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GRAPHENE

DEPARTMENT OF CHEMISTRY

HOOGLY MOHSIN COLLEGE

CHINSURAH, HOOGLY, 712101, WEST BENGAL, INDIA

This issue is dedicated to the memory of
Prof. P. B. Sarkar



(1895-1971)

Courtsey: Sohām Ghosh, Semester 2

Pulin Bihari Sarkar obtained State Doctorate degree of Dr.es.Sc. in 1920 while working at University of Sobornne, Paris specializing in Chemistry. He served as Lecturer, Reader and Professor (during 1920-60), Head (1952-60) and CSIR Emeritus Scientist (1962-67) all at Department of Chemistry, University College of Science and Technology, University of Calcutta, Kolkata.

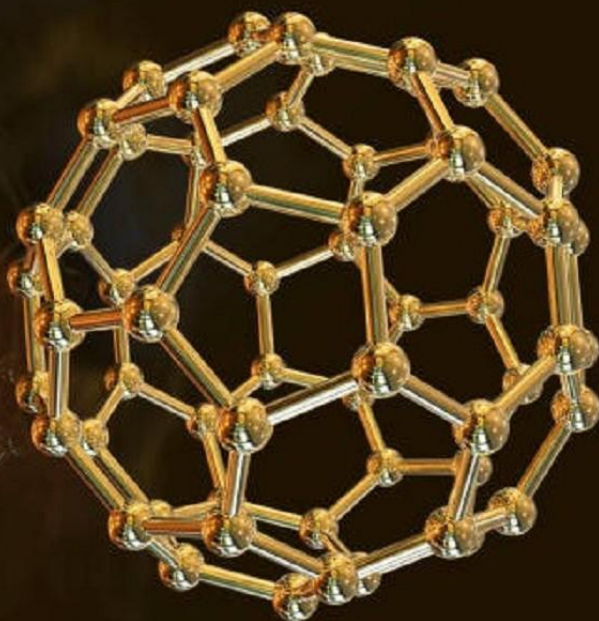
Professor Sarkar did pioneering studies on the chemistry of europium, gadolinium and scandium. He did extensive work on chemical homology and isomerism. He also did some work in analytical chemistry. His main work in the field of minerals and analytical chemistry can be broadly divided into three main categories: investigations on the radioactive minerals in India and determination of the geological age; search of trace elements in minerals and their quantitation; establishment of compositions of complex mineral. He was elected as President, Chemistry Section, Indian Science Congress on 1938 and was a Fellow of Indian Chemical Society.

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MESSAGE FROM*Principal's Desk*

It is a matter of pride that the e-magazine committee of GRAPHENE, erstwhile wall magazine of Chemistry, has put its most excellent effort to bring out the magazine for the academic year 2020-21, in spite of the unprecedented COVID-19 crisis. The magazine, I feel, will share the creative thoughts of students of the department of chemistry among the readers. The articles published in it, I hope, will be of contemporary importance of science. I am also confident that it will serve as a spring of motivation to the students of department of chemistry to contribute articles in future. I sincerely applaud all team members of GRAPHENE for putting their best efforts in bringing out the magazine, in a very useful way.

DR. PURUSHOTTAM PRAMANIK

Principal
Hooghly Mohsin College



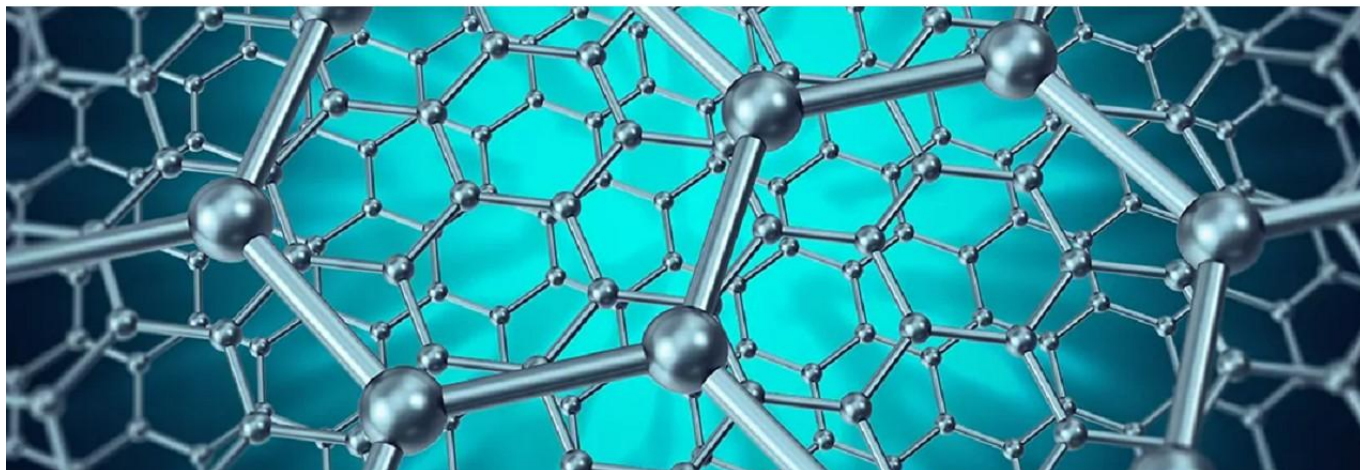
Head of The Department of Chemistry

MESSAGE FROM
DR. SUBRATA SAHA

In view of coronavirus outbreak, GRAPHENE, basically a wall magazine of the Department of Chemistry is being published in electronic format. This issue (GRAPHENE, Issue-01, June, 2021) is dedicated to the memory of Late Prof Pulin Bihari Sarkar, a great teacher and legendary scientist who did extensive work on chemical homology and isomerism.

In our department students are always encouraged to write articles on great discoveries in Chemistry and allied fields in a simple way avoiding technical jargon. Our objective is to draw learners interest towards the wonderful world of Chemistry.

I appreciate those students who contributed articles and at the same time I congratulate the teachers whose relentless effort has made the publication of this e magazine a reality.





MESSAGE FROM

EDITORIAL DESK

GRAPHENE provides a platform to every student of the department of chemistry, to develop their reading and writing skills in the field of modern day chemistry. In this context, our budding talents worked hard, reviewed articles and finally they tried their best to give a shape of it in the form of article in this issue of GRAPHENE, Issue-01, June 2021.

This year, GRAPHENE (Issue-01, June 2021) has been dedicated to the memory of great analytical chemist, writer, and renowned Professor, Late Pulin Bihari Sarkar, in recognition of his valuable contribution to the knowledge of chemistry, especially for his pioneering contribution on the chemistry of europium, gadolinium and scandium.

At this juncture, we would like to thank our Principal, Dr. Purushottam Pramanik, and our head of the department of chemistry, who have guided us at every stage of making this e-magazine. Our sincere gratitude, also due to our esteemed professors of the Department of Chemistry, HMC and the students, for their cooperation and sincere support putting their best in bringing out this issue. We wish all readers a happy reading.

DR. SAROJ ROY

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MESSAGE FROM

STUDENTS' DESK

"THE COMPLICATED OF ALL ANSWERS LIE IN THE MOST STUPID QUESTION EVER ASKED..."

It's an absolute honour to be able to a part of the excruciating journey. "Graphene" was till now a wall magazine published every year on the historic walls of Department of Chemistry, Hooghly Mahsin College. It's for the first time it is published as a full fledged magazine in digital format and will be accessible to wider section. The articles that make this up are knowledge enriching. The chemistry can be more interesting and realistic than we actually consider. The contents contains information about how the knowledge of chemical science explain the very basic actions and products we use now and then. We all had a lot of enjoyable experience while making this piece. We are especially thankful to our HOD, Dr. Subrata Saha Sir and all our Professors helping us shaping our articles and help us maintain the synergy all throughout the lockdown period. Hope this sincere effort of ours will be appealing to all the readers...



Asymmetry in Nature !

Sougat Das

Semester-4

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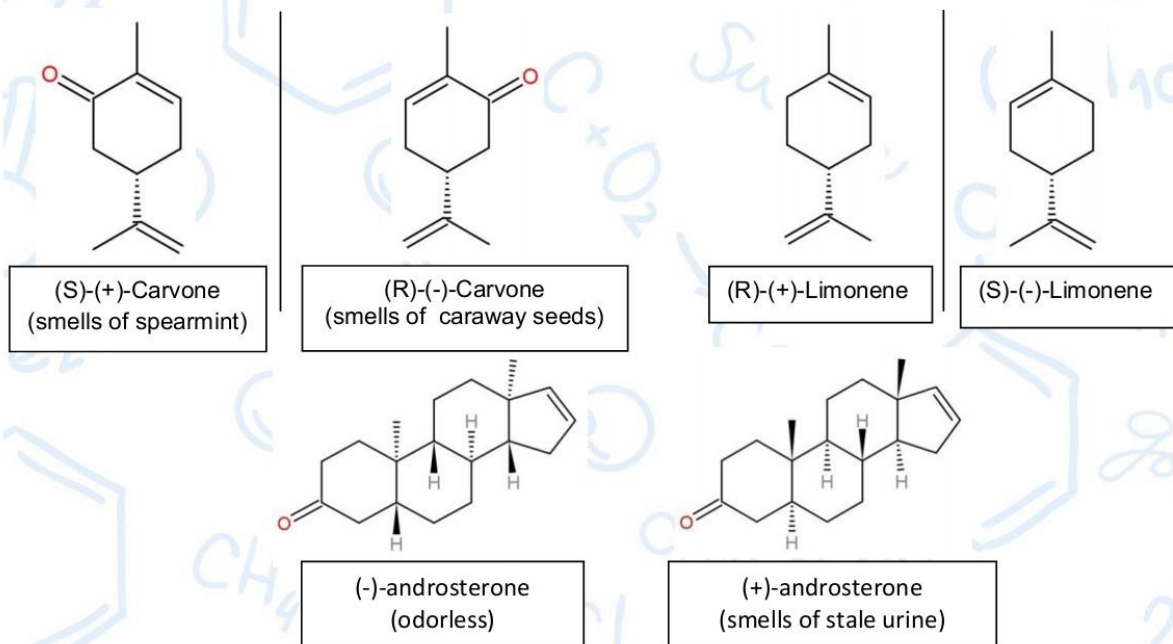
Keywords- asymmetric synthesis, enantiomer, chiral, pheromone

