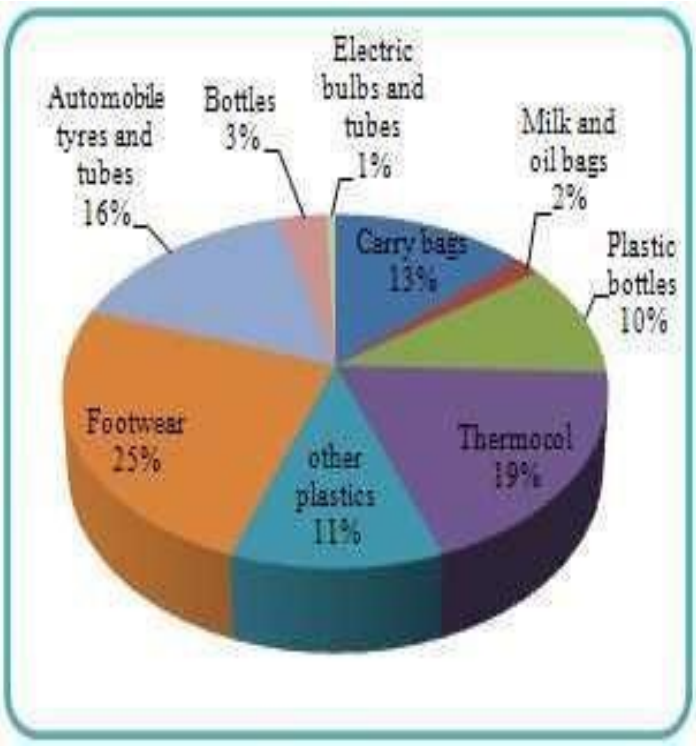
USAGE OF NON-BIODEGRADABLE WASTES IN INFRASTRUCTURAL DEVELOPMENT

TANU SHARMA (Department of Chemistry, Hansraj College)

ABSTRACT

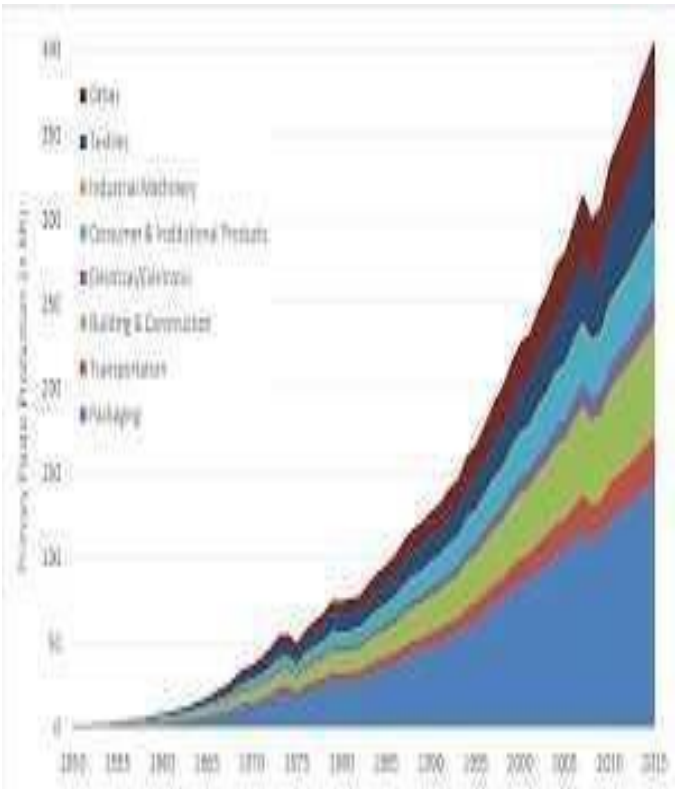
Waste generation; be it degradable or non-biodegradable is a natural outcome of many of the human activities. With an exceptional growth in the industrialization and urbanization, the demand for efficient waste management has been felt strongly. Wastes which were considered as worthless substances as well as hazardous to the environment can now be utilized to give surplus amounts of energy and super strong materials



INTRODUCTION

Nowadays there is a constant search for identifying usage of waste [as additive in concrete] from various activities and thereby preparing ecofriendly concrete in construction works. The construction industry is exploring the use of recycling materials like stone waste, rubber waste, fly ash, palm oil fuel ash, rice husk and municipality solid waste ash for partial replacement in concrete. Moreover, plastic roads have also been successful in waste management and turned out to be a productive alternative for landfills and dumping yards. Wastes after processing are useful in construction industry and can protect the environment, however their properties both physical and chemical must be investigated to see the suitability and compatibility as a component of any construction material.

