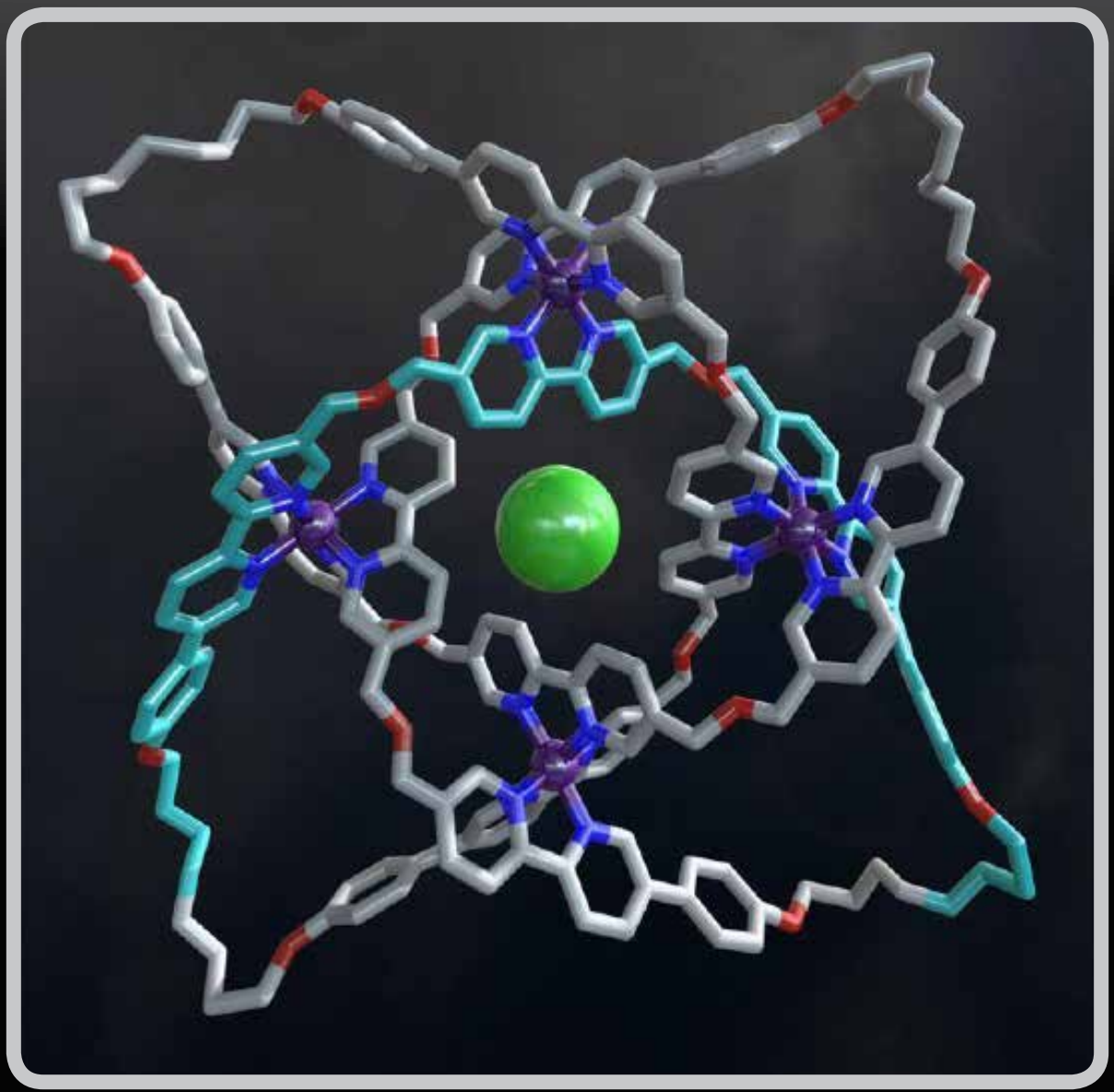
The Tri Annual Publication of the
Institute of Chemistry Ceylon
ISSN 1012-8999

CHEMISTRY
IN SRI LANKA



January 2018 | Volume 35 | No. 01

Inauguration of the 40th batch of the GIC programme

The inauguration of the 40th batch of the GIC programme was held on the 6th of January 2018 at the P P G L Siriwardene auditorium. **Mr. Maithri Gunarathne** (Chairman, Competent Authority, Lanka Mineral Sands Limited) graced the occasion as the Chief Guest. The CCS family warmly welcomes the new batch of students.

Chief Guest, Mr. Maithri Gunarathne delivering his address

Head Table

Chemistry in Sri Lanka

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The Tri-Annual Publication of the Institute of Chemistry Ceylon

Founded in 1971, Incorporated by Act of Parliament No. 15 of 1972

Successor to the Chemical Society of Ceylon, founded on 25th January 1941

Vol. 35 No. 1 **January 2018**

Theme for the year -

Chemists' contribution towards National Policy Development

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Outline of our Institute

The Institute of Chemistry Ceylon is a professional body and a learned society founded in 1971 and incorporated by act of Parliament No. 15 of 1972. It is the successor to the Chemical Society of Ceylon which was founded in 1941. Over 50 years of existence in Sri Lanka makes it the oldest scientific body in the country.

The Institute has been established for the general advancement of the science and practice of Chemistry and for the enhancement of the status of the profession of Chemistry in Sri Lanka. The Institute represents all branches of the profession and its membership is accepted by the government of Sri Lanka (by establishment circular 234 of 9-3-77) for purposes of recruitment and promotion of chemists.

Corporate Membership
Full membership is referred to as corporate membership and consists of two grades: **Fellow (F.I.Chem.C.)** and
Member (M.I.Chem.C.)

Application for non-corporate membership is entertained for four grades: Associate (former Graduate) (A.I.Chem.C.), Licenciate (L.I.Chem.C.), Technician (Tech.I.Chem.C.) and Affiliate Member.

Revision of Membership Regulation
All Special Degree Chemists can now apply directly to obtain Associate (Graduate) Membership. Three year B. Sc. Graduates (with an acceptable standard of Chemistry) can
(i) directly become Licentiate
(ii) obtain corporate membership in a lesser number of years.

Tech.I.Chem.C.
Those who have passed the DLTC examination or LTCC examination or have obtained equivalent qualification and are engaged in the practice of Chemistry (or chemical sciences) acceptable to the Council are entitled to the designation Tech.I.Chem.C.

Members/Fellows are entitled to the designation of **Chartered Chemist (C.Chem.)** on establishment of a high level of competence and professionalism in the practice of chemistry and showing their commitment to maintain their expertise.

All corporate members (Members / Fellows) are entitled to vote and become Council/ Committee members whether Chartered Chemists or not.

Membership Applications
Any application for admission to the appropriate class of membership or for transfer should be made on the prescribed form available from the Institute Office.

Current Subscription Rates
Fees should be payed on 1st of July every year and will be in respect of the year commencing from 1st July to 30th June

Fellow	Rs. 1500
Member	Rs. 1500
Associate	Rs. 1200
Licenciate	Rs. 1000
Technician	Rs. 500
Affiliate	Rs. 1000
Membership for Life	Rs. 15000

Entrance Fee

All the grades	Rs. 1000
Processing Fees*	Rs. 500
Processing Fee for Chartered Chemist designation	Rs. 1000
Institutional Members	Rs. 2500

*per application for admission/transfer to any grade

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CHEMISTRY IN SRI LANKA

Chemistry in Sri Lanka is a tri-annual publication of the Institute of Chemistry Ceylon and is published in January, May and September of each year. It is circulated among the members of the Institute of Chemistry and students of the Graduateship/DLTC course and libraries. The publication has a wide circulation and more than 750 copies are published. Award winning lectures, abstracts of communications to be presented at the annual sessions, review papers, activities of the institute, membership news are some of the items included in the magazine.

The editor invites from the membership the following items for publication in the next issue of the Chemistry in Sri Lanka which is due to be released in May 2018.

- *Personal news of the members*
- *Brief articles of topical interests*
- *Forthcoming conferences, seminars and workshops*
- *Latest text books and monographs of interest to chemists*

All publications will be subjected to approval of the 'Editorial and Publicity Committee' and the Council of the Institute of Chemistry Ceylon.