Introduction

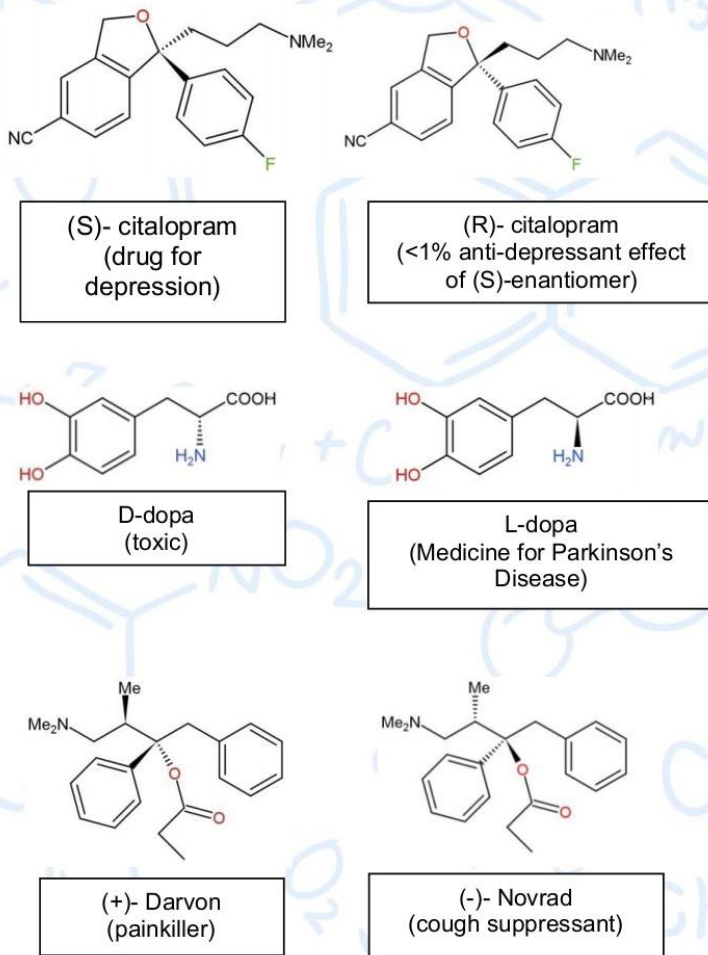
We, human beings, animals, plants or name any living organisms are all inherently chiral. It sounds amusing right! You might be wondering that we seem fairly symmetrical when we look into the mirror. But when you scroll through the pages of a book using your right hand, at the same instant you might process the information with left portion of brain. Few organisms like snail are obviously chiral, as they carry shells that may spiral to the left or to the right. Amazing, not that nature is chiral, but the fact that they exist largely as one enantiomer. When you consider the human body, you will find stomach and heart on the left, liver on the right and so on. Then, honeysuckle (*Lonicera*) climbs by spiraling to the left and all bindweed (*Convolvulus*) spirals to the right.

Right Choice!

Nature by itself can distinguish between left and right of and on its own. Initially we could not distinguish between the smells of orange and lemon. But gradually as we grow, we learn to differentiate just like we learn to wear the right shoe in the right foot. (As a child we all have sometimes mistakenly put right shoe in the left feet - funny though!) The differing smells of orange and lemon comes from the left and right versions of same molecule, limonene. (R)-(+)-Limonene smells rounded and orangey; (S)-(-)-Limonene has a sharp and lemony smell. Similarly again, spearmint and caraway seeds smell quite different, though it differs only in being the two enantiomers of ketone Carvone. May sound ill, but we are regrettably sensitive to the (+)-androsterone which produces the smell of stale human urine. Nevertheless (-)-androsterone is odorless. Even microorganisms like bacteria identifies it's right from left. But how do we know all this? It's all same until we put them in a chiral environment.

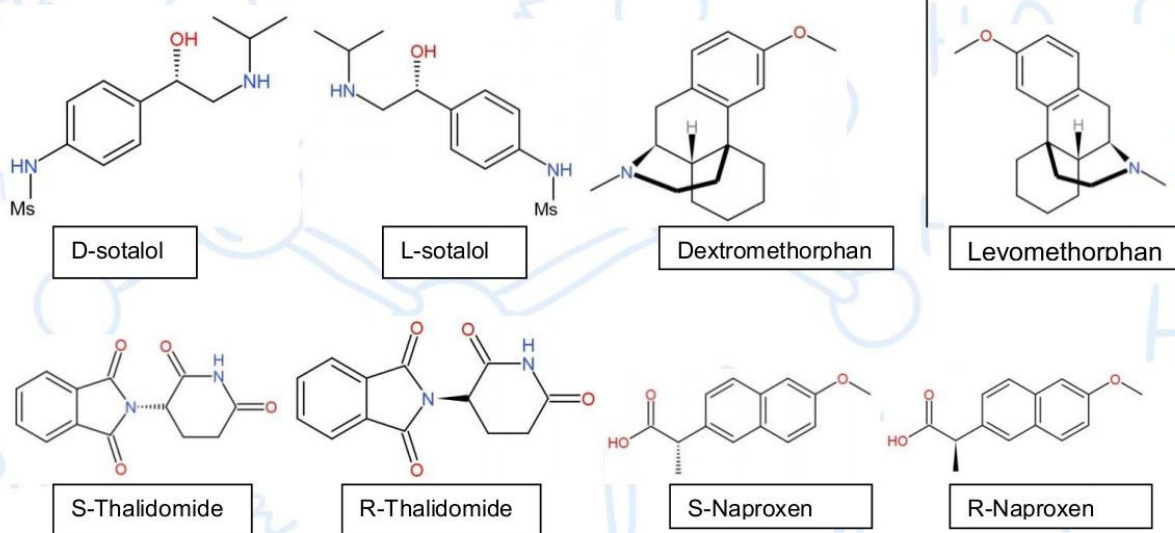


If you wish to be a perfumer or flavor and fragrance manufacturer, distinction between the enantiomers are of utmost importance, like the spearmint flavoured toothpaste. When it comes to drug molecules it becomes a matter of life and death. Parkinson's disease sufferers are treated with the non-proteinogenic amino acid dopa (3-(3,4-dihydroxyphenyl)alanine). Dopa is chiral, and only (S)-dopa (known as L-dopa) is effective in restoring nerve function.(R)-Dopa is not only ineffective, it is quite toxic, so the drug must be marketed as a single enantiomer. Likewise the antidepressant citalopram and the painkiller naproxen are marketed only as their S-enantiomer. Still in few cases both enantiomers have activity like (+)-Darvon is a painkiller and (-)-Novrad is a cough suppressant.

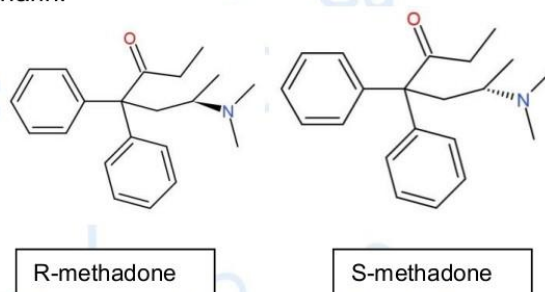


Adverse effects of Isomerism !

Isomerism can lead to different therapeutic uses and adverse drug reactions like Quinine has antimalarial activity while quinidine has an antiarrhythmic property; L-sotalol is alpha-blocker while d-sotalol is antiarrhythmic; Levomethorphan is a potent opioid analgesic while dextromethorphan is a cough suppressant; R-Thalidomide is sedative while S-Thalidomide has been shown teratogenic effects; R-Naproxen is used for arthralgic pain while S-Naproxen is teratogenic; D-Ethambutol is antituberculosis drug while L-ethambutol has been found to cause blindness; (S) (+)-ketamine causes fewer psychotic emergence reactions, less agitated behavior, and better intraoperative amnesia, and analgesia than its enantiomer.

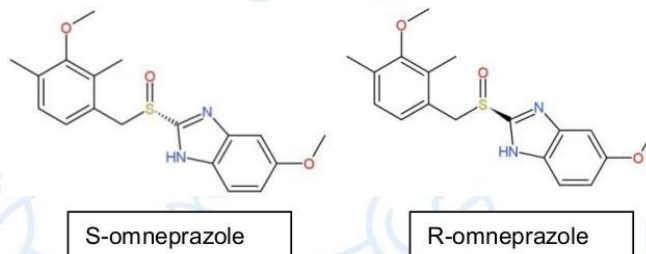


Two stereoisomers can compete for binding to same receptors like S-methadone antagonizes respiratory depression action of R-methadone. If the two isomers are of agonist and antagonist type, then racemic mixture acts as partial agonist like picendol and sulfinpyrazone inhibits the metabolism of S-Warfarin significantly but not of R-Warfarin.^[4]

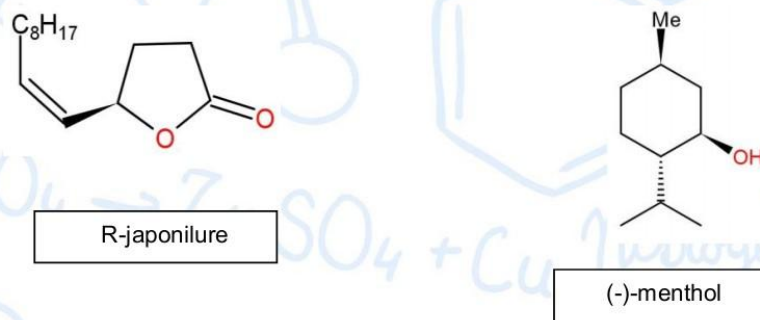


Single Enantiomers vs. Racemic Mixtures

Single enantiomers have less complex and more selective pharmacodynamic profile as compared to racemic mixture, so have lesser adverse drug reactions, improved therapeutic profile, less chances of drug interactions than racemic mixtures. Single enantiomers seem to be more advantageous over racemic mixtures as - adverse drug reactions occurring due to one enantiomers are avoided, patients are exposed to less amount of drug so body is exposed to the lesser metabolic, renal and hepatic load of drug, there is easier therapeutic drug monitoring of the active pure active enantiomers. A number of drugs are marketed now as single enantiomer like Levosalbutamol, Escitalopram, Naproxen, etc. Many antibiotics have only one enantiomer produced because they are made by fermentation and even the semi-synthetic ones start with the natural fermentation product like quinolones and all penicillins. Both omeprazole and its S enantiomer (esomeprazole) have been available and used to treat symptoms of gastroesophageal reflux disease (GERD) and conditions associated with excessive stomach acid secretion for more than a decade.^[4]



The simple lactone, Pheromone released by Japanese beetle *Popilia japonica* is a means of communication. Even more control over the enantiomer is need as 1% of S-enantiomer (though inactive) acts as a powerful inhibitor of R-enantiomer and destroys it's activity. In the last two decades, this asymmetric Nature of substances have occupied more organic chemists than any other. And it is by their efforts, many compounds which are rare in living organisms are produced more cheaply in laboratories.



By 2007, for example at least 30% of the world's supply of menthol was not extracted from plants but made synthetically. A thousand tones (-)-menthol a year is made by the company Takasago in Japan using the techniques of asymmetric synthesis.

Future Scope!