Glabal plastic production 1950-2015

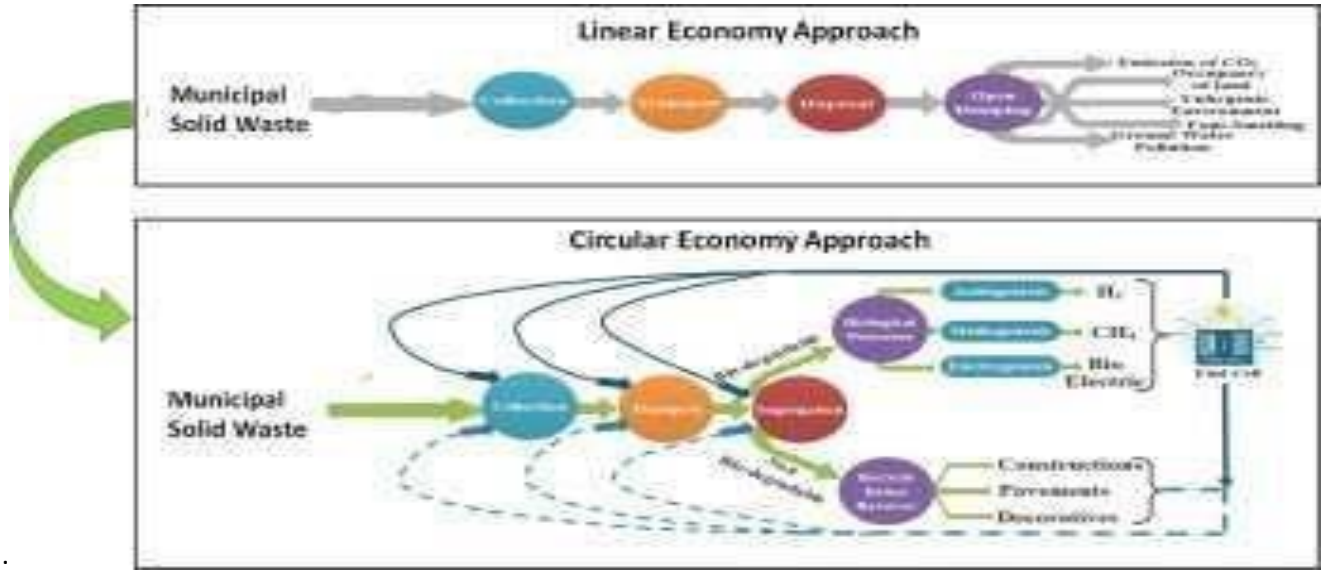


CONCRETE AS A CONTRUCTION MATERIAL

Concrete is a heterogeneous composite material made up of cement, sand, coarse aggregate and water mixed in a desired proportion based on the strength requirements. To increase the tensile strength and ductility of concrete members, polymer fibers can be introduced. Non-biodegradable materials are non-corrosive, resistant to chemical attack, light in weight and easy to handle. The addition of fibers in concrete would act as crack inhibitors and substantially improve the tensile strength, cracking resistance, impact strength, wear and tear, fatigue resistance and ductility of concrete. Subsequent research has identified many benefits of the addition of fly ash in concrete mixes, including improved workability, reduced heat of hydration, increased ultimate strength, increased resistant to alkali aggregates, resistant to sulfate attack and reduced permeability.

PLASTIC ROADS

It consists of modular, hollow and pre-fabricated road elements made from consumer waste plastics or consist of an asphalt mix with plastic waste incorporated into the asphalt mixture. It involves s collection of waste plastics, cleaning it by washing, shredding it to a uniform size, melting the waste plastics at 165 degree Celsius and blending it with hot aggregates and bitumen and using this mixture to lay the road. Some of the most common plastics used are polyethylene terephthalate, polypropylene and high- and low-density polyethylene. These roads can be engineered to meet specific requirements e.g., weather and wear resistance. They do not absorb water and have better flexibility which results in less rutting and less need for repair. Road surfaces remain smooth, need lower maintenance and absorb sound better. Rubber tyres and waste glass can also be used in improving the durability and quality of roads and pavements. Addition of waste tyres as rubber aggregates modifies the flexibility of surface layer.



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CONCLUSION

In this article we got to know about some Non-Biodegradable substances such as plastics, glass, fly ash and rubber tyres which can be efficiently used to make construction materials having better properties in comparison to normal materials. This innovative technology not only strengthens the infrastructure but also increases its life. Thus, use of these substances in infrastructural development leads to a better product while being helpful to the nature.