Further, prospective career opportunities for chemists, could be advertised in Chemistry in Sri Lanka at a nominal payment. The editor welcomes suggestions from the members for improvement of the publication.

Guest Editorial

Exponential Technologies

Professor K.M. Nalin de Silva
Senior Professor in Chemistry, University of Colombo
Science Team Leader, Sri Lanka Institute of Nanotechnology

The major discoveries from pre-historic ages to recent times, have allowed nations to describe themselves and their treasures. These major discoveries include, the first use of tools, shifting from hunting to agriculture, the invention of the wheel, steam engine, computer and many other ground breaking discoveries. These features defined the future direction and provided the basis for greater innovations through advanced technologies. The above technological revolutions were adopted by various countries in Europe and North America. The rapid progress was mainly due to the development through discovery of new products and manufacturing processes. The economic development of the Europe was mainly due to the industrial revolution which later shifted to the United States. The second wave of this technology witnessed Japan and other countries immerge in to the industrial status. Korea and surrounding countries captured the power of information communication technology to reshape their economies and to compete in the global arena.

Are we ready to face the new wave of exponential technologies which will allow the planet to grow in the exponential curve as opposed to the linear curve during last few centuries? This exponential behaviour was easily observed in last two decades due to the great inventions which disrupted many industries. What are exponential technologies? Exponential technologies are those which are rapidly accelerating and influencing major industries and all aspects of our lives. Exponential technologies include artificial intelligence (AI), augmented and virtual reality (AR, VR), biotechnology, nanotechnology, digital fabrication, networks and robotics.

It is believed that the solutions to the major challenges such as energy crisis, water crisis, food shortage, computer power and cancer therapy, lie in the intersection of these exponential technologies. Therefore, the possibility of developing a sustainable solution becomes much more likely when two or more of these technologies are used in combination to attack the challenge. For example, consider a potential health care solution that exploits nanotechnology based sensor to monitor the heart rate, individual health records and genetic profiles to help prevent heart disease. Further, smart phones can be used to gather data through biosensors to predict the presence of cancer.

The usual feature of an exponential behavior is that the power or the speed doubles each year and the cost drops by half. Humans are well capable of overestimating what can be accomplished in the short term and immensely underestimate what we can achieve in the long run. Humans are not programmed to judge or process the exponential growth and we assume a constant rate of change due to our linear thinking rather than exponential. Exponential thinking is the key to great innovative solutions to many challenges. Sri Lanka, despite a remarkable history of excellent engineering and medical knowledge, was late to adopt any of the technological revolutions. However, Sri Lanka is among the early adopters of nanotechnology through a national initiative. The other technologies are also being captured through national initiatives. An exponential mindset should be created among the researchers to exploit exponential technologies to inculcate the innovative ways of thinking. Thinking linearly can prove costly to every aspect of our lives including research, business and government. We should, as a nation, be aware of the disruption happening at the hands of emerging technologies and should take necessary precautions to adopt these technologies. If we can plan for the accelerating pace we can ease the paradigm shift and embrace the future in style.

SCAQA has given green light to the Institutional Review of the Institute of Chemistry Ceylon

Institute of Chemistry Ceylon is the premier body in Sri Lanka producing the largest number of Chemistry graduates annually through the Graduateship programme in Chemistry (GIC). GIC is a professional Degree programme, accredited by the Royal Society of Chemistry, UK and it is well recognised internationally allowing GIC graduates to proceed for postgraduate degrees. In order to obtain full recognition locally, the Council of the Institute of Chemistry Ceylon recently decided to obtain accreditation from the SCAQA (Standing Committee on Accreditation and Quality Assurance) of the Ministry of Higher Education and have forwarded an application requesting for the Degree awarding status. SCAQA has shed green light to the application and has requested to take necessary action to satisfy certain requirements within six months and in the meantime to initiate the programme review process. The College of Chemical Sciences (CCS), the education arm of the Institute is now in the process of preparing documents for the programme review, having a plan of offering the B.Sc. (Honours) Degree in Chemistry programme in 2019. Considering the requirement of offering a minimum of two subjects for a Degree programme, Academic Board of the CCS decided to offer Chemistry as the major subject and Management Science as the second subject. The Chemistry curriculum offered is compatible with international standards and the graduates having good results will be eligible for employment in higher education institutes. Once this programme commences, the Institute of Chemistry Ceylon will be the only higher education institute in Sri Lanka offering B.Sc. (Honours) Degree in Chemistry programme with Management Science as a subject. Industrial sector will provide a rosy path to welcome the graduates completing this new Degree programme because they will be chemists with a solid knowledge and skills in management in addition to the vast knowledge in the field of Chemistry, which is a major need for the industrial sector.

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IChemC to host preliminary round of the Chemistry Olympiad – Sri Lanka – 2018

The Institute of Chemistry Ceylon (IChemC) will host the Chemistry Olympiad Sri Lanka 2018 in May 2018 with the intention of increasing student interest in Chemistry and facilitating the learning of fundamental concepts of Chemistry. The preliminary selection examination of the competition will be held on 11th March 2018 at ten university premises covering Colombo, Kandy, Jaffna, Badulla, Kurunegala, Anuradhapura, Matara and Batticaloa districts. Grade 12 students from both Bio Science and Physical Science sections are invited to participate from each school. Depending on the performances of the preliminary examination, the students will be invited to take part in the final round of the Chemistry Olympiad Sri Lanka 2018. A theory and practical workshop will be conducted at the IChemC for the finalists of the Chemistry Olympiad. For more information of the Chemistry Olympiad Sri Lanka please visit the IChemC website at http://www.ichemc.edu.lk/activities/chemistry-olympiad/

Chemistry of the Cover

Scientists have been able to produce new varieties of molecular knots that do not occur in nature, through chemical synthesis. These knots impose useful restrictions on the knotted molecule resulting in important physical and chemical properties.

The research group led by Professor David Leigh in Manchester's School of Chemistry at the University of Manchester, UK has won the Guinness World Record for tying the tightest ever knot. This knot has eight crossings in a 192-atom closed loop, which is about 20 nanometres long. The knot has been tied by weaving the ligand strands around four octahedral iron (II) forming crossing points, and the ends of the strands have been fused together by a chemical catalyst to close the loop and form a circular triple helix. This is the most complex regular woven molecule yet made by scientists.

https://www.chemistryworld.com/news/molecular-knot-gets-guinness-world-record/3008459.article?utm_content=cw-jan181&utm_source=twitter&utm_medium=social&utm_campaign=mkt-dir-cm01017
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IChemC to develop New Campus at Malabe

On a request made by the Council of the Institute of Chemistry Ceylon, the Urban Development Authority (UDA) has handed over a land of 1 acre and 6 perches in extent located at Halabarawa, Malabe to the Institute in August 2017 for construction of an educational building complex. While the demand for admissions is increasing annually, the present buildings at Rajagiriya will not be sufficient to accommodate the students. Therefore, the Institute has considered that development of the proposed educational building complex is of urgent need.

In the vicinity of the land there are several other multistoried buildings belonging to government and semi government institutes and also to the private sector. On completion of the building complex of the Institute of Chemistry Ceylon, the students will find the place more spacious consisting of a multitude of facilities including more areas for academic and recreational activities.

It is expected to undertake construction in 3 phases and the first phase will consist of 2 lecture halls to accommodate about 200 students in each, 2 laboratories, office, academic rooms, washrooms, sick room, library, reading room, water purification plant *etc*.