Research in the field of stereoisomerism has opened the new challenges and the new field avenues in the field of clinical pharmacology. Currently a large number of clinical trials are going on to compare the efficacy and safety of single enantiomers and the racemic mixture. Many single enantiomer drugs will hopefully flood the market in near future^[4]

Conclusion

At the astronomical level, circularly polarized light has been found in the Orion Nebula, which indicated the existence of large regions of space with asymmetry. Chiral asymmetry in biomolecules has a predominance of L-amino acids, and D-sugars have provided wide speculations for pharmaceutical and agricultural chemistry. The spontaneous process of breaking of chiral symmetry and the high degree of sensitivity has to small chiral asymmetries are fundamentals of the observed asymmetry.^[2]

In the present times, it is a total mystery when it comes to the question of origin of asymmetry. When? Where? How ? Nobody knows; it might be understood scientifically as a result of natural law and we can only assume from the various stages of evolution and it's beginning. Life began on Earth about 4.6 billion years ago. We assume that the synthesis of the amino acids started as back as when the surface temperature was still comparatively high enough.^[3]

"All life is chiral, so all living systems are chiral environments."

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SMARTPHONE- SMARTER LIFE, SMARTEST SCIENCE

Srabasti Dhar, Swarnali Dutta

Semester-2

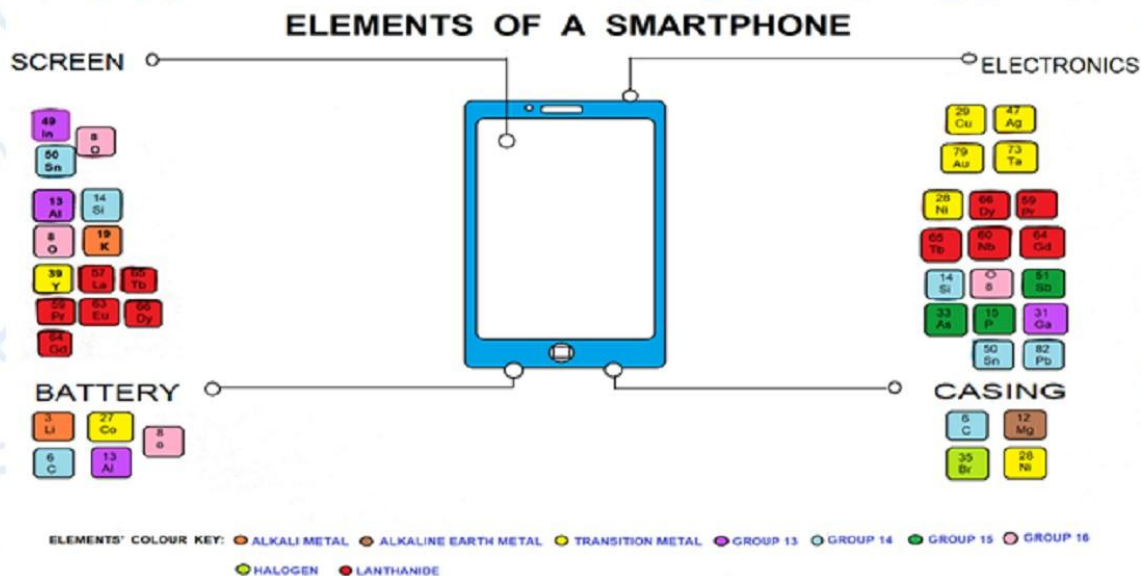
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Keywords- smartphones, capacitive touchscreens, silicon, aluminium, lithium batteries, blue light

Introduction:

It might be an astonishing fact that there's a large role of chemistry behind the smartphone! But if we notice the elements of the periodic table it certainly makes sense that every feature of a smartphone is a direct application of the chemical properties of elements. An average smartphone contains at least 60 different metals. Even the vibration of smartphones is caused by the elements Neodymium & Dysprosium.

Now let's have a look into the implementation of periodic properties of elements to make our digital life smarter.



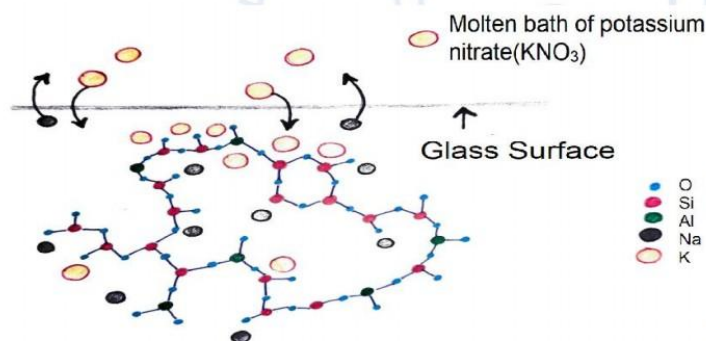
Screen:

Chemical elements used :

- Praseodymium
- Terbium
- Yttrium
- Gadolinium
- Indium
- Oxygen
- Aluminium
- Europium
- Dysprosium
- Silicon
- Potassium
- Lanthanum

Glass-an amorphous solid and ceramics-a crystalline thing combines together to form an extraordinary heat resistant material named as Gorilla glass. This contains aluminosilicate along with sodium and magnesium ions. The process of making this involves a chemical process called an ion exchange. The extreme hardness of this glass is originated by putting it into a molten bath of potassium nitrate at 300°C.

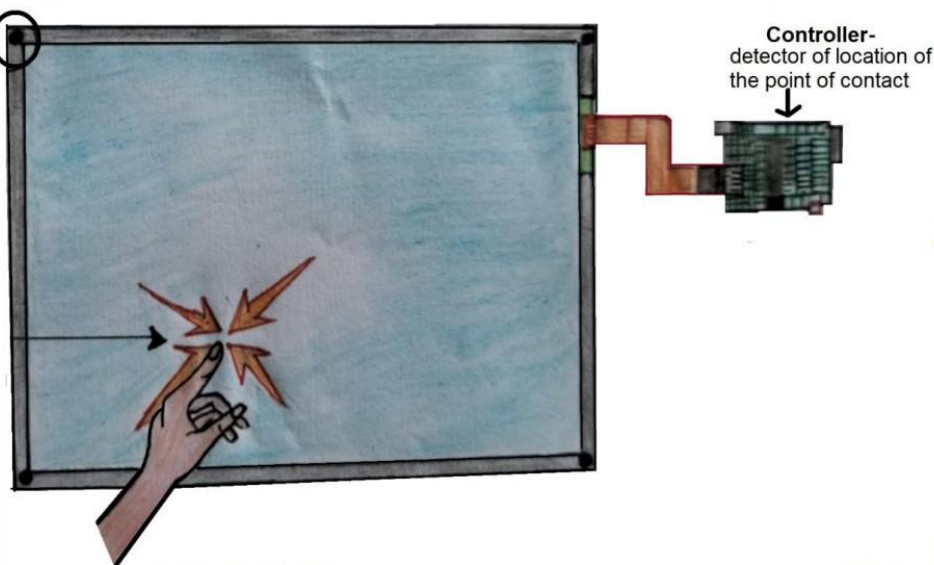
K^+ ions being reactive and larger than Na^+ ions makes the glass compressed and a large energy is Glass Surface stored as elastic potential energy.



The second basic category of touchscreens, called capacitive touchscreens is used in smartphones, which are electrical in nature. The ions present in glass are locked in their position and inhibit the current flow. To continue the flow, a layer of indium tin oxide (ITO) is placed on the glass. In this layer the $3+$ Indium ions are replaced by $4+$ Tin ions. This overcomes the insulating barrier of Indium oxide and makes it a good conductor. Our concept of physics may confuse us by the thought that a conductor which doesn't possess any energy gap between valence and conduction band, is incapable of being transparent. But the ITO being just conducting is able to permit visible ray through it. The ITO Layer has a grid pattern which act as capacitors - storing a few amounts of charges. It's evident that our body is a good conductor of electricity. As soon as we touch the screen the stored charge will be transferred to our finger and there will be a voltage drop in the screen. After processing the location of voltage drop, the software will recognize the change in current at point of contact and will respond by acting as per the corresponding direction. Our fingertips that possess the combination of salt and moisture, create an ionic solution and include our body to be a part of the circuit. A variety of rare earth elements are used to produce colour on the screen. Some are also used to control UV light penetration into phones. These are Y, La, Pr, Eu, Tb, Dys, Gd etc.

All 4 corners of touchscreen are given small amount of voltage

As soon as the finger touches the screen a trace amount of current is drawn from the point of contact

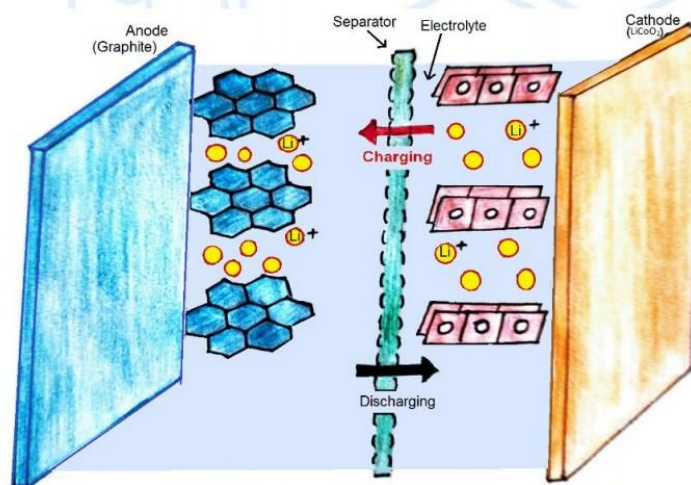


Battery

Major elements in battery:

- Lithium
- Cobalt
- Carbon
- Aluminium
- Oxygen

Lithium-ion batteries found in most smartphones and electronics have a metal oxide cathode made of a cobalt, nickel, manganese or iron mix, a porous graphite anode that holds lithium ions within it and a lithium salt electrolyte. The lithium in the positive electrode is ionized during charging of the battery, and moves into the layers of the graphite electrode. During discharge, the ions move back to the positive electrode.



Casing

Major elements in casing:

- Carbon
- Magnesium
- Bromine
- Nickel

The casing of a smartphone is also made by applying various chemical properties of elements. The metal casings consist of magnesium alloys and plastic casing contains carbon compounds. Bromine being a hazardous and toxic substance, other organic compounds are used to make flame retardants. As prevention of undesired current flow in the device, semiconducting layers are used. Earlier this contained a silicon dioxide layer. But in order to fit the transistor switch in a small allotted area, the layer should be thinner which may lead to leaking of current for the size of silicon atoms. To overcome this inefficiency, hafnium based layers are used. This again requires titanium nitride and titanium aluminium nitride to use in transistors. Moreover, Tungsten is used as bridge metal to connect the transistor with interconnecting copper layers as well as weights for the vibrating motors within the phone.