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IMPORTANCE OF THERMODYNAMICS AND KINETICS

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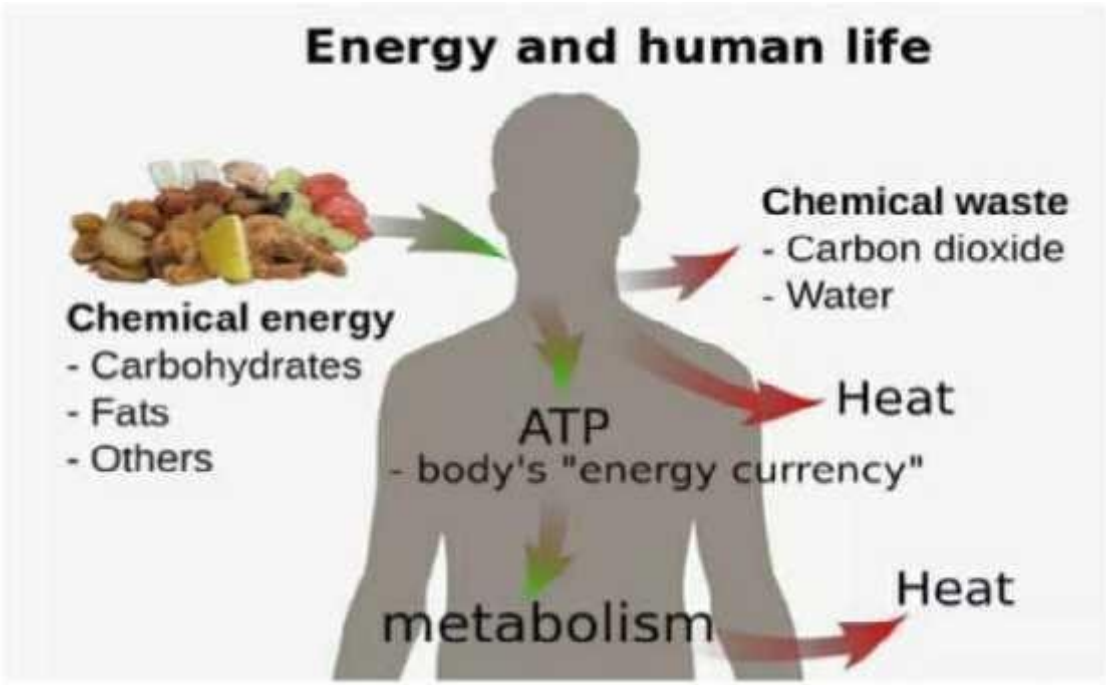
ABSTRACT

Human Body, animals or plants, they all have complex mechanism in this universe. If we talk about our body system, huge amount of reactions are going on inside. Thereare about 30 trillion cells which work in harmony to Carry out all the basic functions necessary for humans to survive. There are about 100 billion immune cells which are produced every day in a person's bone marrow.Well, What are the reactions might be going in these cells and how they are in Counterbalance with nature?

THERMODYNAMICS AND ITS APPLICATIONS

'Thermodynamics is boring right'. But it has contributed a lot to human life. All the processes which occur in nature and daily life are guided by Thermodynamic laws. Thermodynamics deals with energy changes in a chemical reaction. There are twoimportant laws of Thermodynamics which unified principles of biology. All the chemical Processes in biological organisms are governed by these principles.

First law of thermodynamics, states that energy can neither be created nor be destroyed but may change from one form to another and the sum total of energy of the system and surrounding always remain Constant. Also known as law of conservation of energy.All biological organisms require energy to survive. In this universe which is a closed system, energy never consumed but transfer from one form to other. As we know that cells in human body perform various activities which requires energy. In Photosynthesis, energy is supplied by the sun. This energy is absorbed by the cells and stored in the form of Glucose and then it is used to form Carbohydrates to build plant mass.

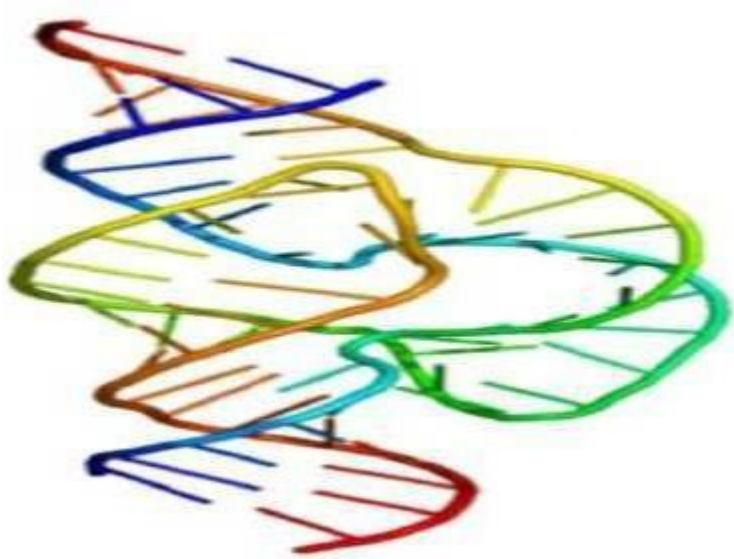


This energy is stored in Glucose, is also released through cellular Respiration. As energy stored in carbohydrates are accessible to the plants through the production of ATP. This energy is consumed in various activities such as DNA replication, Meiosis, Mitosis, Cell Movement etc.