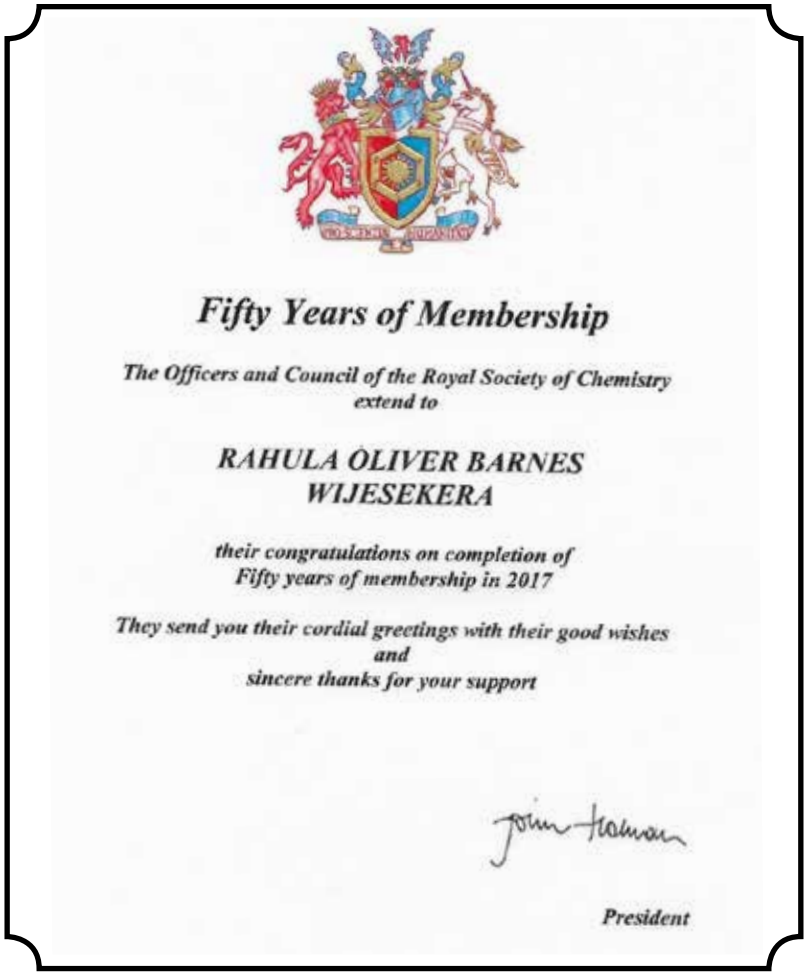
Survey of the land and marking of boundaries were carried out on 9th September 2017 by the surveyors under the supervision of Mr. A M Jayasekara, Additional Registrar of the Institute. The Council has taken steps to entrust the designing and architectural work to a consultancy firm.

Inspection of the land by the Council members on 31st July 2017: The team consisted of Dr. Poshitha Premarathne, Prof. S. Hewage, Prof. M.D.P. De Costa, Prof. Sudantha Liyanage, Mr. K.R. Dayananda, Dr. A.A.P. Keerthi, Mr. N.I.N.S. Nadarasa, Mr. A.M. Jayasekara, Mr. R.M.Ranasinghe Banda Mr. M.R.M. Hanffa and UDA Officials.

Surveying the land on 9th September 2017

The Royal Society of Chemistry recognizes the distinguished Sri Lankan Scientist Dr. R.O.B. Wijesekera

Dr. R.O.B. Wijesekera was recognized by the Royal Society of Chemistry for the completion of the fifty years of membership in 2017.



Fifty Years of Membership

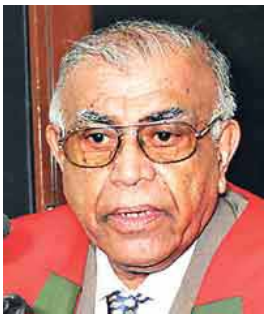
The Officers and Council of the Royal Society of Chemistry extend to

RAHULA OLIVER BARNES WIJESEKERA

their congratulations on completion of Fifty years of membership in 2017

They send you their cordial greetings with their good wishes and sincere thanks for your support

President



Dr. R.O.B. Wijesekera is a distinguished scientist who made significant contributions to the industrial development in Sri Lanka. He joined the Medical Research Institute (MRI) in 1952 after graduating from the University of Ceylon with B.Sc. Special Degree in Chemistry. After obtaining his Ph.D. from the University of Sheffield, he continued the research at MRI to investigate constituents in medicinal plants. During that period he established research contacts with many well-known scientists from Sweden, Canberra, Denmark and India. In 1967 Dr. Wijesekera joined the Ceylon Institute of Scientific & Industrial Research (CISIR) and initiated research on Industrial Natural Products. After returned from his post-doctoral stay at University of California at Davis, he initiated a new area of natural products research on essential oils and spices in Sr Lanka. He was the first Sri Lankan scientist to receive the "Guinness Award for Scientific Achievements" in 1976. He has served the World Health Organization as a Manager of a Special Research Program and was a UNIDO Specialist Technical Adviser in Vienna. He was the Chairman of the National Science and Technology Commission and CISIR. Dr. Wijesekera serves as a Director/ Consultant of the Link Natural Products and he has pioneered the "Link Natural Product Digest" magazine. He became the President of the Chemical Society of Ceylon in 1970, and was a Past President of the Institute of Chemistry Ceylon and the Sri Lanka Association for the Advancement of Science. He is a Fellow of the National Academy of Science and the Royal Society of Chemistry. He has authored several research publications on scientific themes and on science policy and has published several technical books internationally. He has been recognized nationally with the national honour of *Vidya Jyothi*. He has been awarded D.Sc. (*Honoris Causa*) by the Universities of Sheffield, Sabaragamuwa and Peradeniya.

Guest Articles

What is KETO?

Professor S. Sotheeswaran
Emeritus Professor, The University of the South Pacific
Former Senior Visiting Professor, College of Chemical Sciences, Institute of Chemistry Ceylon

The word keto is derived from the word ketosis. Ketosis is a normal metabolic process. When the body does not have enough glucose for energy, it burns stored fats instead which results in a build-up of acids called ketones within the body. Some people encourage ketosis by following a diet called the ketogenic or low-carb diet or keto diet.

The keto diet, with a low carbohydrate and high-fat eating plan, involves drastically reducing the carbohydrate intake and replacing it with fat. The diet results in putting the body into the metabolic state which is ketosis. When this happens, the body becomes incredibly efficient at burning fat or energy. The diet is said to result in significant weight loss, but also improves mental focus, blood pressure, strength and also reduces migraines.

One expert says "On a ketonic diet, your entire body switches its fuel supply to fat". Insulin levels become very low and fat burning increases dramatically. It becomes easy to access fat stores and to burn them off.

Natural fats including butter and olive oil, meats, fish, seafood, eggs, cheese, and vegetables that grow above ground can be considered as keto-diet foods.

The most important thing is to keep your daily carbohydrate intake under 50 grams and ideally below 20 grams. The lower the carbohydrate intake, the more effective the keto-diet will be. That means the vegetarians can never be on a keto-diet.

Foods such as potatoes, rice, pasta, bread, chocolates, soft drinks, lollies, and doughnuts are definitely not to be included in your diet, if you want to be on a keto-diet and lose weight.

You can drink water, coffee, and tea with minimal or no milk and sugar. An occasional glass of wine is considered to be acceptable.

Shifting your body into a ketogenic state is no easy feat given that you have to subsist on a diet compose of 20 percent protein, 75 percent fat and 5 percent carbohydrate. Sports scientists say it takes the body anywhere from two weeks to six months to move into a ketogenic state.

"Once done, it's done, and you have achieved fat-burning status that can stick with you for life," writes a sports scientist, Greenfield, who says the ketogenic diet improved his triathlon performance, reduced hunger, improved mental clarity, reduced gas and bloating, and lowered inflammation markers. The keto lifestyle also puts you at risk of some significant side effects. "There is a risk of constipation because sometimes you are not getting as much fibre, and there is a risk of calcium deficiency as people often cut out dairy," Greenfield says.

Diabetes UK warns that actively trying to get your body into ketosis is potentially dangerous because high levels of ketones can make the blood acidic. In fact, ketosis sets in the case of diabetics with high blood sugar levels. In this case the body is unable to use the glucose in the blood due to lack of insulin and the body relies on body fats to produce what is often referred to as ketoacidosis. Without enough insulin, the body's cells cannot use glucose for energy. To make up for this, the body begins to burn fat for energy instead. This leads to accumulation of ketones in the blood which also appear in the urine.

Ketoacidosis is related to hyperglycaemia and it occurs in people with type 1 diabetes, it very rarely occurs in people with type 2 diabetes.

A ketogenic diet can lead to high cholesterol, triglycerides and thyroid issues. Some people feel they have reduced energy although reports have indicated increased energy.