Electronics

Chemical elements used in Electronics:

- | | | | |
|-------------|--------------|----------------|------------|
| • Copper | • Silver | • Gold | • Tantalum |
| • Nickel | • Dysprosium | • Praseodymium | • Terbium |
| • Neodymium | • Gadolinium | • Silicon | • Oxygen |
| • Antimony | • Arsenic | • Phosphorus | • Gallium |
| • Tin | • Lead | | |

The chip and processor of a smartphone is made of n-type or p-type semiconducting materials mainly silicon doped by phosphorus, antimony, arsenic, boron, indium or gallium. Copper is used predominantly as wiring within smartphones, it also comprises a number of micro-electrical components in devices. Earlier the electrical components were joined by soldering with lead and tin. For being a poisonous substance, the use of lead is obsolete and a combination of tin copper and silver is used nowadays to marginalize the pollution caused by lead. The microphone and speaker of the phone contain magnets, which are usually neodymium-iron-boron alloys or contain arsenic and gallium. Nickel is also there in the components of the microphone. Gallium has mainly been used in amplifiers for mobile phones' integrated circuits. Palladium and Platinum are used as other minerals in the electrical circuits of phones.

Conclusion

In spite of having plenty of good impacts, its evil side is an adverse effect on human health and as a result an immobilized generation is compelled to be formed. The blue light that emits from the screen of a smartphone contains a very short wavelength and high energy which may damage our exposed body parts. It's found that this light may destroy the photoreceptor cells of the eye which can lead to blindness. Cell phones emit low levels of non-ionizing radiation, also referred to as radio frequency (RF) energy which may be fatal to human health.

Leaving aside these injurious consequences, smartphone's necessity is enhanced vigorously due to its extraordinary capabilities of bringing the whole world in our hands. Thus, we can readily say that there are broad future aspects of a smarter digital lifestyle. As chemistry will modify day by day with invention of new elements, smartphones along with other virtual mediators will re-flourish.

Retention of Future use

The future of smartphones is likely to include a greater range of larger yet thinner stretchable and foldable screens on offer. The next step in the evolution of smartphones is mind control. The technology will allow us to perform every task that we want to do, via touch or voice with our mind. Also, holographic phones with 3D displays can be a reality one day.

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AN INTRODUCTION TO NOTHINGNESS - VIRTUAL PARTICLES

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Semester-4

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Keywords – virtual particle, uncertainty principle, vacuum energy, particle, anti-particle

Introduction

Let's imagine an ideal vacuum with absolutely nothing inside. But what is actually really profound is that empty space is not actually entirely empty, in fact according to quantum mechanics empty space is actually with an ocean of virtual particles. It can be said that virtual particles are subatomic particles that come out of nothing for a very short moment of time in reality and then disappear again out of reality.

Uncertainty Principle and Virtual Particles

Virtual particles have quantifiable effects, but to observe them, we have to violate the uncertainty principle, which is impossible.

The Heisenberg uncertainty principle states that the product of the uncertainties in the momentum and the position of a particle equals $h/(4\pi)$ or more (i. e. $\Delta x \Delta p \geq h/4\pi$, here h is Planck's constant which is equal to 6.6×10^{-34} joule-second). This means that the more precisely you measure the position of a particle, the less precisely you can know its momentum. And the more accurately a particle's momentum is measured, the less accurately its position can be known (valid for micro subatomic particles).

There is another form of Heisenberg's uncertainty principle (the product of the uncertainty in an energy measurement and the uncertainty in the time interval during which the measurement is made also equals $h/(4\pi)$ or more) for simultaneous measurements of energy and time. Energy and time are also characterized by complementary uncertainties. i. e, $\Delta E \Delta t \geq h/4\pi$, (ΔE is the uncertainty in energy and Δt is the uncertainty in time). As a result of the second form of uncertainty principle, there is always, at every point in time and space, even in a ideally vacuum space, an uncertainty in energy and an uncertainty in duration. Any two conjugate uncertainties (position, momentum; and energy, time) can't be brought down to zero simultaneously. Thus we can conclude that the points in space will follow the uncertainty principle and never have energy equal to zero (which can be measured accurately). Thus according to the uncertainty principle, something can come out of "nothing" if that "something" goes back to the "nothing" in an extremely small period of time ¹. From knowledge of uncertainty principle: energy and time of a quantum system is limited. So when the time is significantly less than \hbar over two of the lower limit of the possible knowledge of both the variables then the value of the energy must be very great in order to bring the value high enough to fulfill the equation, same way, if the energy is very less than \hbar over two the time the virtual particle exists must be very great.

The concept of "virtual particle" is very confusing. Let's imagine the vacuum (empty) space as a series of points. If energy is added by introducing photons or particles to one of these points, the point will start oscillating with the same amount of energy in a harmonic motion which might affect the surrounding points in the space.

As in the previous assumption it is imagined that the vacuum space is an ocean of points in space that constantly change, causing what is called quantum vacuum fluctuations. It causes the points oscillating

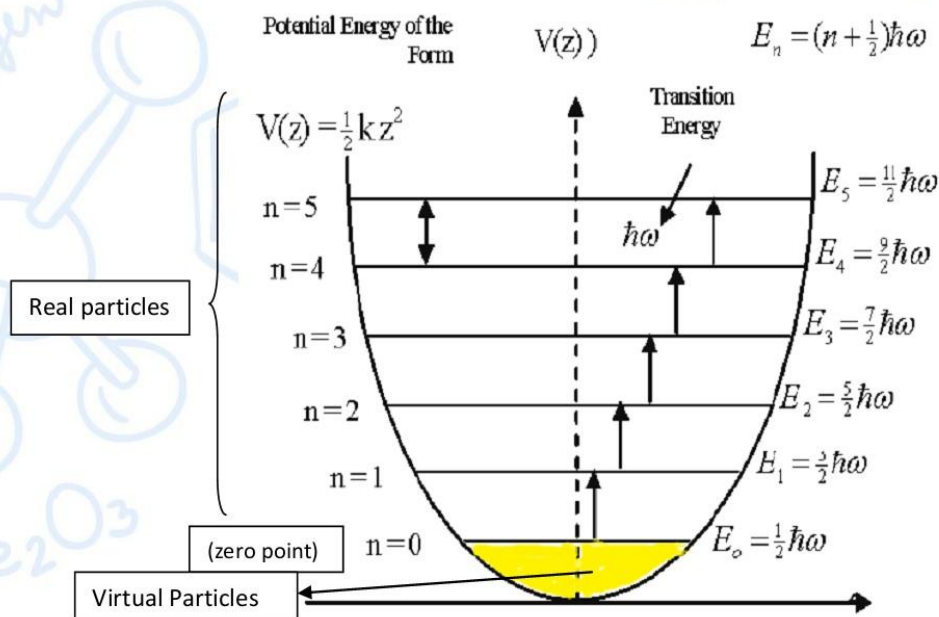
back and forth, as a result the energies of all these points constantly change between different energy levels. This switching of energy in the vacuum creates 'vacuum energy'.

Vacuum Energy

In the 19th century it was believed that light (which is an electromagnetic wave) needs a medium for transmission. It was named an ether. But later it was discovered that light can travel through vacuum and doesn't need any medium. According to Feynman's quantum field theory electromagnetic field is quantized at each and every point in space. So zero point energy can be applied here. But the magnetic waves cancel each other.

Virtual Particle and Harmonic Oscillator

In the quantum harmonic oscillator system there is a energy of the ground state which is called zero-point energy, the lowest possible energy allowed in a quantum system. All real particles (e. g. electrons) exist up to zero point. At any point below zero point, energy so low that real particles cannot exist in that area. The area below zero point is actually disturbance in vacuum which is called a virtual particle. (In fact, according to some scientists, 'virtual particles' are not particles. They are actually a disturbance in a field that can't be a particle.)²



(Fig.-1) Harmonic Oscillator

Though virtual particles are present in "empty" space, it seems that nothing is present. Hence matter-antimatter pairs must arise there spontaneously and then destroy themselves in a very short period of time after they are formed back and produce other particles. Though it's impossible to observe those particles individually, their existence can be indicated. Those pairs have no rest mass.

Real effects of virtual particles

Vacuum birefringence

If light moves through empty space there must not be any restriction e.g. its speed should not be slowed down, or light should not show bending, or breaking into multiple wavelengths.

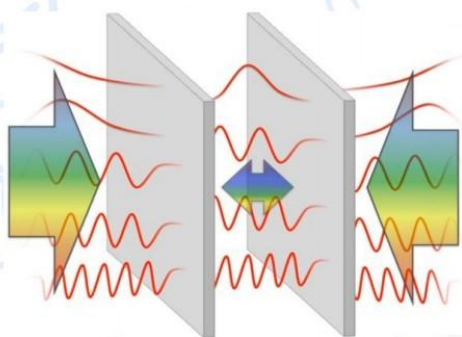
The phenomenon doesn't even change either in presence of pairs of particles- antiparticles or in the presence of strong magnetic field. But when two factors come together i.e. a strong magnetic field is applied on a space where exists pairs of particle-antiparticle It shows real effects. As, particles and antiparticles have opposite charges but equal velocities, these will bend in the opposite direction. When light passes in such an environment it will get polarized. This effect is known as vacuum birefringence. In space where the magnetic field is very high this effect is observed (e. g. neutron stars).².

Casimir Effect

The Casimir effect is an observable indication of the reality of virtual particles. It is a type of attractive force between two closed parallel uncharged conducting plates. Quantum vacuum fluctuation of the electromagnetic field is the cause of the force.

The existence of the effect was predicted by the Dutch physicist Hendrick Casimir in 1948, and was experimentally measured in 1997.

When two parallel thin plates are placed very close to each other in vacuum, the plates attract each other. This can be explained by virtual particles. As in the vacuum there are virtual particles that come out in existence and annihilate themselves all the time, between these parallel plates a small amount of virtual particles is enclosed. As a result there are more virtual particles outside the plates than between the plates. So, more particles hitting the plates from the outside compared to inside, and the particles outside push the plates together. This experiment is proof that there are virtual particles which create energy in vacuum.



Simple Pictorial Representation Of Casimir effect

Conclusion

Virtual particles are a helpful tool to understand van der Waals force. These particles can even explain black hole's theory - Hawking radiation. So, there are many observations which can be explained in a better way compared to real particles. I hope this short article helped to see empty space with a new perspective.

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HUMAN HEALS HUMANS ALSO

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Keywords: Painkiller, human saliva, Opiorphin, STR-324, Catherine Rougeot

Opiorphin^[1]

Background

There is nothing that people can't do. Well, can people be the cause of people's healing? Probably, Opiorphin^[2] may have originated from this question, which arose in the minds of scientists. Animals in particular are seen licking the area if there is a wound anywhere on their body, and from this it was speculated that human saliva may be effective in healing human wounds. However, in reality, this is not exactly the case, but this human saliva is effective as a painkiller. Saliva from humans has yielded a natural painkiller up to six times^[3] more powerful than morphine (narcotic analgesic), called Opiorphin.

Discovery and development

Opiorphin is a naturally occurring potent analgesic human peptide^[4]. It protects enkephalins^[5] from degradation and inhibits pain perception in various acute pain models via activation of endogenous opioid pathways. However, the efficacy of opiorphin continuous infusion and its chemically stable form, STR-324^[6], postoperative pain is unknown.

Catherine Rougeot^[7], an Institut Pasteur guest researcher, was recognized by the Institut Pasteur in 2017 for her work in discovering a non-opioid analgesic, today called STR-324, stable analog of Opiorphin, causes analgesia in postoperative pain by activating endogenous opioid receptor dependent pathways.