The second law of thermodynamics states that during the transfer of energy, the energy available at the end of the transfer process is lesser than the energy at the beginning. Also, all of the available energy will not be useful to the organism due to Entropy which is the measure of disorder in a closed system.None of the transfer energy is 100% efficient in all biological processes. As in case of photosynthesis, not all the energy given by the Sun is absorbed by the plant. Some of energy gets reflected back and some of them lost as heat. The energy which returned to the surrounding environment give rises to increase of disorder or Entropy. Unlike plants and other photosynthetic organisms, animals cannot generate energy directly from the sunlight but they consume plants or other animal organism for energy.Also, the energy keeps on decreasing as the energy transfer increases. So, the organisms at the higher level of chain are left with less amount energy from the total available energy, HENCE, In order to maintain the highly ordered state such as of cells, the living system requires constant energy . In the process of ordered state, the loss of energy to the surrounding take place and thus, the Entropy increases in the surroundings.

KINETICS AND ITS APPLICATION

The enzymes present in body of living beings causes many positive and negative changes. As RNA, have an enzyme called Ribosome's which have the ability to catalyze specific biochemical reactions such as RNA Splicing in gene expression. As kinetics means something which speed up the reaction such as we use different catalyst in performing the reactions. Likewise, our body system undergoes various reactions in order to fight against all the odds from outside. In case of Ribosome, it was used against HIV. As RNA called gene shears has been developed for HIV infection. In the same way, Ribosome has been designed to Target the hepatitis C virus, Influenza A and B and even SARS Corona virus. Despite these efforts by researchers, these projects have remained in the preclinical stage. The function of many proteins is to act as catalysts for biological reactions. Enzyme kinetics is complicated substrate. That's because it keeps on changing rapidly according to the needs. To be surprised, Enzymes can carry out as many as 106-107 reaction per second. It takes about microsecond to second to change its structure. Various biological processes such as gene expression, DNA replication, signally, motility etc. undergoes through Kinetics. Some reactions take place at greater speed and moderate Further, enzymes have great significance in medicine for targeting various diseases and for their treatment.



CONCLUSION

To conclude, we can say that living beings are made up of complex structure. Whether it's about thermodynamics or kinetics, each has equal importance for the growth of organism.

