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Chemistry & Allied Sciences – Emerging Future Technologies to Boost up Lives

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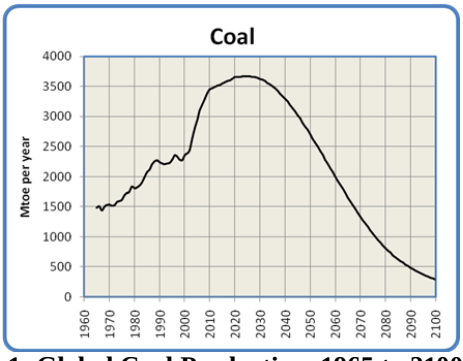
ABSTRACT
Man from ancient time started to discover and use fire due to the necessity thereof. So Necessity can be considered mother of all type of developments going around us. The class of development differs from person to person entirely based upon the curiosity inside. Some researchers believe in the sustainable developments of the processes but on the other hand industrial developmental approach makes us to develop the processes and technologies that are approachable to common people, but these industrially driven technologies sometimes neglect our most precious environmental security. So with all that progress we are also facing challenges in forms of fatal diseases like skin cancer, Global Warming, environmental disasters etc. Now, future is to develop the things in a very wise, planned and sustainable manner creating a "win-win" situation all around. Here authors have tried to discuss the future of the developmental chemistry and related science that will come true in near future to ease our lives without harming our surroundings. One side Energy crisis of world is expected to be solved with the research and exploration of more number of green fuels, on the other side medicinal treatment is going to be very advance with emerging technology of Nanorobotics. Research trends and future applications of carbon nanotubes, genetics and green chemistry are also discussed along with efforts going on for extension of human life.

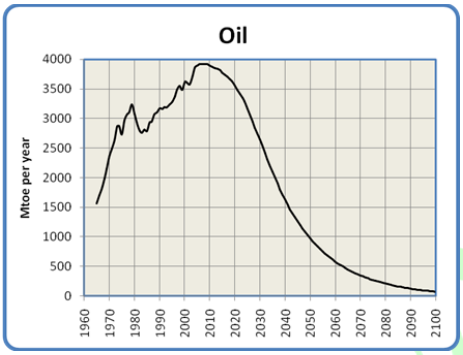
Keywords **-** Global Warming, Win-Win situation.

I. INTRODUCTION
Chemistry is a mature field. A lot of chemistry is already known. Infact, chemistry is known to date back to as far as the prehistoric times. By 1000 BC, ancient civilizations used technologies that would eventually form the basis of the various branches of chemistry [1]. Not even though in ancient population, we can observe dependence on chemistry to a great extent in present time too, nearly everything we touch or use has some element of chemistry in it. Though researchers and chemists have done great developments in the field of chemistry, but with all that, the hazards and pollution created in environment cannot be avoided and the question comes in our mind is that what the future of chemistry is likely to be? Is there going to be any drastic change that leads us towards a safer and green world? To search for the answer of these types of questions, here we are going to discuss the future prospects of some of the fields of chemistry which are expected to become dominant in near future.

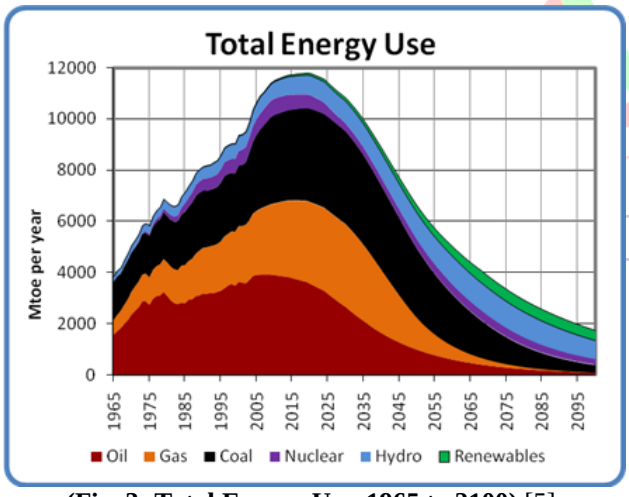
II. FUTURE ENERGY SOURCES
With civilization man always tried to explore natural energy sources. When even science was not established sun was the crucial source of energy for mankind. After the discovery of fire, wood became chief energy source, but that caused rapid deforestation .So world has started using coal and this was the period of industrial revolution. Coal is a very abundant source of energy. At the current rate of use, coal will last another 200 years [2]. Coal is used in many industrial applications, especially in steel industry, in the generation of electricity. 38% of the world's electricity is generated by coal [3]. Oil has been used as a source of energy for thousands of years but the modern petroleum industry was started just on August 27, 1859 when Edwin L. Drake started the modern petroleum industry by drilling a well at a local oil seep near Titusville, Pennsylvania [3]. But the dependence of mankind on petroleum as source of energy for various industries, vehicles etc. has been increased tremendously and the increased use of fossil fuel has posed several problems. All of us who drive know that the price at the petrol pumps keeps rising, fuelling our houses and paying the bills gets harder and harder, we hear so much about the real environmental cost of flying, and recently the Stern Report on Climate Change and Global Warming told the world we must change our lifestyles or face catastrophe [4].As the resources are fast running out and may last just for few years more. So research to get alternative energy sources is prime concern of developed or even developing countries.