The researchers injected a pain-inducing chemical into rats' paws, 1 milligram of opiorphin per kilogram of body weight achieved the same painkilling effect as 3 milligrams of morphine.

The substance was so successful at blocking pain that, in a test involving a platform of upended pins, the rats needed six times as much morphine as opiorphin to render them oblivious to the pain of standing on the needle points.

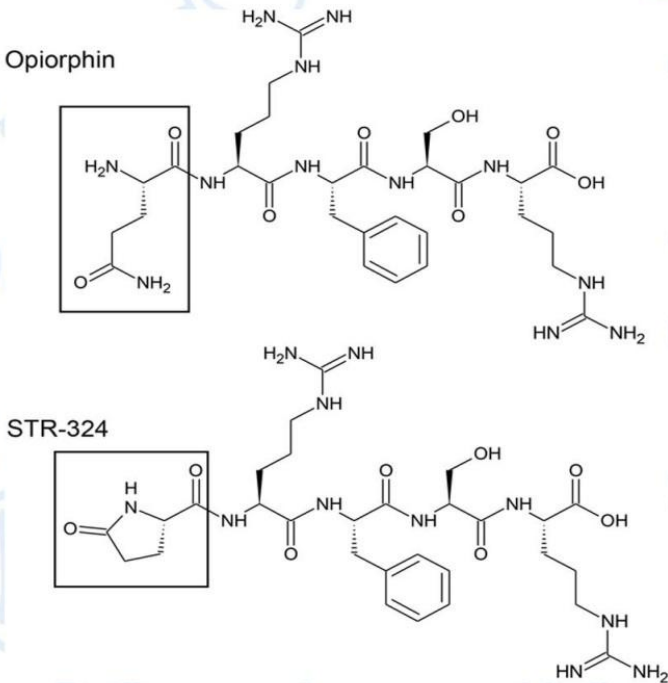


Conclusion

Opiorphin is an endogenous chemical compound first isolated from human saliva. Initial research with mice shows the compound has a painkilling effect greater than that of morphine. It works by stopping the normal breakup of enkephalins, natural pain-killing opioids in the spinal cord.

Informations

Information about Opiorphin

Structure	
 <p>Opiorphin</p> <p>STR-324</p>	
Names	
IUPAC name	(2S,5S,8S,11S,14S)-14,17-diamino-8-benzyl-2,11-bis(3-guanidinopropyl)-5-(hydroxymethyl)-4,7,10,13,17-pentaoxo-3,6,9,12-tetraazaheptadecan-1-oic acid
Other name	Gln-Arg-Phe-Ser-Arg;L-Glutaminyl-L-arginyl-L-phenylalanyl-L-seryl-L-arginine
Properties	
Chemical formula	C ₂₉ H ₄₈ N ₁₂ O ₈
Molar mass	692.779 g·mol ⁻¹

Future scope

It has not yet been possible to synthesize opiorphin in the laboratory, hoping to one day synthesize Opiorphin in large quantities without having to isolate it from saliva and also Opiorphin has not yet been reported to be applied to the human body, but it is hoped that it will soon be used as a healing ingredient in humans.

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- [5] https://www.youtube.com/watch?v=lc_dLVgrD8
- [6] <https://pubs.asahq.org/anesthesiology/article/125/5/1017/19753/STR-324-a-Stable-Analog-of-Opiorphin-Causes>
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ASTROCHEMISTRY

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Keywords - colored barcode, spectrum, interstellar formaldehyde, radio waves

Introduction

Astrochemistry is the study of the abundance and reactions of molecules in the universe, and their interaction with radiation. The discipline is an overlap of astronomy and chemistry. The word "astrochemistry" may be applied to both solar system and to the interstellar medium. It explores new type of chemical reactions that occur under the extreme conditions of space. The formation, atomic and chemical composition, evolution and fate of molecular gas clouds is of special interest, because our milky way galaxy is filled with enormous islands of gas. ^[2]

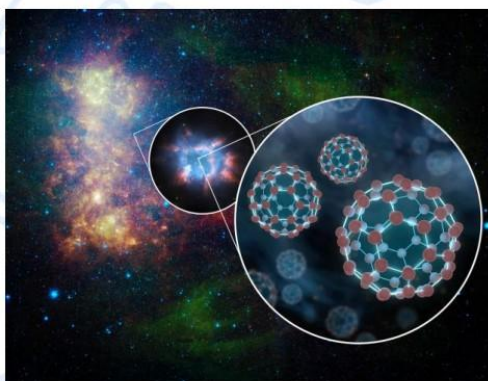


Fig.1. Astrochemistry^[4]

Spectroscopy and its analysis

These great clouds glow from the radiation of super bright stars shining nearby. Astronomers discover the nature of these clouds by studying the colors of light their glowing gas emits. When we spread open the light, each element and molecule in the gas reveals a unique "barcode" of colored lines. We don't analyze these barcodes as colored lines, however, we plot the strength and width of the lines as a light graph we called "spectrum". These colors are from excited electrons. A nearby star energizes an atom of gas, making its electrons take a quantum leap back down to their normal orbits, spritzing out the excess energy as packets of colored light, we call it "photons".

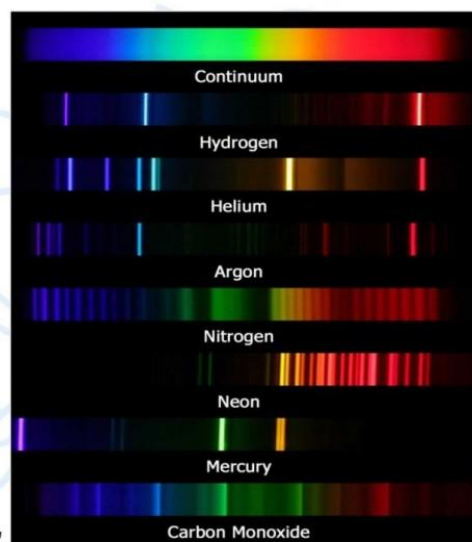


Fig.2.Barcode Colors^[4]

Some gas clouds are dark and cold, no star energize them. No electrons are jumping orbits here to make photons for us to see. So how can we learn what dark clouds are made of? Not all photons are visible to us. Visible light is just a tiny sliver of a vaster spectrum of many more colors. Perhaps the most powerful technique for detection of individual chemical species is radio astronomy, which has resulted in the detection of individual chemical species, including radicals and ions, and organic compounds. Beyond the 'red' end of the visible spectrum is the radio spectrum. Radio is a kind of light travelling as a wave too long for our eyes to detect. Clouds that appear dark to our eyes are actually shining in radio light. Scientists build immense radio telescopes to gather these feeble radio waves from these dark islands of space. They graph the wave strength of radio "colors" (what we call "frequencies") to make radio spectrum.^[1]

With radio frequency, we have discovered dozens of complex molecules in the dark clouds and throughout space. One of the most abundant interstellar molecules, and among the easiest to detect with radio waves (due to its strong electric dipole moment) is CO (carbon monoxide). In fact, CO is such a common interstellar molecule that is used to map out molecular regions. Interstellar formaldehyde was the first organic molecule detected in the interstellar medium. After that, many other complex molecules were discovered e.g., Glycine (Discovered in space, Sep 2003), Anthracene (Discovered in space, Feb 2006) , Acetamide (Discovered in space, Aug 2006), Dimethyl Ether (Discovered in space, Nov 2006), Acetaldehyde (Discovered in space, Oct 2007), Ethyl Formate (Discovered in space, Dec 2009).^[2]

Recall, these complex molecules don't emit photons by excited electrons jumping between " orbits ". Instead, these cold molecules radiate weak radio waves whenever they change their rotation speeds. Each molecule can spin only in a few specific speeds, with no speed in between. Each speed change results in a specific spectrum sprits or gulp of radio light, and every molecule reveals it's own unique spectrum each time it changes it's speed. Therefore, even when there are lots of molecules in a vast cloud, we can tell what kind they are by examining the radio spectrum coming from the cloud.

Many of the molecules we find are the organic building blocks of life on earth. We want to know why we are finding them out in space. So, astronomers have built powerful radio telescopes capable of detecting fainter and weaker signals and chemists have built state-of-the-art laboratories that recreate the increasable temperature and densities in which the molecules seem to form in space. Scientists study how molecules grow and transform on to the surfaces of tiny dust grains and even in the near vacuum found in molecular clouds. ^[3]

Conclusion

Chemists are sharing these large catalogues of molecular spectra, these fingerprints of molecules with astronomers to help them identify mysterious molecules found in space. That astrochemistry collaboration may one day uncover the cosmic origins of the complex molecules that make life possible.

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DISCOVERY OF HUCKEL'S RULE OF AROMATICITY

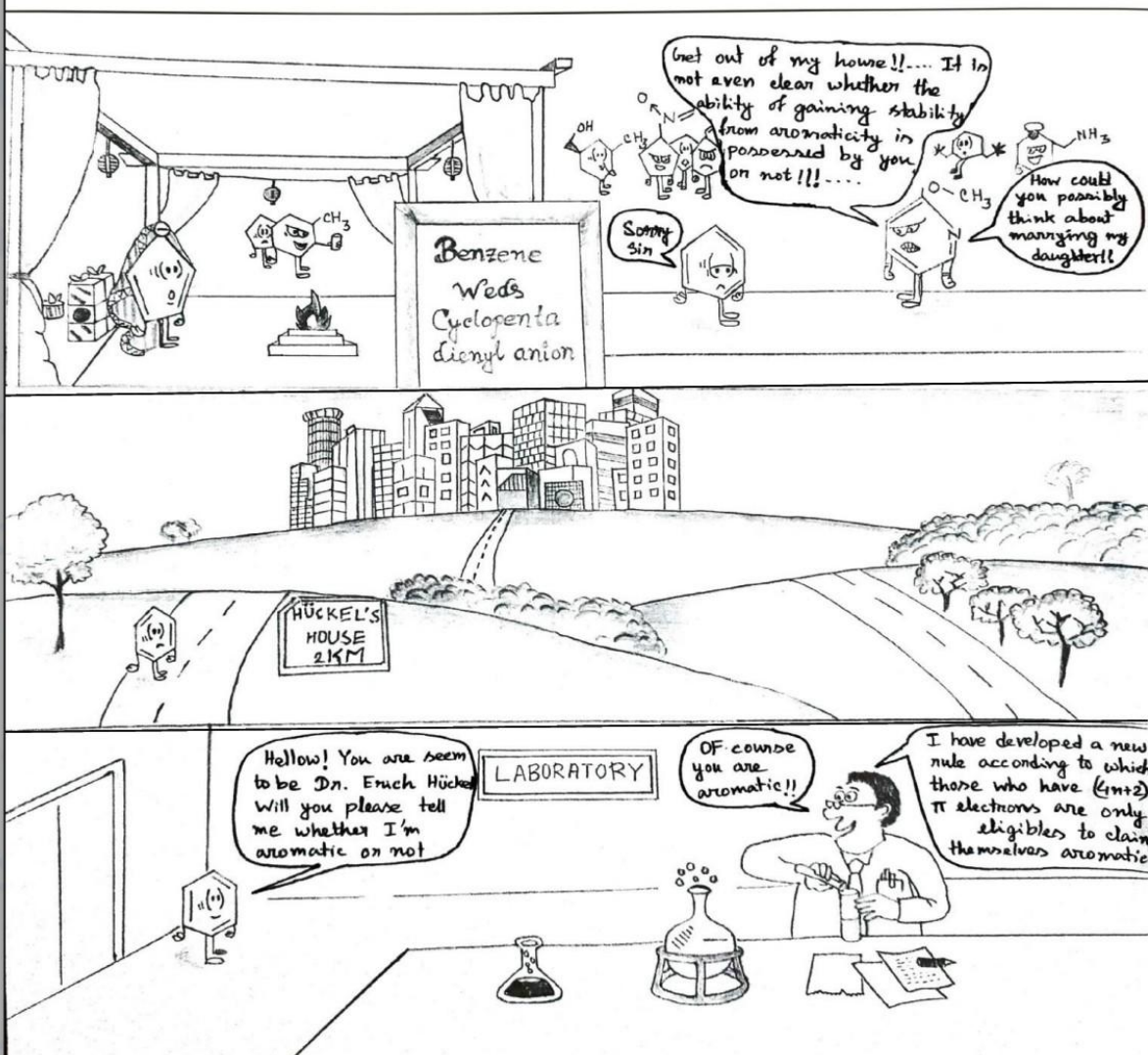
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YEAR : 1931