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RAMAN SPECTROSCOPY FOR DETECTING DISEASE CAUSING BACTERIA

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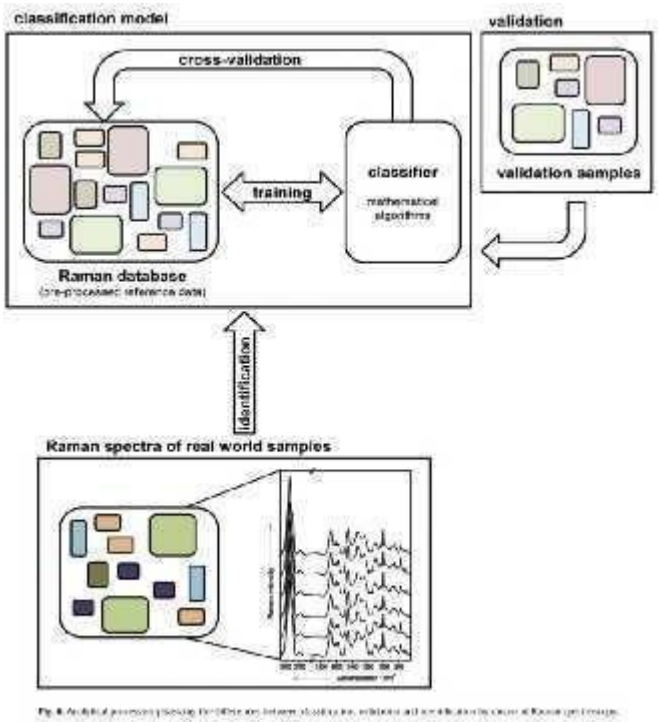
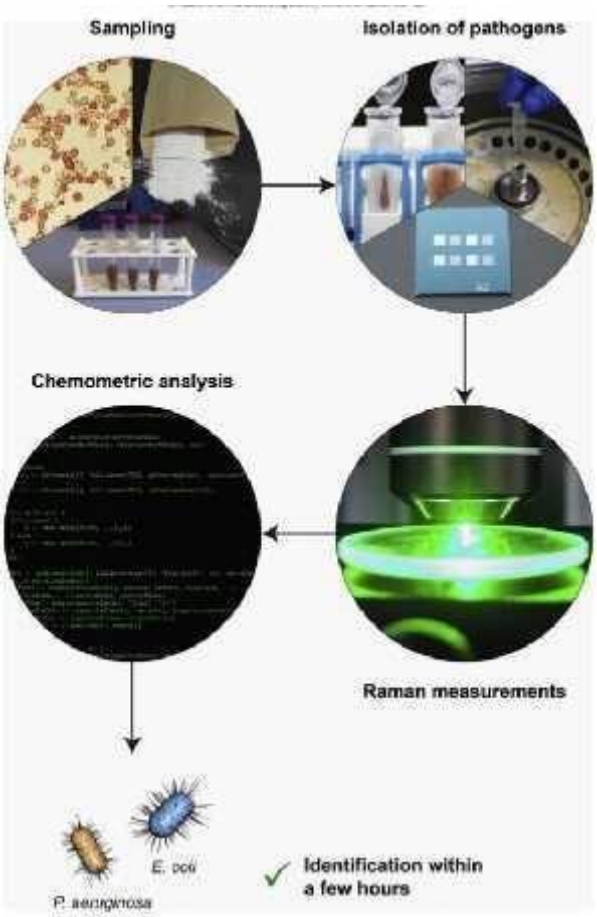
Raman spectroscopy exploits the effect that laser light is scattered inelastically to a small extent, when interacting with a sample. During this process energy is transferred between the incident photons and the sample molecules. The amounts of energy correspond to specific molecule vibrations. The fact that the Raman spectrum displays the molecular composition of the investigated sample with unique specificity makes this spectroscopic technique highly attractive for various analytes. By combining a Raman setup with a microscope even very small sample volumes within the range of a few µm3, including single cells, can be investigated separately. Additionally, Raman measurements can be performed unimpededly on microbial



cells, since water is a very weak Raman scatterer. Usually, visible wavelengths are used to probe microorganisms. Eventually fluorescence can hamper the measurements and dominate the spectra, since the laser light used for the Raman measurements can also excite fluorescence emission in the samples. The rather weak, but very sharp Raman bands can be masked by a broad and intense fluorescence background, appearing in the samespectral region.



The choice of an appropriate excitation wavelength is one option to overcome this problem. On the one hand the wavelength one option to overcome this problem. On the one hand the wavelength can be chosen so that the excitation is far away from any absorption process, but on the other hand it is useful to select a wavelength which matches with an absorption to partially get a resonant effect. This phenomenon, known as resonance Raman spectroscopy, is additionally a method to enhance the intrinsically weak Raman process, Surface enhanced Raman spectroscopy (SERS) is another well-known possibility to face this problem. Here, nanoparticles or nanostructured metal surfaces are used in order to enhance the intrinsically weak Raman signal by several orders of magnitude.Regarding SERS based detection of bacteria, there are several possibilities, some of which are schematically depicted in the figure. For example the samples can be analyzed using nanostructured arrays as shown in the figure. Various types of metallic nanoparticles or colloids are also frequently employed for acquiring SERS spectra of bacteria. It is also possible to deposit the nanoparticles directlyonto the bacterial cell wall as indicated in the figure. While all thepreviously mentioned approaches usually aim to detect the bacteria cell.

In this work, we apply state-of-the-art deep learning techniques to noisy Raman spectra to identify clinically relevant bacteria and their empiric treatment. A CNN model pre-trained on our dataset can easily be extended to new clinical settings through fine-tuning on a small number of clinical isolates, as we have shown on our clinical dataset. We envision that fine-tuning processes such as the one demonstrated here could be important components for continuously evaluating and improving deployed models. Our model, applied here to the identification of clinically relevant bacteria, can be applied with minimal modification to other identification problems such as materials identification, or other spectroscopic techniques such as nuclear magnetic resonance, in frared, or mass spectrometry.This study uses measurement times of 1 s, corresponding to SNRs that are an order of magnitude lower than typical reported bacterial spectra — while still achieving comparable or improved identification accuracy on more isolate classes than typical Raman bacterial identification studies. A common strategy for reducing measurement times is surface-enhanced Raman scattering (SERS) using plasmonic structures, which can increase the signal strength by several orders of magnitude.