It's very difficult to follow such a strict diet in today's culture, especially anybody who wants to have a social life.

There is a place for ketosis. It is a good state to aim for if you are overweight or have insulin resistance or Type 2 diabetes. However it is not to be recommended for a person of average weight who just wants to drop a few kilos.

Production of precursors for specialty polyamides from bio-sourced lipids

Dr. Y M A L W Yapa
Department of Chemistry, University of Ruhuna, Matara

Importance of renewable materials

Synthesis of commodity chemicals and fuels from renewable sources is gaining an increasing attraction due to concerns over depletion of fossil resources as well as the effects on the climate change. According to a recent theoretical model on the oil production, the peak of oil production lies somewhere between 2010 and 2025 and in the ideal case, the oil production peak was to be in 2013. Both, the extraction of existing oil resources and the demand for oil, is rapidly increasing with the current population growth. Fuels, polymers, surfactants, and lubricants are few essential commodities in today's life, which are derived from petroleum sources. To cater the growing demand with the depleting nature of petroleum resources, world is searching for alternative sources for the existing petroleum based materials. Bio-based materials such as bio-fuels, biopolymers, bio-surfactants, and bio-lubricants are hopeful alternatives that have been discussed frequently in scientific literature to overcome hurdles incurred by limitation of petroleum sources. Use of bio-based materials has extra advantages over petroleum-based materials when the environmental impact is considered. Environmental pollution is linked with all the steps of oil processing and can be affected to water, air, soil and all the living being of the planet. Bio-based materials are easily biodegradable, renewable, and account less for the carbon footprint of the planet.

Bio-sourced lipids as a feedstock

Among the obtainable constituents (carbohydrates, lipids, proteins) from biomass, lipids are especially suitable as a feedstock for commodity and specialty chemicals because of their less oxygenated nature. Thus, the majority of the processes for production of biofuels, biosurfactants, bio-based coatings, and biopolymers were developed using lipids as a feedstock. For example, in the field of polymer industry, synthesis of polyesters, polyamides, polyurethanes, polyepoxides, and polycarbonates from fatty acids have been reported. The rapid advancement of the technologies however has not yet impacted chemical industries to replace the traditional feedstock, in part due to lack of economic advantage. Therefore, new technologies for production of renewable commodity/specialty chemicals, that is not only clean and efficient but also economically competitive, is still actively being sought and researched.

Polymers

Polymers are macromolecules made from large number of monomers. They can be natural (such as polysaccharides, proteins, silk, DNA, and natural rubber) or synthetic (such as polyolefins, polyamides, polyesters, and polyurethanes). Synthetic polymers have become essential materials in modern world: nearly replacing the use of metals, woods and natural fiber based cloths in many industries. Their precursors are mainly synthesized from petrochemicals although alternative feedstocks such as natural lipids are also studied.

Specialty polyamides

Polyamide is a polymer with the general molecular formula $-[(CH_2)_n\text{-}CONH]-$ or $-[(CH_2)_n\text{-}CONH\text{-}(CH_2)_m\text{-}CONH]-$ invented by Wallace Carothers and has become one of the most widely using polymers today. Polyamides such as polyamide 11 and 12 are described as specialty polymers as they are produced for special purposes. Polyamide 11 and 12 are two high value specialty polyamides that find applications in many fields including medical, automobile, electrical, mechanical and sports industries due to their excellent physical and chemical properties. Polyamide 13 is also reported to have similar properties to nylon 11 and 12 (Figure 01).

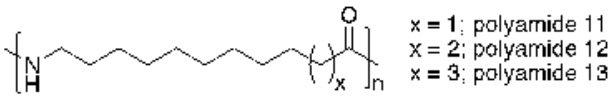


Figure 01: Examples of three specialty polyamides

At present, synthesis of polyamide 12 precursor is done by using petrochemical 1,3-butadiene as the substrate while precursor for polyamide 11 is synthesized from castor oil extracted from seeds of castor beans. Polyamide 13 is still not produced in industrial scale. Polyamides 11 and 12 have become essential materials in automobile industry today. This was clearly proven by a shortage of polyamide 12 to the automobile industry due to an explosion occurred in a leading polyamide 12 manufacturing plant in Germany in the year 2012. After this incident, an article appeared in Chemical & Engineering News reported it, as "without Nylon 12, production of vehicles would grind to a halt, one model at a time, in only a few weeks".

Many alternative syntheses for precursors of these specialty polyamides are found in literature. Most of these studies are focused on the use of renewable feedstocks and to device safer synthetic routes. Fatty acids available in fats and oils have become the major starting material in many of these studies. Examples for several fatty acids that can be used to produce polyamide 11, 12, and 13 precursors are

shown in the figure 2.

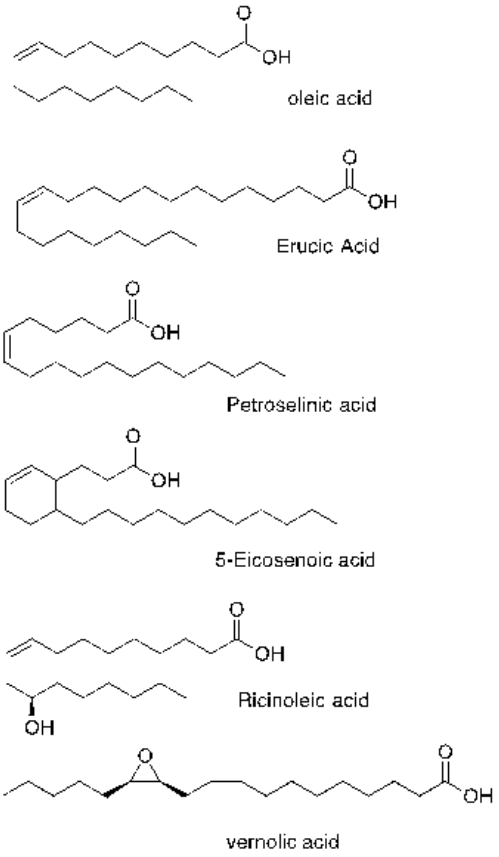
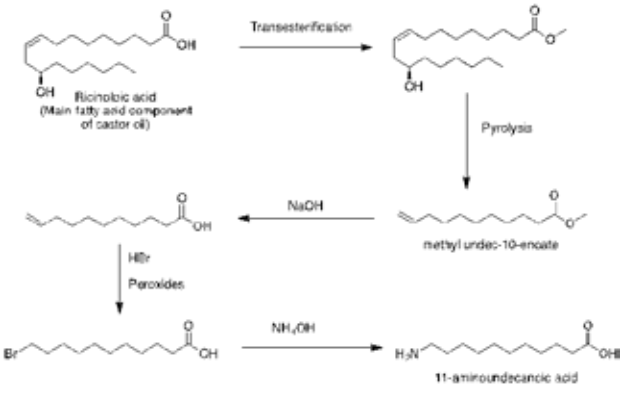


Figure 2: Examples of fatty acids studied to make renewable polyamides

Synthesis of 11-aminoundecanoic acid from ricinoleic acid is a well known industrial example for a bio-based polyamide precursor (Scheme 1). However, castor bean is the sole source for ricinoleic acid in industrial scale. Further, this plant is grown only in some parts of the world. Due to these reasons, use of other fatty acids for the synthesis of bio-based polyamide precursors are being sought.



Scheme 1: Synthesis of polyamide 11 precursor from ricinoleic acid extracted from castor beans.

Oleic acid is a frequently used fatty acid for this purpose due to its abundance in many different sources such as vegetable oil, animal fats, and algal oils. Olefin metathesis of methyl oleate with different olefin partners with right carbon lengths to make bifunctional compounds has been frequently studied as a potential route for polyamide 11 and 12 precursors. These intermediate bifunctional compounds are then can be converted to precursors of polyamide 11 and 12.

Synthesis of polyamide 13 precursor, 13-aminotridecanoic acid, is reported by starting with erucic acid as the substrate. Mustard oil and rapeseed oil are two sources that contain erucic acid. Esterification followed by ozonolysis of erucic acid produces half ester of brassylic acid. This has been successfully converted to amide ester, nitrile ester and amino ester. Finally 13-aminotridecanoic acid has been obtained by hydrolysis of amino ester.