After discovery of aromaticity in 1855, many arrogant molecules began to dream of being aromatic. But even then no formula for checking aromaticity was discovered....



BEYOND Pi-BONDS

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Keywords – sigma, pi, delta and phi bonds

Introduction

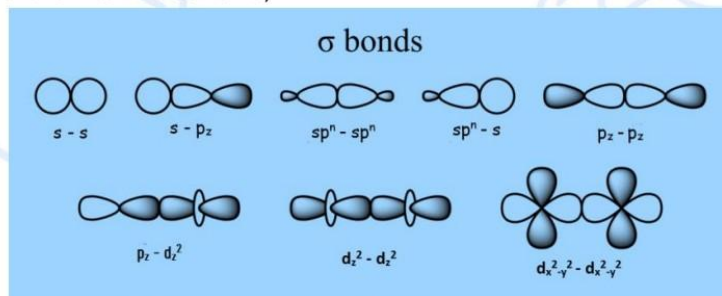
The subject of chemical bonding is at the heart of chemistry. In 1916 Gilbert Newton Lewis (1875–1946) published his seminal paper suggesting that a chemical bond is a pair of electrons shared by two atoms. Bonding in polar molecules (called electrovalent those days) such as KCl was explained on the basis of coulombic interaction between the oppositely charged K^+ and Cl^- . But it was a puzzle to the scientists how non-polar molecules like H_2 , F_2 are bound. Having understood the stable electronic configuration of the rare gases, Lewis suggested that H and F atoms can both attain such configuration, if they were to share one electron with each other. While it may sound trivial today, the impact of it was revolutionary. Since then a century has passed, chemistry has progressed by leaps and bounds but there are still some aspects of chemical bonds which are still under research till date.

Types of Covalent Chemical Bonds

We all know the basic types of covalent bonds found in compounds - sigma and pi bonds.

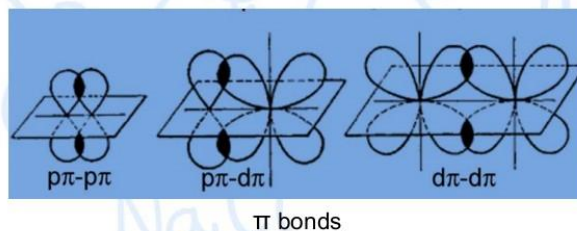
Sigma " σ " Bonds

A sigma bond " σ " is the strongest chemical covalent bond. It is created by the "end-to-end" overlap of atomic orbitals. Common forms of sigma bonds are $s+s$, p_z+p_z , $s+p_z$ and $d_z^2+d_z^2$ (where z is defined as the axis of the bond or the internuclear axis).



Pi " π " Bonds

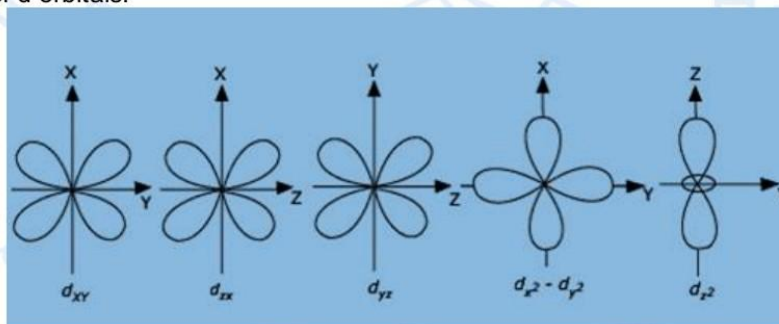
Pi Bonds " π " are created by the "side-to-side" overlapping of two parallel p-orbitals. A pi bond is a weaker chemical covalent bond than a sigma bond. From the perspective of quantum mechanics, this bond's weakness is explained by significantly less overlap between the component p-orbitals due to their parallel orientation. Pi bonds are used to form double bonds and triple bonds. ^[1]



But, what lies beyond pi-bonds? Is there any bond possible other than sigma and pi bonds? How would they be formed? Which compounds would form those? At the end of this article we will surely be able to answer those questions.

Delta "δ" bonds

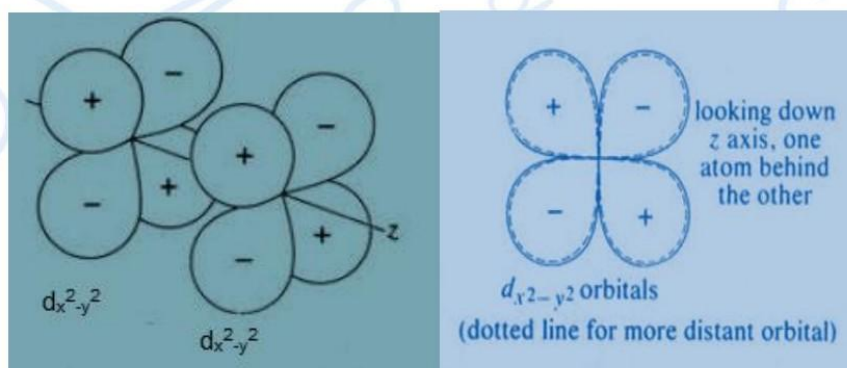
The Greek letter δ in their name refers to d orbitals. As only d orbitals form delta bonds, let's quickly recap the shape of d orbitals.



Although the notation of the delta bond was developed in 1929, the first structural evidence of the delta bond came in 1964 when a quadruple bond ($\sigma + 2\pi + \delta$) was invoked to explain the short Re–Re distance and eclipsed conformation in $[\text{Re}_2\text{Cl}_8]^{2-}$. This type of bonding is observed in atoms that have occupied d orbitals with low enough energy to participate in covalent bonding, for example, in organometallic species of transition metals.^[2]

How are these bonds formed?

Delta bonds are formed by face-to-face overlap of 4 lobes of two parallel d orbitals; when viewed from top, it looks like they are stacked on top of the other. As d_{z^2} has only two lobes, it can't form delta bonds. Among the remaining four d orbitals – d_{xy} , d_{yz} , d_{xz} , $d_{x^2-y^2}$, only d_{xy} and $d_{x^2-y^2}$ can make delta bonds.

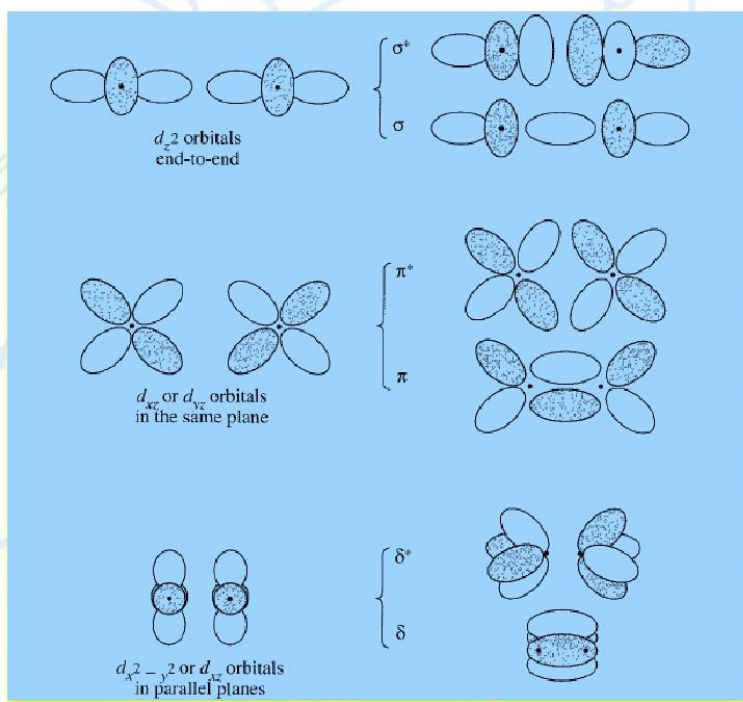


Why only d_{xy} and $d_{x^2-y^2}$ can make delta bonds? It is because while forming a quadruple bond, we need 1 σ , 2 π and 1 δ bond. But only d_{z^2} forms the strongest sigma bond by head-on overlap (the head-on overlap of the remaining d orbitals is very weak compared to d_{z^2}). And to form a delta bond, the four lobes of a d orbital need to meet face to face. As a sigma bond is already formed along the z-axis, a face

to face overlap is only possible in a plane perpendicular to the z axis, which is the xy-plane. Only d_{xy} and $d_{x^2-y^2}$ have their four lobes in the xy plane. So, only they can form delta bonds. The d_{yz} and d_{xz} orbitals form the remaining two pi bonds of the quadruple bond.