SERS spectra can be highly variable and difficult to reproduce, particularly on cell samples, making it difficult to develop a reliable diagnostic method based on SERS. However, with a dataset capturing the breadth of variation in SERS spectra, a CNN could enable a platform that processes blood, sputum, or urine samples in a few hours. Compared to other culture-free methods including single-cell sequencingo and fluorescence or magnetic tagging, Raman spectroscopy has the unique potential to be a technique for identifying phenotypes that does not require specially designed labels, allowing for easy generalizability to new strains. To achieve treatment recommendations as fine-grained as those from culture-based methods, larger datasets covering more resistant and susceptible clinical isolates, greater diversity in antibiotic susceptibility profiles, cell states, and growth media and conditions would be needed. Though collecting such datasets is beyond an academic scope, requiring highly automated sample preparation and data acquisition processes, there is promise for clinical translation. Similarly, studies applying the Raman-CNN system to identify pathogens in relevant biofluids such as whole blood, sputum, and urine are a promising future direction to demonstrate the validity of the method as a diagnostic tool. When combined with such an automated system, the Raman-CNN platform presented here could rapidly scan and identify every cell in a patient sample and recommended an antibiotic treatment in one step, without needing to wait for a culture step. Such a technique would allow for accurate and targeted treatment of bacterial infections within hours, reducing healthcare costs and antibiotics misuse, limiting antimicrobial resistance, and improving patient outcome.

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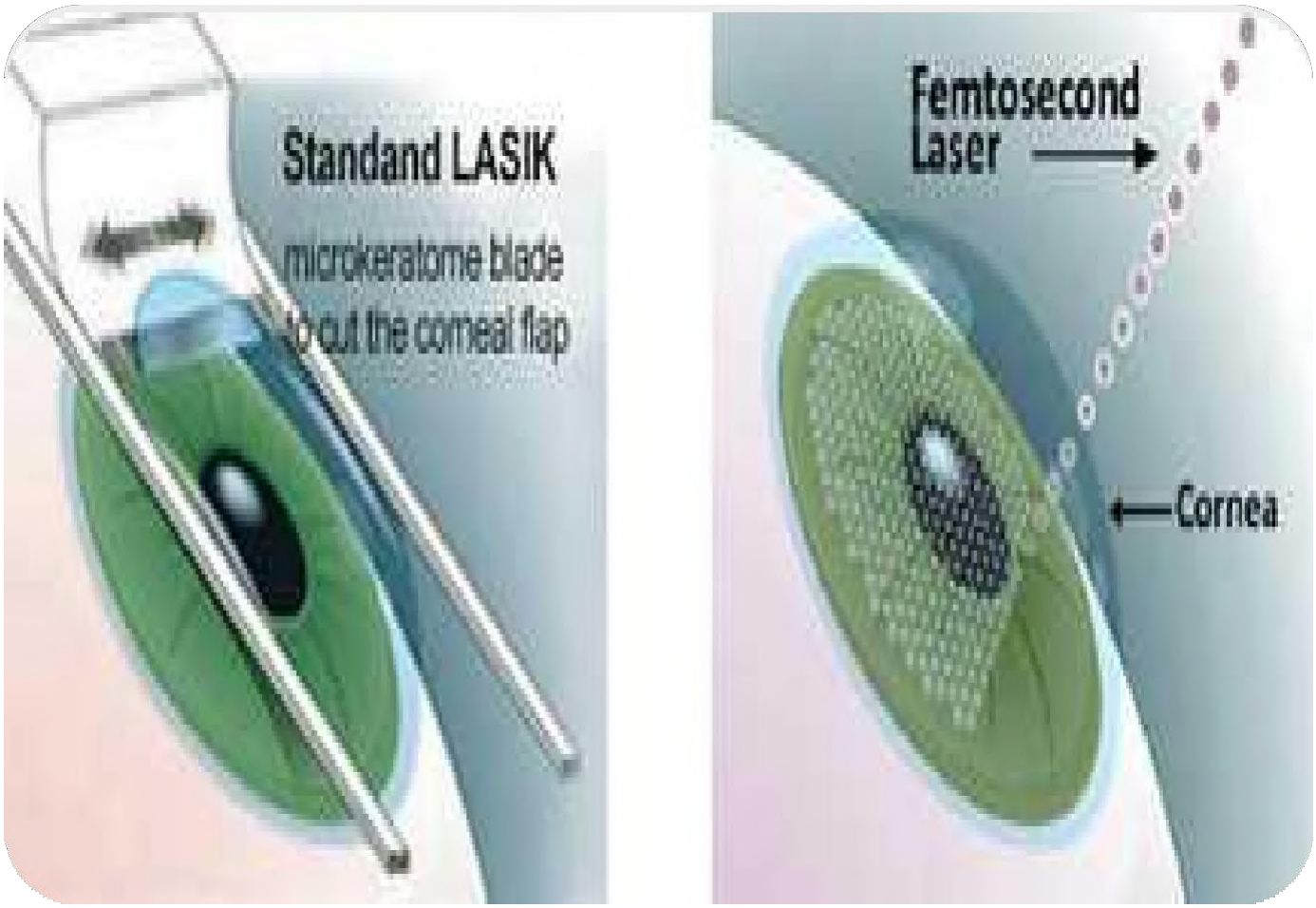

TRACKING AEROSOLS DURING EYE SURGERIES

YASHIKA (Department of Chemistry, Hansraj College)

ABSTRACT

There is increasing evidence suggests that the transmission of novel corona virus, SARS-CoV-2, through Aerosols. Aerosols are the tiny droplets that can remain suspended in the air for hours in closed spaces. Aerosols generated during surgeries and out-patient procedures can be risky to healthcare workers.