Apart from the above-mentioned procedures, many different approaches are reported in literature to make precursors of specialty polyamides. Due to the higher unit price, synthesis of these bio-based polyamides will become economically feasible in future and replaces current syntheses from petroleum feedstock.

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Silica from Rice Husk: Value Addition to Agro-wastes

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Sri Lanka rice cultivation occupies 34 percent of the total cultivation area and produces about 1.5 to 3 million metric tons per year depending on the weather condition according to the data from rice research and development institute and the department of census and statistics in Sri Lanka. Once rice is processed the major waste is the rice husk (RH). In general, 20 percent of raw rice grain contains husk. At present RH is used in different fields such as alternative fuel, bio-fertilizers, absorbent in building materials and material for animal husbandry. However, the amount of RH used in such industries with respect to the total production is very small. Consequently more often RH dump in to landfills. Burning of RH can get good amount of energy owing to its high calorific value of about 16000 joules per gram. Even after combustion at high temperatures it generate ash, which accounts about 20 percent of the RH. Rice husk ash (RHA) contains about 90 percent silica with trace amount of other metal oxides. If we follow the above statistics, the total rice production of Sri Lanka per year produces about 300,000 to 600,000 metric tons of RH. If one assume 50% of such RH is burned it generates about 30,000 to 60,000 metric tons of RHA. Since it contains about 90% silica, it is possible to produce 27,000 to 54,000 metric tons of silica per year. This could be even doubled if all the RH is utilized. Thus, extraction of silica from RHA would be a great value addition to rice industry as well as a solution for the waste management which impact environment positively. Further this provides new business opportunity to generate additional revenues from the waste.

Silica is one of the multipurpose chemical compounds that exist in gel, crystalline and amorphous forms. The major industries where silica uses are rubber industry especially the tyre manufacturing, pharmaceuticals, cosmetics, paints, printing tonners and so on. Conventional silica production method is based on the reaction between sodium carbonate and quartz at high temperatures. However, the processes involved in traditional method are energy intensive. Considering the abundance and cheap cost as agro waste RHA, many researchers and industrialist especially in other paddy cultivation countries have focused their efforts on the possible uses of RHA to extract the silica. Being biogenic origin the author and his research team believes that the silica extracted from RHA has a high value with respect to the chemically synthesized silica. At present the author and his research team extensively studies the cheapest and most effective ways to extract silica form RHA. Further, conversion of such silica into nanosilica and surface modifications of silica to make them compatible in rubber matrices are also being investigated. In this brief, the chemical process involves in silica extraction from RHA is discussed.

Rice husk ash in fully burned condition contains high amount of silica. Thus, selection of ash is important as
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the quality of ash determines the yield as well as the quality of end product. If it fully burned at high temperature for long time it appears as white-grey in colour as shown in Figure 1.a, with comparison to the black-coloured ash obtained from incomplete combustion as shown in Figure 1.b.

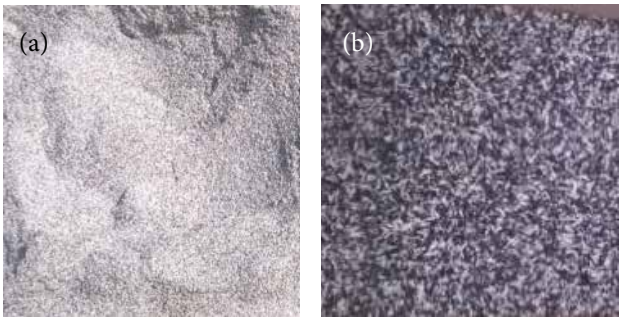

Figure 1. Colour of the a) well burned RHA and b) incomplete burned RHA

We experienced that unburned contents and remaining carbon in the ash hampers the silica digestion as well as the impurity level in the final yield. Thus mechanical sieving of the RHA an obtaining particles size below 125 μm mesh gave a better characteristics in the end product. In general, the extraction of silica by chemical method involves the dissolving of silica in sodium hydroxide followed by precipitation by acidifying the medium. The initial reaction of extraction of silica from ash as sodium silicate using caustic soda is given below.

$$\underset{\text{(ash)}}{SiO_2(s)} + \underset{\text{(caustic soda)}}{2NaOH(aq)} \rightarrow \underset{\text{(sodium silicate)}}{Na_2SiO_3(aq)} + \underset{\text{(water)}}{H_2O(l)}$$

Above reaction needs high temperature and mechanical agitation. However, the temperature depends on the quality of the ash selected. After couple of hours slurry is obtained which can be decanted off to get the slightly yellowish colour sodium-silicate solution. The intensity of the colour depends on the dissolved impurities present in the medium. The next step of the process is the precipitation of silica from sodium silicate solution using an acid. Sulfuric acid or mixture of sulfuric acid with hydrochloric acid is commonly used. However, sulfuric acid is very expensive and consequently any process involves sulfuric is too costly. Thus, possibility of using carbonic acid for the precipitation of silica is being currently investigated. The preliminary result shows that it can be effectively used. If this method is success, the carbon dioxide evolve in the combustion of RH can be effectively used which will dramatically reduce the production cost. The reaction of precipitation of silica from sodium silicate solution with addition of sulfuric acid is shown below.

$$\underset{\text{(sodium silicate)}}{Na_2SiO_3(aq)} + \underset{\text{(sulfuric acid)}}{H_2SO_4} \rightarrow \underset{\text{(silica)}}{SiO_2(s)} + \underset{\text{(sodium sulphate)}}{Na_2SO_4(aq)} + \underset{\text{(water)}}{H_2O(l)}$$

The silica is formed as a gel. This could be dried in a conventional oven or spray dried. This silica has metal oxides as impurities. Washing this product with hydrochloric acid and successive washing with demineralized water will do further purification. The conductivity of the effluent can be easily used to evaluate the purity of the final product. The X-ray diffraction pattern of before and after purification is shown in Figure 2. The broad halo without sharp peaks of the purified silica confirms the amorphous nature of the extracted silica and the effectiveness of the process.

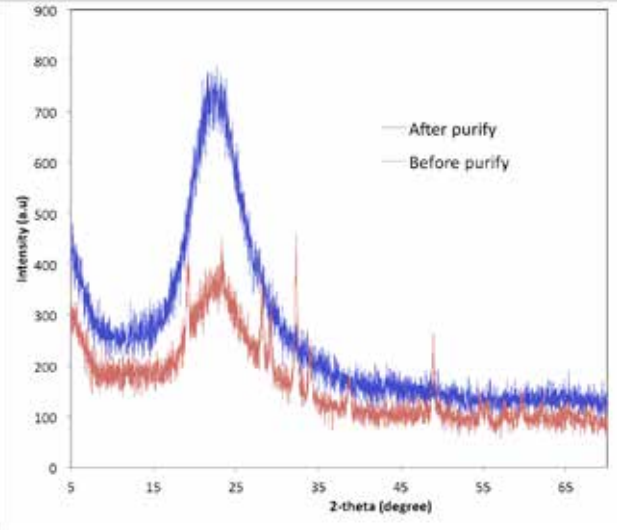

Figure 2. X-ray diffraction patter on unpurified and purified silica extracted from RHA

Depending on the type of acid used there are associated recoveries. For example if sulfuric acid is used sodium sulphate is a by-product. By evaporation of water, followed by crystallisation, filtration and drying, crystals of sodium sulphate can be obtained. Sodium sulphate has multiple uses. If carbonic acid is used sodium carbonate can be obtained as a by-product. In addition to these in the first step activated carbon can be generated if our RHA contains unburned carbon. This activated carbon may be used in purification of industrial effluents. Thus, the major product as well as all the by-products of this process has a commercial value and have a high demand in the market. This kind of value addition to agro-waste can reduce the pollution to great extent. Further, this process does not generate any toxic effluents hence this process does not pollute the environment. There is also very attractive return on investment on the project.

Currently in Sri Lanka, no one is doing this value addition. If one metric ton of imported silica cost around $1000, Sri Lanka rice industry can save around 27 to 54 million US dollars per year. The opportunity to make profit from this agro-waste is still open up for the new and existing entrepreneurs.