(Fig. 1: Global Coal Production, 1965 to 2100) [5]



(Fig. 2: Global Oil Production, 1965 to 2100) [5]



(Fig. 3: Total Energy Use, 1965 to 2100) [5]

In 1925 **Henry Ford** expressed an opinion that **"**The fuel of the future is going to come from fruit like apples, weeds, sawdust almost anything. There is fuel in every bit of vegetable matter that can be fermented". Recently the ability of sugarcane and corn to produce bio fuel alcohol [6] or oil producing plants like "*Jatropha*", "*Pongammia pinnata*" or "Soya bean" to create bio diesel [7] is proved. Recent technological innovations have created the fields of advanced bio fuels, which focus on non-food sources and waste renewal as energy source. By converting landfill material, as well as wood and inedible plant parts, into green fuel, we not only cut down on the use of fossil fuels but also effectively recycle enormous amounts of waste to solve the problem of pollution. These bio fuels help quell the debate on whether growing crops for fuel will result in fewer available food crops. Many countries like USA, China, India, Brazil etc are now doing extensive research on algae, which is easy to cultivate and grows extremely quickly as the source of **"green fuel"**. They are trying to develop hardy, resistant strains called "super algae" which will be highly efficient in converting the sunlight and carbon dioxide into lipids and oils which will be refined to make diesel or jet fuel. One acre of these algae can produce 200 times as much oil as one acre of corn. Moreover, algae can be cultivated at wasteland or water and subsequently no direct competition with food production [8]. Researchers are also looking to seaweed as the next frontier in algae-based bio fuels.

In search of non living energy sources, compressed air is soon going to become a popular alternative fuel to run cars [9]. The basic principle of running cars purely on air is to feed the stored air under pressure to the engine to generate torque. The future cars powered by air will have huge storage tanks filled with compressed air preferably made of carbon-fibre to reduce weight whilst maintaining strength of the engine. The use of air will effectively reduce the cost of the car because in such a case there will be no need to build spark plugs and cooling system. It will also result in reduced emissions and lower cost of running. Tata Motors has already started its venture with a French-based technology inventor, MDI to produce the world's first air car [10].

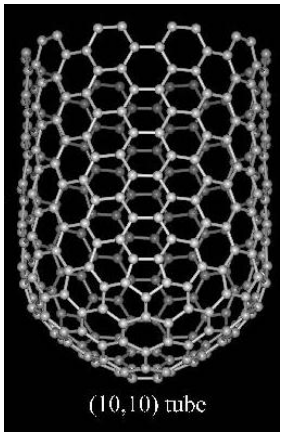
Studies have also proved that Vanadium nitrogenase, an enzyme found in the roots of soybeans, can convert carbon monoxide (CO), a common industrial by-product, into propane, the blue-flamed gas. The new study could produce fuel and eventually gasoline from thin air containing CO. Obviously this could lead to new ways to create synthetic liquid fuels if we can make longer carbon-carbon chains, if perfected, the technique could lead to cars partially powered on their own fumes. Even further into the future, vehicles could even draw fuel from the air itself [11].

It is also speculated that "Hydrogen may very well become a favorite fuel of the 21st century, when the process of producing it, economically is more perfected". Someday, we may fuel up our car in a yard with a garden hose. Does that sound futuristic? The future may be closer than we think, thanks to a recent discovery by Peter Iyere who uncovered a method of producing hydrogen from its most common source water using such simple materials as aluminum foil in the production process [12]. Aluminum and water are everywhere and can be easily obtained to make hydrogen. Hydrogen does not pollute the environment, since the combustion of hydrogen yields

only water, burning of hydrogen in place of fossil fuels such as petroleum, coal, and natural gas has tremendous advantages.