To unfold this mystery and to ensure safer OT practices, a series of experiments- AEROSOL PROTECTIVE PREDICTION EXPERIMENT AND APPLIED RESEARCH (APPEAR) were designed by Ophthalmologists at Narayana Nethralaya, an eye hospital in Bangalore.

INTRODUCTION

High-speed imaging and aerodynamic models were used to visualize the generation of droplets during procedures such as cataract and LASIK surgeries (Laser Eye surgeries). The size of the droplets were identified, the speed and distance to which they travel was also calculated. The experiments carried out using Femtosecond LASIK and SMILE machine, shows no observed Aerosols as said by SaptarshiBasu, Professor at the Department of Mechanical Engineering, IISc, and co-author of two papers published in the Journal of Cataract and Refractive Surgery.

STUDIES DONE IN THIS FIELD

The first study focused on phacoemulsification, a type of cataract surgery where an ultrasonic needle is used to break up the cataract. The fluids are then suctioned out and the eye is rehydrated with a balanced salt solution. The needle and a sleeve carrying the salt solution are usually combined into a single disposable probe. In the study – conducted during surgeries on humans and animal eyes in a closed chamber – the researchers employed a technique called shadowgraphy, which uses a light source such as pulsed laser or LED to cast shadows of fast-moving droplets onto the sensor of a high speed camera. The High Speed – Ultra High Resolution Camera could capture 20,000 frames per second with this even the smallest of aerosols can be picked up.

Succession of tests was performed on artificial anterior chamber. As long as the probe was restricted to the inner layer of the eye called anterior chamber, no aerosols were observed. The experiments were carried with different incision and sleeve sizes of eye. The observation was still same – no aerosols were picked up at all. However when the incision size exceeded sleeve size, the results were exactly same. Aerosols were formed only when the probe was exposed to the salt solution on the eye's outer surface called cornea. Therefore, replacing the salt solution with more gelatinous or viscous materials can prevent fluid spurting and aerosol generation, the researchers say.

The second study investigated aerosol generation during LASIK surgery, performed to correct near- or far-sightedness. It uses an oscillating blade to cut and lift a thin flap from the cornea's top layer to reshape the inner layer called stroma. The researchers found that, as the blade cut through to the stroma, some droplets were generated, likely due to the balanced salt solution used as a lubricant prior to the procedure. However, most of the droplets were found to be large in size (>90 micrometers) and therefore likely to settle down fast, reducing the risk that they will become aerosolized. Because the droplets were found to travel up to 1.8 m in a simulated surgery setting, adequate precautions and protective equipment should be adopted by doctors, the researchers suggest.

CONCLUSION

Based on these findings, the hospital has identified and implemented specific safety protocols, says corresponding author Abhijit Sinha Roy, Chief Scientist at Narayana Nethralaya Foundation. “Because of COVID-19, a lot of other surgical procedures are getting delayed. Our concern is that patients should not end up compromising their vision just because they delayed getting the appropriate healthcare they needed. They should feel at ease after seeing these robust studies and safety measures implemented in our eye clinics,” he says.

For the safety of the surgeon Several prophylactic OT measures were formulated:

- Proper Draping.
- Avoid pooling of fluid on the ocular surface.
- Ensure adequate drying of the ocular surface
- Use of shield attached to microscope to safeguard the Operating Surgeon from Aerosols.
- Maintain social distancing from machine and patient.
- Change Gloves after operating each eye.

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ABOUT THE SCIENTIST

SIR JOHN ANTHONY POPLE

British Chemist, Sir John Anthony Pople, who died on 15 March 2004(aged 78) was born on 31 October 1925 at Burnham - on - sea, Somerset in England. He was awarded the Nobel Prize in Chemistry with Walter John in 1998 for his development of computational method in quantum chemistry. Pople's research centered on applying the complicated mathematics of quantum mechanics to study the chemical bonding between atoms within molecules. The use of quantum mechanics was problematic in this regard, because the necessary mathematical calculations for describing the probability states (wave functions) of individual electrons in molecular systems are so complex. However, the development in the 1960s of increasingly powerful computers that could perform such calculations opened up new opportunities in the field. In the late 1960s Pople designed a computer program, Gaussian, that could perform quantum-mechanical calculations to provide quick and accurate theoretical estimates of the properties of molecules and of their behavior in chemical reactions. Gaussian eventually entered use in chemical laboratories throughout the world and became a basic tool in quantum-chemical studies. The computer models provided by this program have increased the understanding of such varied phenomena as interstellar matter and the effect of pollutants on the environment. These models also enable scientists to simulate the effectiveness of new drugs.