So, to sum up, in a quadruple bond-

- d_{z^2} form the sigma bond
- d_{yz} and d_{xz} form the two pi bonds
- d_{xy} or $d_{x^2-y^2}$ form the delta bond

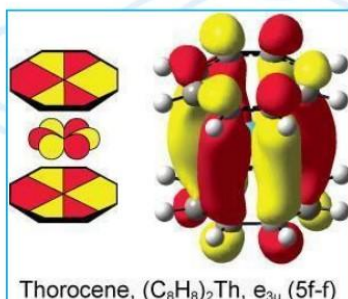


Since the discovery of delta bonds, studies of metal-metal multiple bonds have progressed a lot. In a momentous discovery, a complex with a quintuply bonded ($\sigma + 2\pi + 2\delta$) dichromium unit was isolated using bulky terphenyl ligands. Today, the coordination chemistry of the quintuple bond comprises several dichromium, a few dimolybdenum, and a single Mn-Cr hetero bimetallic species. The reactivity of these quintuply bonded species are currently being explored, and initial studies show promise as inorganic counterparts to the wider reactivity of unsaturated carbon-carbon bonds.^[4]

Phi ' ϕ ' bonds

In phi bonds, six lobes of a f orbital overlap six lobes of the other f orbital. Theoretically phi bond can exist in the actinide metals—the 14 consecutive elements beginning with actinium at the bottom of the periodic table—but experimental proof remained elusive until the Los Alamos and LBNL team developed a way to make the new bond reveal itself.^[4]

The Advanced Light Source (ALS) beam-line facility at LBNL allowed the team to take x-ray absorption spectroscopy measurements on a pair of uranium- and thorium-containing molecules (both actinides). The compounds—part of a class of molecules called a sandwich complex because the uranium or thorium is sandwiched between two ring-shaped hydrocarbon structures—were carefully chosen because their symmetry simplifies these transitions and allows the team to interpret the x-ray data more clearly. The plan paid off when the first convincing experimental evidence of the phi bond showed up for the thorium sandwich complex, as revealed by its elaborate, never-before-seen symmetry.^[5]



Future Scope

The Los Alamos and LBNL team's next challenge is to move from the relatively simple actinocenes to more elaborate actinide–ligand linkages. They are trying to recapture this F interaction in heavier metals by a little ligand tuning. Hopefully they will succeed and we will be able to learn more about these unusual bonds.

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E-CIGARETTES - AN ORAL LUCIFER!!

Suchisman Kundu

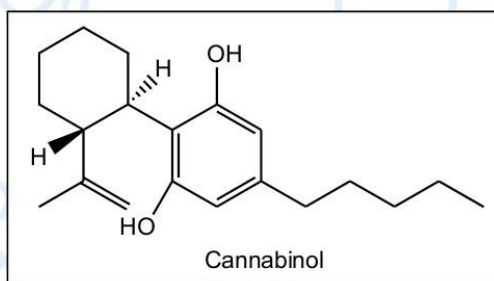
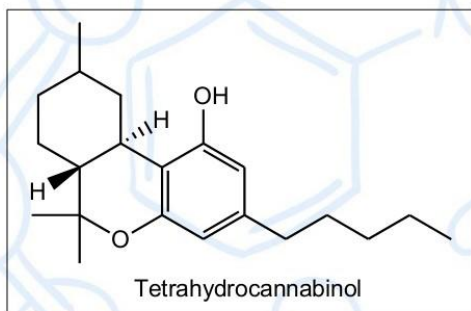
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Keywords: *vaping, electronic cigarettes, nicotine, carcinogens, flavoring agents*

Introduction

This article mainly focuses about the chemical constituents of e-cigarettes and how it affects lives of many US citizens, mostly in their late teens and early 20s and normal healthy people who pass of as passive smokers.^[2] They experienced flu-like symptoms, including vomiting, fatigue, followed by severe shortness of breath. Some of them ended up on ventilators for months. Health investigators determined that the common ground which host these cases are vaping. Health researchers speculated a large number of factors, including product contamination, THC (Tetrahydrocannabinol) over usage and device evolution. The spike in severe illnesses raised new alarms over e-cigarettes. Nevertheless, public health officials warned that vaping could have unforeseen long-term effects. Although E-cigarettes are a new introduction to market, however, for doctors to know what those effects might be. There is a well-recorded latency period for tobacco-related disease, spanning a minimum of 25 years.^[3] It will thus be at least two decades until definitive findings from long-term studies on e-cigarette use are available. Meanwhile, investigations of e-cigarette aerosol chemistry can provide information needed for evidence-based decisions and policies.



E-Cigarettes- a short profile

The term electronic cigarette refers to a variety of evolving devices that are designed to deliver nicotine and/or other substances under aerosolization conditions without combustion and tar generation.^{[4][7]} An e-cigarette typically has four parts: a mouthpiece, a rechargeable battery, a cartridge along with a liquid, a pod and an atomizer. The liquid contains nicotine, water, flavouring, and various solvents, including glycerine or propylene glycol, that stabilize the mist formed in the atomizer. The atomizer is a little chamber that heats the solution from the cartridge, producing an aerosol mist of tiny liquid droplets (technically not a vapour) that the user inhales. It is a tiny, nicotine- and flavour-delivering

version of a humidifier. When users inhale the mist, their lungs absorb the nicotine and other compounds.

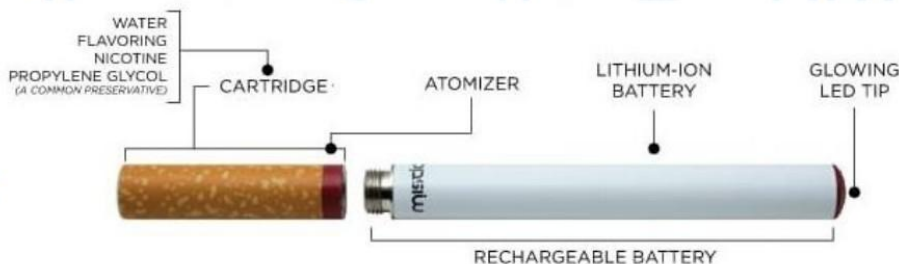


Fig.1. Components of an E-cigarette

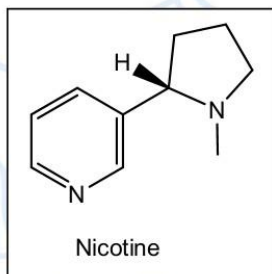
According to researchers,^[7] there are currently four generations of e-cigarettes are available. There are some basic difference between a traditional cigarette and an e-cigarette. Conventional cigarettes on burning produces smoke containing vaporized nicotine that the user inhales. The smoke also contains thousands of other substances including at least 70 carcinogens, compounds that promote the development of cancer. Capillaries in the lungs absorb the nicotine and other substances, and they enter the bloodstream. The bloodstream carries the absorbed substances to the brain and other parts of the body. In contrast, electronic cigarettes are tobacco-free. They use a non-combustion method to deliver nicotine to the user.

Various toxins in E-cigarettes

There are approximately 600 ingredients in traditional cigarette tobacco that produce 7,000 chemicals upon combustion, including numerous toxins. ^[9]E-cigarette emission levels of known inhalation toxins such as the carbonyls acrolein, acetaldehyde, and formaldehyde, are reported over relatively wide ranges. Even at low toxin levels in e-cigarette, aerosols can promote cardiovascular harm. Other toxins found in e-cigarette aerosols include heavy metals, nanoparticles, plasticizers, and flame-retardants.

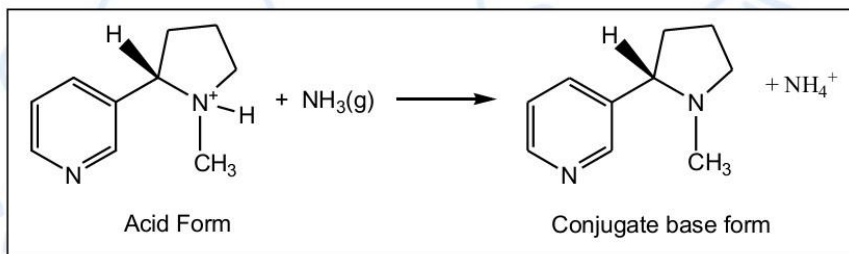
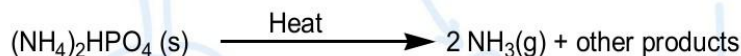
E-liquids contain solvents and other molecules that are not present in significant amounts, or at all, in traditional cigarettes. This includes the organic solvents PG (Propylene glycol) ,as well as most other additives.^[5] The inhalation exposure route circumvents the first-pass metabolic effects of the stomach and liver, thereby enabling direct delivery of inhaled chemicals to circulation. This includes various organic solvents, as well as most additives. E-cigarettes contain fewer total toxins compared to traditional cigarettes, supporting the current case for harm reduction. Although the emphasis to date on comparing the relative health effects of e-cigarettes to traditional cigarettes is clearly necessary, downplaying the chemistry and health impacts unique to e-cigarettes is not only limiting but also irrelevant to the large number of young people who are vaping without having ever smoked a cigarette. Investigations of e-cigarette chemical constituents and properties clearly show that e-cigarettes are not harmless. Unbiased research on e-cigarette aerosol chemistry has afforded knowledge in contrast to industry marketing claims, such as e-cigarettes produce "harmless water vapour".

What vaping and tobacco smoking consists in common is nicotine^[3]. Nicotine is in a class of compounds known as alkaloids. Alkaloids are organic (carbon-based) molecules that occur naturally in plants. In addition to carbon and hydrogen, alkaloids contain at least one nitrogen atom and usually possess important pharmacological activity, meaning that they act as drugs in the body. Many modern medicines are either alkaloid derived from plants, or synthetic drugs based on substances originally derived from plants. In addition to nicotine, other well-known alkaloids include caffeine, codeine, cocaine, and morphine.



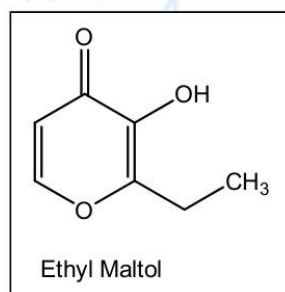
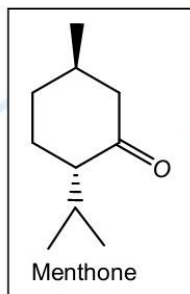
The nitrogen atoms in alkaloids give them another important property: They can exist in the acid or conjugate base form.^[1] The alkaloid's nitrogen atoms are basic, meaning the unbounded electrons can accept a proton (H^+). In the reverse reaction, H^+ removed from nitrogen. These reactions occur rapidly in both directions at roughly the same rate, so no overall change in the concentrations of reactants and products are observed. Nicotine has two nitrogen atoms in its structure, and both can technically be protonated. One becomes protonated only under very acidic conditions, $pH < 2$, which is an unlikely condition for a consumer product, so let us focus on the other N.^[3] At a pH above nine, there are more OH^- ions than H^+ ions present in solution, so the conjugate base form of nicotine would dominate. In acidic solutions, there are a lot more H^+ ions. These ions would protonate the nitrogen, making the protonated form of nicotine dominant.

Therefore, the lungs more readily absorb the conjugate base form of nicotine. To create products with a higher ratio of this form, tobacco companies add ammonium salts to their cigarettes. When the tobacco in a cigarette burns, the heat causes the salts to form ammonia and other compounds. The ammonia reacts with the acidic form of nicotine, removing the proton. This produces more and more conjugate bases of nicotine. This is the reason behind a proton in acid form of nicotine deems a major importance in the reactions taking place in lungs while inhaling.