Acknowledgement:

The author would like to acknowledge his research team (Dr. Dilru Ratnaweera, Ms. Kirushanthi Thangavel, Mr. Ishara Wijesinghe, Ms. Randi Iresha) involved in this great piece of work. Further, partial financial support given by Uva Wellssa University capital grant (UWU/RG/2016/11) is greatly appreciated. A portion of this research used resources at Instrument Center operated by the Faculty of Applied Sciences of the University of Sri Jayewardenepura is also acknowledged.

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Role of Chemistry in Personalized Medicine

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Wellbeing of a person is a crucial factor in life which facilitates the performance of his or her day to day routine work in well-organized manner. However, it is a known fact that we all get sick and we need to take suitable medicines accordingly, as prescribed by clinicians. Even though millions of people are taking medications daily, they are found to be effective only on a part of the population who use them. Some drugs, such as 'statins' which are frequently used to lower cholesterol are known to be effective only on 1 in 50 patients. On the other hand, some drugs cannot be metabolized by some people leading to arouse toxicity and allergy on them. Thus, the importance of the identification of this personal difference in medication has now been considered in designing and prescribing drugs for different diseases, opening avenues to the new paradigm in medicine, '**personalized medicine (PM)**'. Hence, personalized medicine represents the alignment of medical treatments to the individual characteristics of each patient, which are determined by the genetic make-up or the genome of that particular patient. This new approach of medicine is based on the revelations on the correlation between person's unique molecular or genetic profile and certain diseases. Ultimately, PM can predict the safety and effectiveness of a medical treatment on each individual, enhancing the precision of the treatment based on the molecular profile of the patient, by reducing harmful side effects and ensuring the successful outcomes on the patient. Cancers including breast cancers and cardiovascular diseases are the prominent candidates to be treated using PM approach.

Personalized medicine relies on the interdisciplinary research not only to find out specific bio-markers to diagnose a disease or predict the risk of having it, but also to deliver targeted treatment to each individual or group of individuals suffering from the disease. In this regard, medicinal chemistry which overlaps with different disciplines of science, including organic chemistry, bio-organic chemistry, physical organic chemistry, biochemistry, pharmacology, toxicology, analytical chemistry, molecular biology and genetics play a major role to build up the bridge between chemistry and PM. Medicinal chemistry can greatly catalyze the process of drug discovery and development, with the collaboration of pharmaceutical industry to bring new medicines from bench to market. Not like in early ages, complex synthetic methods and technologies such as combinatorial chemistry (comb-chem), microwave assisted organic synthesis (MAOS) and high-throughput (HTS) biological screening methods are accompanied with new drug discovery programs which accelerate the process of discovery. Comprehensive knowledge of the synthetic chemistry, computational chemistry, and biology literature ultimately can propel the discovery forward until it passes to the end market. Finding of potential drug targets has now been enhanced by the knowledge of molecular biology, especially the information on human genome and proteome (total protein content of a given organism, tissue or a cell at a given time). Medicinal chemists use this information to identify relevant targets capable of being affected by the interactions with candidate drug compounds. This process is now been facilitated by different computational approaches, such as 'molecular docking', in which interactions between drug targets, especially protein molecules and drug molecules are predicted. Subsequently, those candidate drug molecules are short listed according to their effectiveness to choose the best candidates before proposing, synthesis and testing for direct action on protein targets, in order to effectively treat a wide variety of diseases. Herein, chemist can analyze the interaction of the drug with the wide array of target molecules which depends on the personal variation. Thus, he or she can modify the structure of the drug to be more suited for the particular patient or the group of patients.

Molecular biology in combination with computational chemistry, especially computer based drug designing has now enabled chemists to rationally design new drug molecules targeting the known bio-molecules. Compared to the traditional methods in developing a drug against a disease, this new approach saves time and allows for a more comprehensive understanding of the drug-target interplay. In this process, initially the major molecule/s which show/s the desired biological activity should be identified using new technologies such as HTS and combinatorial chemistry. Thereafter, those molecules need to be modified and optimized, by using structure-activity analysis (SAR) in order to improve the desired pharmacological properties
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by considering absorption, distribution, metabolism, and excretion of the molecule/s. Finally, the optimized molecule/s should be scaled-up for further drug development process and efficacy testing.

In the area of bio-marker studies related to PM, antibodies used as molecular probes have now been replaced by 'aptamers' which are single-stranded synthetic oligonucleotides composed of DNA or RNA, with a length of 20-100 nucleotides. These aptamers are promising molecules with binding affinity to a variety of targets such as metal ions, small molecules, proteins, and intact cells. Aptamers are produced by an *in-vitro* selection process called 'Systematic Evolution of Ligands by Exponential Enrichment (SELEX)' depending on chemical artistry. They are chemically synthesized and can be designed to conjugate with other molecules such as bioaffinity molecules, chemical linkers and nanomaterials. Thus, aptamers are used as indispensable molecular tools for biomarker studies.

In summary, PM is becoming promising field in medicine which improves the precision of medications based on personal variations of patients due to the diversity of their genetic make-up. Chemistry, especially medicinal chemistry plays a significant role in PM to enhance its efficacy by proposing and synthesizing drug molecules based on computational approaches in drug development programs. Moreover, chemical synthesis of different molecular probes solely based on chemical artistry has improved the efficacy on bio-marker based studies in drug development. Likewise chemistry in collaboration with modern molecular techniques is ever moving the field of medicine forward, especially with the novel approaches like PM, speed of which is also getting enhanced day by day on as a result of the promising researches in the field of medicinal chemistry.

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Photochemical Water Reduction by Organic Hydrides

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Increasing concerns on anthropogenic climate change, skyrocketing global energy needs, and depletion of fossil fuels have made the discovery of alternative carbon-neutral and sustainable energy sources, one of the most urgent challenges in the scientific community. Among many renewable energy sources, solar energy stands out as the most promising candidate since it is the highest exploitable resource, delivering more energy in one hour to the earth surface than the amount of energy that we consume worldwide in an entire year. However, its nature of diurnal variation, intermittence, and unequal distribution requires efficient and cost-effective capture, conversion, and storage. Molecular fuels produced from solar energy input represent an promising approach to meet this goal, due to the high energy density that can be stored within chemical bonds. As such, hydrogen generated from solar-driven water splitting has been widely considered as an attractive option; the sole product of hydrogen combustion is water, rendering a carbon-neutral energy cycle, and the substrate water is by far the most abundant chemical on earth. However, water splitting involves the transfer of multiple electrons and protons ($2H_2O \rightarrow O_2 + 4H^+ + 4e$ and $2H^+ + 2e \rightarrow H_2$), hence catalysts are needed to make it energetically feasible.

The molecular hydrogen-evolving catalysts are more diverse than the corresponding water-oxidation systems, due to the fact that proton reduction involves a relatively simple, two-electron transfer step. For this reason, molecular hydrogen-evolving electrocatalysts can be directly coupled with a light-absorbing chromophore to achieve the photocatalytic process. The electrocatalysts that are currently explored fall into several major categories: (i) bimetallic Ni-Fe and Fe-Fe based catalysts inspired by natural hydrogenases; (ii) monometallic Co, Ni and Mo based catalysts, which generally evolve H_2 *via* Co(III) or Mo(IV) hydride species generated by the reaction of protons with electrogenerated Co(I) or Mo(II) intermediate. Some of
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these electrocatalysts were used to design photocatalytic systems by mixing in or covalently linking the chromophores in the presence of sacrificial electron donors such as amines or ascorbic acid. The chromophores frequently utilized for this work exhibit strong absorption in the visible range and long-lived excited states, and are either transition metal complexes (such as Ru, Ir, and Pt based chromophores), or organic dyes (such as Eosin Y and Rose Bengal).