The followings are reflections on the life and work of John Pople:

John Pople was a towering figure in the field of Theoretical and Computational Chemistry. Trained as a mathematician, his interests developed towards theoretical chemistry through the influence of his Ph.D. advisor Sir John Lennard-Jones at the University of Cambridge, where Pople began his academic career. After becoming a Lecturer in the Mathematics faculty, in 1958 he was named head of the Ba sics Physics Division at the National Physical Laboratory near London. In 1964, he moved to the USA as Professor for Physical Chemistry at Camegie-Mellon University. Following his retirement from CMU in 1993, Pople became Board of Trustees Professor at Northwestern University and continued his very active career. Pople's early papers in statistical mechanics attracted attention, but he became well known for his theoretical work in NMR spectroscopy and his seminal contributions to π and valence electron theory. Pople developed the PPP (Pariser-Parr-Pople) and the CNDO/INDO/NDDO set of approximate methods. His important NMR (with Bernstein and Schneider, 1959) and semi-empirical MO (with Beveridge, 1970) monographs remained standard references for many years

Olah proposed a clear demarcation between 'trivalent' carbenium ions (for example, CH3+), in which the positively charged car bon center forms bonds with three other groups, and carbonium ions (such as CH5 +), in which the carbon forms bonds with five or more other groups. He showed that the two types of ion are both intermediates in electrophilic reactions, but in different ways. (The former involves electrons donated from π orbitals, as found in double bonds, and the latter involves donations from σ orbitals, a 'nonclassical' situation in which two electrons are shared by three atoms.) This important distinction had not been previously established. Olah's work overturned the long-held assumption that a carbon atom could bind to no more than four other atoms. He proved the existence of the 2-norbornyl cation, a non-classical ion proposed by his friend Saul Winstein. Olah used low-temperature NMR and superacids to establish the non-classical structure of this carbocation at the center of the debate over classical ions and non-classical ions. Olah's studies on compounds containing carbon atoms with more than four bonds led to a new area of 'hypercarbon chemistry'. He extended the types of reaction that were possible by showing how to activate electron-seeking species, or electrophiles, into superelectrophiles.

His work on fluorine chemistry helped thousands of researchers to study and develop many fluorinated pharmaceuticals. About 25% of all drugs currently on the market are fluorinated compounds. In 1977, Olah moved with his group to the University of Southern California in Los Angeles, where he founded the Loker Hydrocarbon Research Institute. His post Nobel research with long-time collaborator Surya Prakash focused on green fuels derived from carbon dioxide capture and recycling. In particular, they worked on methods to convert natural or shale gas efficiently to methanol, a clean-burning renewable liquid fuel that can be used in place of petrol and diesel, and as a feedstock for petroleum-derived products. This new approach not only solved our long-range dependence on decreasing fossil fuels (oil, gas, and coal) but also at the same time promised to mitigate global climate change (warming) caused significantly by derived greenhouse gases such as carbon dioxide and methane. Carbon dioxide is now converted to methanol commercially at the George Olah Renewable Methanol Plant near Grindavík, Iceland.

After reports that carbon ions had been observed in space, he suggested that methanol could have had a key role in the evolution of complex building blocks of biology, and eventually of life. His Nobel-prize winning work on carbocations has led to applications including better oil and gas refining, new methods for synthesizing small molecules and the discovery of drugs and materials. He was also awarded the Priestley Medal, the highest honor granted by the American Chemical Society and F.A. Cotton Medal Award for excellence in Chemical Research of the American Chemical Society in 1996. Olah's immense breadth of knowledge has been captured in his well recognized books notably: Beyond oil and gas: The Methanol, Superelectrophiles and their Chemistry, Superacid Chemistry, Hydrocarbon Chemistry and many more.

As Paulo Coelho wrote in his book Alchemist, "And, when you want something, all the universe conspires in helping you to achieve it, George Andrew Olah managed to prove this. Inspired and guided by an inspiring vision he worked tirelessly to revolutionize the field of science and Organic Chemistry in particular. A life of Magic Chemistry is an autobiography of George Olah which will guide us through his remarkable journey. His fascinating researches are and will always be celebrated.