III. FUTURE APPLICATIONS OF CARBON NANOTUBES

A very interesting discovery in field of chemistry is considered will be of carbon nano tubes that is going to change complete scenario of world in future. The scientific journey of discovery of carbon nanotubes began in 1975, with the discovery of "buckyballs" fullerenes by Dr. Richard E. Smalley, Dr. Robert F. Curl, and Dr. Harold W. Kroto. In experimenting different methods for condensing bucky balls from carbon vapours, it has been discovered accidentally by Dr. Iijima, that similar methods also yielded tubular molecules, only a few atoms in diameter, which spontaneously form from hexagonal arrays of carbon atoms [13]. Moreover, under certain conditions, these tubes sealed themselves by joining with the two halves of a split buckyball as end caps [14].



(Fig. 4 The carbon nanotube) [14]

These tubes are found 100 times as strong as steel [15] and assembled bits of "rope" made up of carbon nanotubes is a promising future substitute of existing fibre reinforced composites. The future soldier's uniform would incorporate soft woven ultra strong fabric with capabilities to become rigid when an enemy breaks his legs and would also protect him against pollution, poisoning and other hazards. Armour made by it will be so hard that bullets bounce right of it [16].

Several recent reports show that nanotubes only one-50,000th the thickness of a human hair can perform the same electronic functions as vastly larger silicon-based devices. Two slightly dissimilar nanotube molecules joining end to end may function as a diode [17]. Looking farther into the future, Dr. Zettl suggested that clumps of carbon nanotubes might spontaneously organize their electronic interactions into complex webs analogous to the neural networks of the brain. He also speculated in an interview that a random jumble of nanotubes in a small cube could generate a network of nano computers that might be able to perform complex tasks [18]. This is going to revolutionize the field of electronics. With carbon nanotubes, scanning tunnelling microscopes are going to be developed, which can scan the surface of an object and detect individual atoms [19].

Hydrogen-Oxygen Fuel cell has already been proved an eco friendly device to generate electricity but also suffers with issue of storage of highly combustible hydrogen gas. Carbon nanotubes may be a viable option. Carbon nanotubes are able to store hydrogen and could provide the safe, efficient, and cost-effective means to achieve this goal [20].

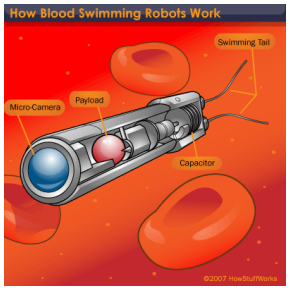
Nanotubes are commonly found in laboratories today, and research is stimulated by large amounts of money invested in it. Some companies are already specialising in the production of carbon nanotubes[21], and give research a boost. It is not known exactly when and where nanotubes will find their applications on a massive scale, but it seems highly likely. In the future according to Dr. Smalley we're going to see the flowering of a new branch of organic chemistry based on carbon nanotubes. There's no end to its possibilities.

IV. Future of Medicinal Chemistry

21st Century is going to witness a drastic change in field of medicine. Imagine going to the doctor to get treatment for a persistent fever. Instead of giving you a pill or a shot, the doctor refers you to a special medical team which implants a tiny robot into your bloodstream. Yes, that is the expected scene of any clinic of future. Nanorobots are nanodevices that will be used for the purpose of maintaining and protecting the human body against pathogens. They will have a diameter of about 0.5 to 3 microns and will be constructed out of parts with dimensions in the range of 1 to 100 nm. The main element used will be carbon in the form of diamond / fullerene nanocomposites, because of the strength and chemical inertness of these forms. Many other light elements such as oxygen and nitrogen can be used for special purposes. To avoid being attacked by the host's immune system, the best choice for the exterior coating is a passive diamond coating.The smoother and more flawless the coating, the less the reaction from the body's immune system. Powering of the nanorobots will be done by metabolising local glucose and oxygen for energy, otherwise would be externally supplied acoustic energy. Medical nanodevices would first be injected into a human body, and would then go to work in a specific organ or tissue mass. There it will detect the cause of ailment by checking the antigens present at the surface of cells and will provide a dose of

medication directly to the infected area. The doctor will monitor the progress, and make certain that the nanodevices have gotten to the correct target treatment region. The doctor wants to be able to scan a section of the body, and actually see the nanodevices congregated neatly around their target (a tumour mass, etc.) so that he or she can be sure that the procedure was successful. Communication with the device can be achieved by broadcast-type acoustic signalling. When the task of the nanorobots is completed, they can be retrieved by allowing them to exfuse themselves via the usual human excretory channels [22].