Chemistry of flavouring agents

There are thousands of e-liquid flavor formulations available. Behar^[11] used gas chromatography-mass spectrometry (GC-MS) and a ranking strategy to identify the most prevalent flavoring molecules in a library of commercial e-liquids. Six compounds were found at both relatively high concentrations of > 1 mg/ml and prevalence in 41–80% of the products. These included menthone, *p*-anisaldehyde, menthol, cinnamaldehyde, vanillin, and ethyl maltol. Transfer efficiencies from e-liquid to aerosols were high, except in the case of ethyl maltol (58–62 %), showing that aerosols can deliver high concentrations of flavoring compounds. Most of the refill fluids that exhibited low cytotoxicity had total flavoring chemical concentrations of <5 mg/mL, supporting the hypothesis that toxicity is correlated with higher concentrations of flavor chemicals.^[8] E-liquid flavoring molecules have shown additionally to promote elevated levels of toxic carbonyls (generally) or furans (e.g., furfurals from the heating of sugars). E-cigarette proponents challenged their findings; however, the researchers followed up their study by finding elevated levels of toxic aldehydes in the exhaled breath of a cohort of e-cigarette users. Moreover, Quand co-workers^[10] found that carbonyl emission factors increased linearly with flavoring base content. They calculated a 40-year cancer risk due to formaldehyde (a 70-kg e-cigarette user inhaling 5% flavoring base content e-liquid at 120 puffs/day⁻¹) to be approximately 10⁻⁶ times than 10⁻² times for various solvents alone.

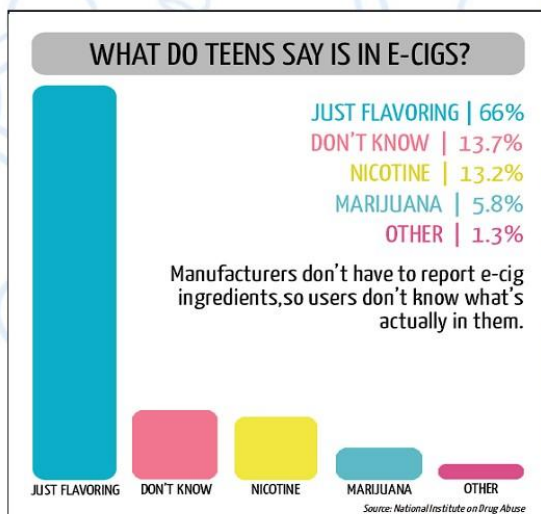


They found that propylene glycol adversely affected cell viability.^[8] A total number of chemical ingredients in e-liquids correlated with enhanced cytotoxicity. Vanillin and cinnamaldehyde was specific flavoring molecules associated with relatively high toxicity levels. Flavorings in vaping liquids could have their own set of health effects. Preliminary lab studies involving human endothelial cells, which line the lungs, have shown that some of the flavored liquids used in e-cigarettes causes significant damage to the cells.

Conclusion

All smokers should be encouraged to quit and to use e-cigarettes when they are the most appropriate choice for one's situation.^[9] Research towards uncovering the risks of e-cigarette use is aligned with optimizing harm reduction and with encouraging smoking cessation. There has been a recent progress in addressing the challenges inherent in e-cigarette chemical and analytical research. This has resulted in heightened understanding of the origins of inter laboratory variability in reporting toxin levels. However, much still needs to be accomplished. As devices continue to evolve, new trends need to be quickly revealed, with improvised wicking efficiency and airflow, thereby reducing the production of thermally degraded by-products.

Under the guise of harm reduction, manufacturers are creating high-dose, flavored nicotine products of great appeal to children and adolescents. Evidence continues to mount, based largely on unbiased investigations of e-cigarette chemistry, that e-cigarettes are not nearly as harmless as advertised.



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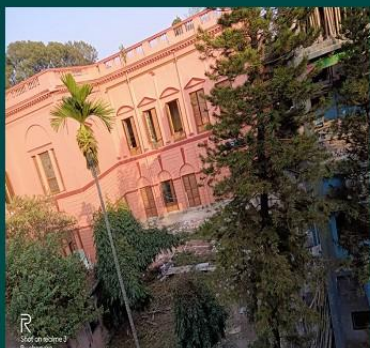
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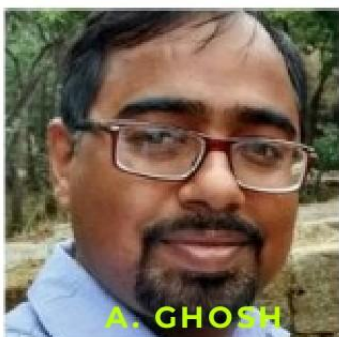
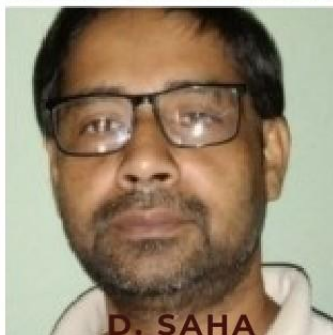
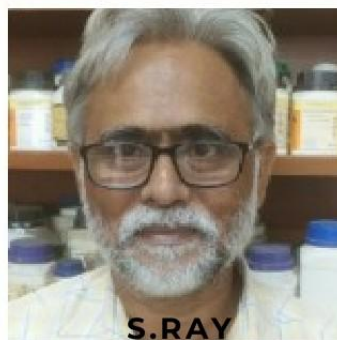
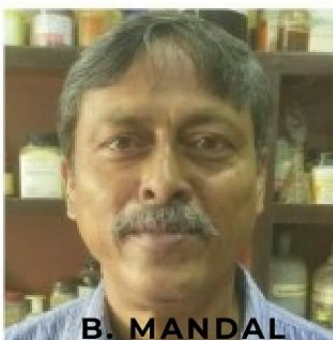
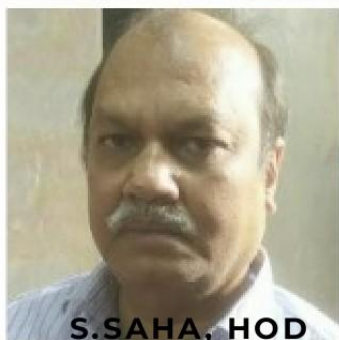


The Department It started its journey in 1907, first in the intermediate level, and then was upgraded to degree level in 1913 and finally Honours Course was introduced in 1948.

This Department is very well-known for its excellent standard of teaching by efficient teachers. Many distinguished scholars and eminent faculty members were associated with this department. The list includes the teachers like Prof Asutosh Mukherjee, Prof. P K Dutta, Prof. Parimal Krishna Sen and many others. The department also encourages the faculty members to carry out research works in addition to teaching. A good number of research papers have been published in highly esteemed national and international journals by our faculty since the last few years.

The research laboratories are equipped with sophisticated instruments like IR spectrophotometer, UV spectrophotometer and low temperature bath along with other normal instrumental facilities.

The result of the Honours students of this Department is fabulous – on an average 60 to 70% of the students pass out with first class degree every year. They have fared excellently in the past and the tradition is being continued by the present generation of students in their Post Graduate courses in different Universities, IITs of the country, and different institutes abroad. Many of our alumni are highly placed in premier institutions/organizations within the country and also abroad. A few of them are Prof. Sankar Prasad Bhattacharya, IACS, Kolkata, Prof. Gautam Lahiri, IIT, Mumbai, Prof. Susanta Lahiri, SINP, Kolkata, Prof. Thakahari Goswami, IIT, Kharagpur, Prof. Mousumi Banerjee, IIT, Kharagpur, Dr. Krishnananda Chattopadhyay, IICB, Kolkata, Dr. Sukanta Mondal, IIT, Kharagpur, Dipankar Koley, CDRI, Lucknow, Dr. Dipankar Sukul, NIT (Durgapur), Prof Tapos Ghosh (University of Texas).



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THOSE WHO ARE INDESPENSIBLE FOR THE

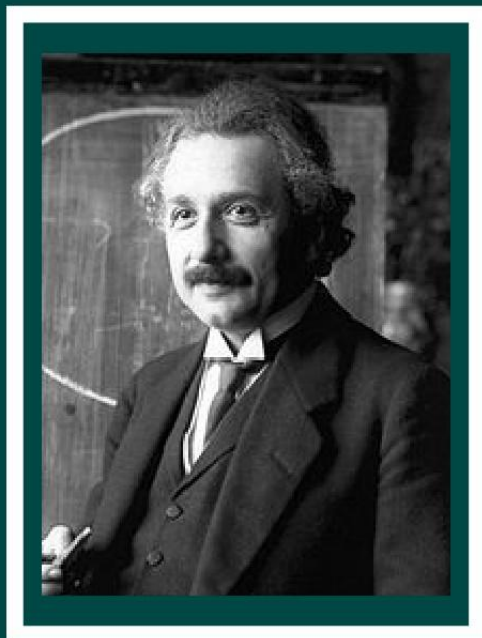
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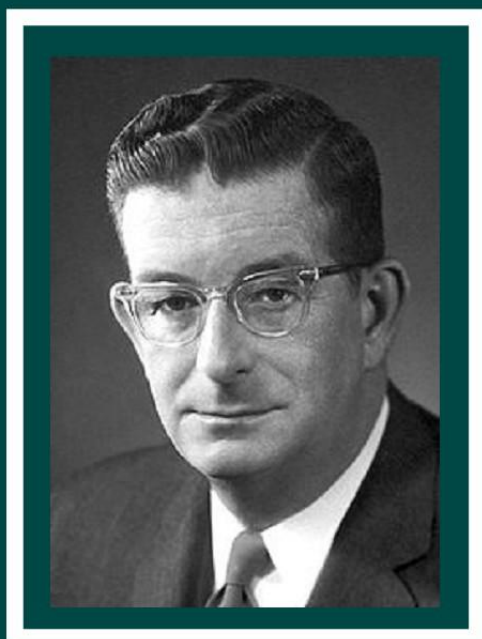
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ALBERT EINSTEIN

"A HUNDRED TIMES EVERY DAY I REMIND MYSELF THAT MY INNER AND OUTER LIFE DEPEND ON THE LABOURS OF OTHER MEN, LIVING AND DEAD, AND THAT I MUST EXERT MYSELF IN ORDER TO GIVE IN THE SAME MEASURE AS I HAVE RECEIVED AND AM STILL RECEIVING."



ROBERT BURNS WOODWARD

"THE STRUCTURE KNOWN, BUT NOT YET ACCESSIBLE BY SYNTHESIS, IS TO THE CHEMIST WHAT THE UNCLIMBED MOUNTAIN, THE UNCHARTED SEA, THE UNTILLED FIELD, THE UNREACHED PLANET, ARE TO OTHER MEN ... THE UNIQUE CHALLENGE WHICH CHEMICAL SYNTHESIS PROVIDES FOR THE CREATIVE IMAGINATION AND THE SKILLED HAND ENSURES THAT IT WILL ENDURE AS LONG AS MEN WRITE BOOKS, PAINT PICTURES, AND FASHION THINGS WHICH ARE BEAUTIFUL, OR PRACTICAL, OR BOTH."