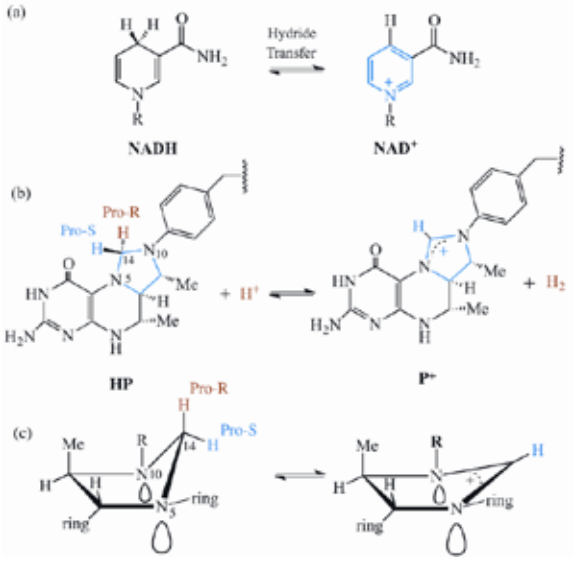
The major drawback of these multicomponent photocatalysts is that they require two consecutive photoinduced electron transfer steps, each of which can undergo unproductive charge recombination or undesired chemical reactions. Thus, photocatalytic systems with fewer components are desirable for efficient photocatalytic H_2 generation. An interesting approach towards single-component catalysts is investigated by the D G Nocera's team, who study bimetallic photocatalysts that split hydrogen-halides ($2HX \rightarrow H_2 + X_2$) in two separate photochemical events.

The complexity of the chromophore-catalyst multicomponent systems could be reduced if the chromophore is made of an organic hydride that photochemically undergoes heterolytic C-H bond scission and reduces protons. ($R\text{-}H + H^+ + h\nu \rightarrow R^+ + H_2$). In such an approach, the excitation event can be directly coupled with the hydrogen-forming step, and the generation of reactive intermediates can be avoided if the photoreduction can be achieved in a concerted fashion. The oxidized R^+ formed in the photochemical event can be chemically or electrochemically reduced back to R-H.

While photohydrides are yet to be discovered, the ground-state organic analogs are abundant in nature. For example, the most common hydride source in biological systems is the reduced form of nicotine-adenine dinucleotide (NADH), which acts to reduce carbonyl groups, carbon-dioxide and other substrates. The hydride release from NADH is driven by the aromatic stabilization of the oxidized product, NAD^+ (Scheme 1a). The mechanistic studies of model systems have demonstrated that, depending on the type of the transition state, the overall hydride ion can be transferred either in a single concerted step or by one of the stepwise processes, such as electron-hydrogen atom or electron-proton-electron transfer steps.

Another important example of a biological organic hydride donor can be found in a hydrogenase called methylenetetrahydromethanopterin dehydrogenase(MD). Unlike well-studied metal-containing [NiFe], [FeFe] and [Fe] hydrogenases the active cofactor of MD is an organic, pterin-derived hydride HP, which performs a hydride transfer reaction to generate molecular hydrogen and the corresponding iminium ion P^+ (Scheme 1b).

It is interesting to note some structural similarities of NADH and HP: both compounds are nitrogen containing cyclic derivatives that, upon hydride transfer, generate stable iminium cations that delocalize the positive charge through the conjugated or aromatic framework. In the case of HP, the hydride transfer is facilitated by an additional mechanism: the lone pairs of nitrogen atoms 5 and 10 are in hyperconjugation with the antibonding σ* orbital of the anti-periplanar C14-H bond, which significantly weakens this bond and facilitates the hydride transfer (Scheme 1c).



Scheme 1. Ground-state natural hydride donors. (a) Hydride release from NADH forming aromatized NAD^+ (b) Reaction catalyzed by MD to form N5,N10 methylenetetrahydromethanopterin cation (P^+) and H2 from N5,N10 methenyltetrahydromethanopterin (HP) and H^+. (c) Hyperconjugation effect which weakens the pro-R C14-H bond leading to the hydride release.

The design of photochemical analogs of NADH and HP requires the extension of their π conjugation, to assure that the excited states can be generated using visible photons. One of the simplest NADH mimics that exhibits extended π conjugation is the acridine derivative Ph-AcrH (Figure 1: the triplet state is shown). The ground-state hydride release from this and related compounds has been documented and extensively studied by Fukuzumi. The absorption maximum of PhAcrH appears at 287 nm, which is not the desired spectral range for solar fuel applications, but this model system enables the initial thermodynamic and kinetic analysis of the photoinduced hydride transfer and potential for the proton reduction ($PhAcrH + H^+ + h\nu \rightarrow PhAcr^+ + H_2$).

An important aspect of acridine framework is that its derivatives exhibit a tendency to convert to the aromatic iminium cation ($Ph\text{-}Acr^+$) upon photoexcitation. For example, the hydroxylated analog (PhAcrOH) and the corresponding methoxy derivative (PhAcrOMe) undergo efficient photochemical release of HO- and MeO- groups in protic solvents. It is interesting to note that the photoin-

duced heterolysis does not occur in aprotic solvation, indicating that the solvent-induced hydroxide/methoxide ion stabilization is required for this reaction.

Photochemistry of the model photohydride, PhAcrH, is similar to that of PhAcrOH.

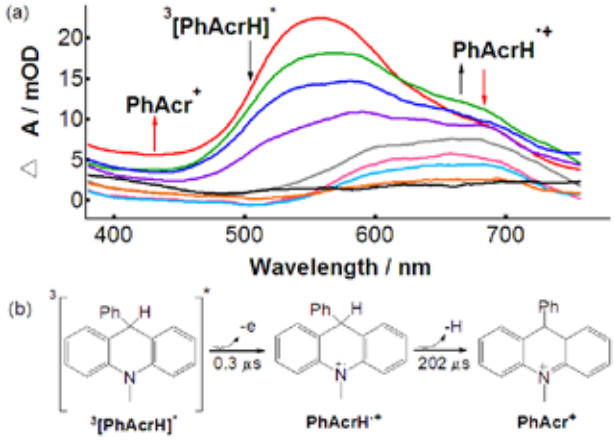


Figure 1. Photochemical hydride release from PhAcrH. (a) Nanosecond transient absorption spectra of PhAcrH in ACN and pH 0.65 H2O mixture (V:V=1:1). (b) Proposed mechanistic scheme for stepwise hydride release.

For example, irradiation of PhAcrH in acidic medium generates the corresponding iminium ion PhAcr$^+$ due to the associated hydride transfer to the solvent mixture. The yield of H_2 is low, (2.5 %). Even though the electron-hydrogen atom transfer mechanism eventually leads to an overall hydride transfer process, the stepwise mechanisms are not energetically desirable. For example, photoinduced electron transfer from PhAcrH to aqueous protons requires ~80 kcal/mol of energy, and such process can be driven only by UV photons, while the direct concerted hydride transfer could be achieved by visible photons if one designs the organic hydride with appropriate absorption characteristics. For this reason, it is desirable to find systems in which the concerted hydride release mechanism predominates over other competing mechanisms.

There are certain approaches that could be taken to achieve this concerted mechanism. One such approach towards improved photohydrides is to increase the thermodynamic driving force for the excited-state hydride transfer process (ΔG^* for the reaction: R-H + H^+ + hυ → R^+ + H_2). Even though thermodynamic arguments alone do not assure that the photochemical reaction will take place, the likelihood of the process is expected to rise with increasingly negative ΔG^* values. This concept along with other scenarios need to be thoroughly evaluated in order to produce effective photohydrides.

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Riboswitches as Therapeutics Targets

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Regulation of gene expression includes a wide range of mechanisms that are used by cells to control the production of specific gene products. It has long been recognized that organisms make extensive use of protein based control systems to regulate gene expression. In eukaryotes, the networks of protein signaling and gene control factors are very complex, where numerous factors typically work together to influence transcription, translation, mRNA processing/degradation and other mechanisms that control the levels of gene products in a cell. However, research over the past several years have found that RNA, which was considered only as a cellular messenger carrying out genetic information also plays a more intimate role in the control of gene expression. A variety of microRNAs (miRNAs) and related short-interfering RNAs (siRNAs) are functioned by a series of protein-mediated processing events that regulates gene expression by forming base paired structures with target mRNA resulting in inactivation of the targeted gene by subsequent nuclease processing or by other non-nucleolytic mechanisms.