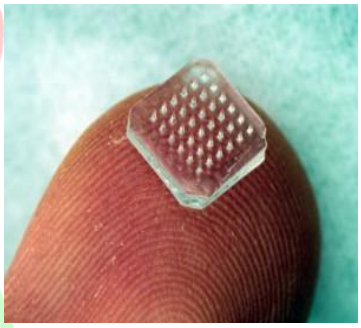
Some possible interesting applications using nanorobots may be use of a cream containing nanorobots to cure skin diseases, that can remove the right amount of dead skin, remove excess oils, add missing oils, apply the right amounts of natural moisturising compounds, and even achieve the elusive goal of 'deep pore cleaning' by actually reaching down into pores and cleaning them out. A mouthwash full of smart nanomachines could identify and destroy pathogenic bacteria while allowing the harmless flora of the mouth to flourish in a healthy ecosystem. Further, the devices would identify particles of food or plaque and lift them from teeth to be rinsed away. Being suspended in liquid and able to swim about, devices would be able to reach surfaces beyond reach of toothbrush bristles or the fibres of floss [23].



(Fig. 5) [23]

Some more Applications of nanorobots are expected to provide remarkable possibilities. An interesting utilization of nanorobots may be their attachment to transmigrating inflammatory cells or white blood cells, to reach inflamed tissues and assist in their healing process [24]. Nanorobots will be applied in chemotherapy to combat cancer through precise chemical dosage administration, and a similar approach could be taken to enable nanorobots to deliver anti-HIV drugs. Such drug-delivery nanorobots have been termed “pharmacytes” by Freitas [25]. Nanorobots could be used to process specific chemical reactions in the human body as ancillary devices for injured organs. Monitoring and controlling nutrient concentrations in the human body [26], including glucose levels in diabetic patients will be a possible application of medical nanorobots. Nanorobots might be used to seek and break kidney stones. Another important possible feature of medical nanorobots will be the capability to locate atherosclerotic lesions in stenosed blood vessels, particularly in the coronary circulation, and treat them either mechanically, chemically or pharmacologically [25].This would prevent most heart attacks.

Development of vaccine adjuvants and delivery vehicles of the nanoscale size may facilitate the development of novel vaccines for viral and parasitic infections, such as hepatitis, HIV, malaria, cancer, etc. A new vaccine-delivery patch based on hundreds of microscopic needles that dissolve into the skin would allow persons without medical training to painlessly administer vaccines. Patches containing micron-scale needles that carry vaccine with them as they dissolve into the skin would simplify immunization programs in future by eliminating the use of hypodermic needles -- and their "sharps" disposal and re-use concerns[27].



(Fig. 6) [27]

An array of 36 dissolving microneedles is shown here on a fingertip for size comparison.

V. Future Industrial Advancements

Now if we look at industrial advancement in future, the term that comes first in mind is “Green chemistry”. Current methods of chemical synthesis have created so much pollution, as they are not based on the principles used by the nature to produce the same, for example the charge is stored across the plasma membrane via concentration gradient of biochemically common alkali metal ions i.e. Na^+ and K^+. In contrast, most batteries used for storing charge require biochemically foreign, toxic elements, such as Pb and Cd. Because of this strategic difference, manmade technologies often distribute throughout the environment persistent pollutants that are toxic because they contain elements that are used sparingly or not at all in biochemistry [28].

In making efforts for decreasing harm to nature by chemical reactions and formulations, in early 1990s chemists have developed the concept of Green chemistry.

In contrast to the traditional wisdom, green chemistry adopts a totally new philosophical approach to address the delicate balance of economic development and environmental protection by creating a new chemistry that eventually will enable industry to produce the same products in the most direct, economical, and socially/environmentally responsible manner possible. It also designs the chemistry so it is less hazardous. It ensures minimized hazard is a performance criterion in the feedstock, reagents, solvents, transformations, and products that we make. Many biological synthesis processes are replacing conventional refining or hazardous polymerization processes. Concepts such as supramolecular chemistry achieve reactions in a solid state without the use of any solvents and achieve up to 100 percent yields [29].

Great efforts are still undertaken to design an ideal process that starts from non-polluting initial materials, leads to no secondary products and requires no solvents to carry out the chemical conversion or to isolate and purify the product. "The biggest challange of Green chemistry is to use its rules in practice."This is the hope that in the future we will have industries using only green processes, students of chemistry all aware of principles of Green chemistry and chemists researching new processes based on it, and with all that our earth will be completely free from pollutants.

VI. Future of Human Genome

Genetic engineering, an interdisciplinary branch of chemistry is very hotly debated topic from its beginning in 1970s. Genetic Manipulations are becoming common as a means of genetic engineering. There are many methods of introducing new genetic material into a cell or organism, or altering the existing material. Special viruses have been altered and put to use which can introduce new genetic material to an organism. Gene Therapy on the reproductive cells could be used to introduce whatever genes are desired into an organism, even a human, when they are still a single cell. This technique is mainly used in the medical treatment of diseases by repairing the defective genes or replacing them by the therapeutic genes. In human beings this technique is used to treat genetic disorders and cancer, it also helps in supplying new body parts. With cloning technology, even mammals have been successfully cloned [30]. This is where genetic engineering stands right now.

But still the limitation is that the functions of all the human genes are not known .Research in animals is uncovering the functions of the precursors of human genes, and that research helps in determining the precise function of human genes. There may come a time when we have the option of children who are Albert Einstein, Mahatma Gandhi and Bill Gates (or their female equivalents) rolled into one. But for getting such mastery in the field, we need to direct our research beyond the set of rules that have been handed over to human race by 4 billion years of evolution. It may be possible one day to change genetic codes in such a way that every codon may code for a different amino acid, it needs a simple change in the sequence of DNA coding t-RNA. It would allow for as many as 64 different amino acids. DNA itself could have more variety, how about 6 nucleic acids instead of 4. A three nucleic acid sequence could then code for 216 amino acids. We can only imagine the variety and diversity of functional proteins possible with it. That much possible variety of protein will make us able to completely eradicate genetic diseases, creating new type of organisms with many advantageous traits, more sustainable crops/ agriculture. There is likely to be a truly amazing revolution in the biological sciences within the next 50 years [31].

VII. Life extension May become possible:

Most controversial research is being done by researchers in the field of life extension or to create a new human life in laboratory. Some life extensionists suggest that therapeutic cloning and stem cell research could one day provide a way to generate cells, body parts, or even entire human bodies. In one experiment, a functioning dog's bladder was grown and proved to be viable after implantation [32]. For cryonicists storing the body at low temperatures after death may provide an "ambulance" into a future in which advanced medical technologies may allow resuscitation and repair. They speculate cryogenic temperatures will minimize changes in biological tissue, giving the medical community ample time to cure all disease, rejuvenate the aged and repair any damage, even after the death. Cryonicists do not believe that legal death is "real death" because stoppage of heartbeat and breathing , the usual medical criteria for legal death occur before biological death of cells and tissues of the body. Even at room temperature, cells may take hours to die and days to decompose. They state that rapid cooling and cardio-pulmonary support applied immediately after certification of death can preserve cells and tissues for long-term at cryogenic temperatures. People, particularly children, have survived up to an hour without heartbeat after submersion in ice water. In one case, full recovery was reported after 45 minutes underwater [33]. No mammal has been successfully cryopreserved and brought back to life yet, and cryonics is not currently accepted as viable by science. Some individual scientists support the idea based on their expectations of the capabilities of future science.

On the basis of above discussion we can say that in near future environment of chemistry will be entirely advanced from today. We will be having flying cars, eco friendly

industries, very fast, portable nano electronic devices, much advanced medical facilities, house hold appliances able to talk, solvent free dry Labs, our vehicles would be able to run on wind energy, crime would be controlled as criminals would be caught just from a piece of heir or nail left, by gene maping even we would be able to create a child of desired traits or resuscitate the dead ones. But in developing such advance technologies we should never forget, there is a great deal of truth in a remark attributed to **George Bernard Shaw**, "Science is always wrong. It never solves a problem without creating ten more." It is up to us that how we lead that all advancement in favour of mankind, without imposing any further hazard to the nature. Man should never try to play role of a God, and supremacy of nature should not be challenged.

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