One of the most striking recent examples of how RNA regulates gene expression was revealed by the discovery of riboswitches, a common means of genetic regulation at the mRNA level in the bacterial kingdom. Riboswitches are complex folded RNA domains that serve as receptors for specific metabolites. These domains are found in the 5′-untranslated region (UTR) of mRNAs that exert their regulatory control over the transcript in a cis-fashion, by harnessing allosteric structural changes that are brought about by metabolite binding without the obligate involvement of a protein factor. They are mostly located upstream regions of bacterial mRNAs associated with metabolism and transport of their cognate metabolites.

The term 'riboswitch' was first coined by Breaker and co-workers confirming the existence of a 5′-UTR sequence in *E.coli btuB* mRNA which selectively binds to the coenzyme B_{12}. A number of different riboswitches that bind and sense different cellular metabolites like amino acids and their derivatives, carbohydrates, and nucleobases and their derivatives have been discovered. Some of the recently discovered riboswitches include those that bind to c-AMP-GMP, 5-Amino-4-imidazolecarboxamide riboside 5′-monophosphate (ZMP), cations Mn^{2+} and Ni^{2+}/Co^{2+} binding motifs and anions such as fluoride.

Riboswitches typically consists of two parts: an aptamer domain and an expression platform. The aptamer domain which functions as a molecular sensor adopts a compact three-dimensional fold to scaffold the ligand binding pocket. It has high selectivity and specificity to discriminate and bind to chemically similar metabolites. The expression platform is typically located immediately downstream from the aptamer domain, and in many instances the two domains overlap to some extent. The role of the expression platform is to transduce metabolite-binding events into gene-control consequences by allosteric modulation of the structure of the 5′-UTR. Switching sequence located between these two domains plays a pivotal role, whose pairing directs folding of the RNA into one of the two mutually exclusive structures in the expression platform that represent the on and off states of the mRNA.

Many mechanisms are known for the regulation of genes by riboswitches at various levels of transcription and translation. One of the most general mechanisms involves the formation of ligand-dependent intrinsic terminator stem, which is a GC rich stem and typically trailed by a run of six or more U residues. This causes RNA polymerase to abort transcription before the coding portion of the mRNA has been made. When the aptamer domain is un-complexed with ligand, it permits formation of an anti-terminator stem, which precludes formation of the intrinsic terminator stem and thereby permits transcription of the complete mRNA. In the second mechanism, similar structural changes in full-length mRNA control ribosome access to the ribosome binding site or start codon sequences thereby leading to blockage of translation initiation. Furthermore certain ligand associations with riboswitches bring about self-cleavage of mRNA while certain other riboswitches lead to the production of antisense RNA. Additionally there are combined forms of riboswitch dependent gene regulations such as tandem riboswitches.

Emergence of antibiotic resistance is a serious public health issue all over the world. Riboswitches, as metabolite sensing domains of bacterial mRNAs, represent a promising novel solution to multiple drug resistance (MDR), since they can be considered as antimicrobial targets when agonistic ligands are employed to knock down the expression of associated gene or genes. Examples of such riboswitches used as antimicrobial targets include: thymine pyrophosphate (TPP) riboswitch, glycine riboswitch, lysine riboswitch, FMN riboswitch, glmS riboswitch and guanine riboswitch.

TPP, which is a target of one of the most widespread riboswitch classes, is commonly involved as a coenzyme for decarboxylase enzymes. This riboswitch negatively regulates the expression of proteins involved in the biosynthesis and transport of thymine in bacteria. It binds to its ligand with a

dissociation constant of 100 nM and discriminates by a factor of 100 fold against thiamine phosphate (TP) which only differs from TPP by one phosphate. Pyrithiamine which is an isosteric pyrimidine analog of thiamine is phosphorylated to pyrithiamine pyrophosphate and then binds to the TPP riboswitch.

Lysine riboswitches are involved in the control of biosynthesis and transport of lysine. L-aminoethylcysteine (AEC) and DL-4-oxalysine are lysine analogs that inhibit the growth of some Gram-positive bacteria. They bind to the *lysC* riboswitch of *B. subtilis* and repress expression of a lysine riboswitch regulated reporter gene in *B. subtilis*. Roseoflavin, an analog of riboflavin and FMN, is a pigment from *Streptomyces davawensis* with antimicrobial activity. Roseoflavin inhibits the growth of several Gram-positive bacteria, and roseoflavin resistant mutants overproduce riboflavin. In Gram-positive bacteria, all genes involved in riboflavin synthesis are under the control of a single FMN riboswitch. It was found that roseoflavin binds FMN riboswitch *in vitro* and down regulates the expression of a *lacZ* reporter gene under the control of FMN riboswitch. Mutation in all the above mentioned riboswitches cause disruption of antimicrobial activity and inhibit their activity.

glmS riboswitch has the unique capacity of mRNA self-cleavage through binding to GlcN6P. A 5′-OH terminus RNA product of cleavage is recognized by RNase J1 which degrades *glmS* mRNA. The cognate ligand, GlcN6P, is the precursor of peptidoglycan biosynthesis making it an essential metabolite needs for bacterial cell wall synthesis. In addition, most of the *glmS* riboswitches are present in Gram-positive organisms and it has been shown that *glmS* riboswitch-ribozyme cleavage-inhibition leads to inability of sporulation or forming biofilm. According to different analog studies, three functional groups of GlcN6P including the anomeric hydroxyl, the amine and the phosphate are important to interact with *glmS* riboswitch. As a result, some compounds such as glucosamine (GlcN), L-serine, serinol, tris and ethanolamine which contain vicinal amine and hydroxyl groups are weak activators of *glmS* riboswitch.

Targeting the riboswitches provides many advantages over other molecular targets. Compared to the rRNA, which is one of the most common targets of antibiotics, riboswitches bind small molecules more selectively and specifically. This is because riboswitches are RNA receptors. Most of the riboswitches exist mainly in bacteria and not in eukaryotes. Therefore this will reduce the cross reactivity of bacterial riboswitch sensing ligands. Since most of the riboswitches are associated with genes that are important for survival or/and resistance, targeting them will lead to the death of the organism or weakening of the organism.

Riboswitches offer new therapeutic approaches to address human diseases due to their structural sophistication, specificity, and their function as genetic regulators of essential bacterial genes. Structure-guided rational design, high-throughput screening methods, and riboswitch- specific assays have been applied to the discovery of novel riboswitch-targeted drugs. These efforts have produced compounds with *in vivo* antibacterial activity that appear to be functioned by targeting riboswitches. Previously reported antibiotics and newly identified compounds that function through riboswitches emphasize the progress made in the field and provide a foundation for future discovery of new riboswitch-targeting compounds.

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Synthesis and Applications of Cellulose Sulfates

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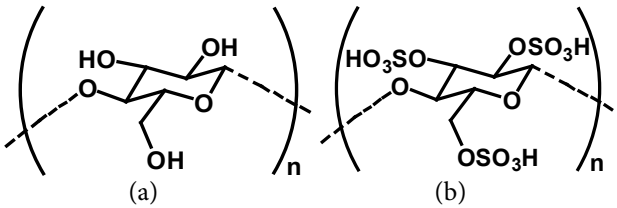
Cellulose is the most naturally abundant renewable polymer with the formula $(C_6H_{10}O_5)_n$, n ranging from 10,000 to 15,000. The monomer of cellulose biopolymer is anhydroglucose unit (AGU) and it has three hydroxyl groups (Figure 1(a)). These –OH groups form network of hydrogen bonds between individual cellulose polymer molecules and convert them into complex structures. Therefore, cellulose becomes less soluble in common organic and inorganic solvents. Cellulose can be used as a green source to develop biodegradable and biocompatible materials with attractive properties by chemical modifications or mixing with other components. Cellulose sulfate is such a modified material which is an inorganic ester of cellulose. Sulfation of cellulose replaces the hydrogen atoms of the primary and secondary hydroxyl groups of cellulose monomer (β-D-glucopyranosyl units) by $–SO_3H$ groups (Figure 1.(b)).



(a) (b)

Figure 1. Structure of (a) Cellulose and (b) Cellulose Sulfate

The level of substitution is generally expressed in terms of degree of substitution (DS) and it can have a value between 0 and 3. Cellulose sulfate polymer molecule is a combination of tri-, di-, mono- and un-substituted monomers. Unlike cellulose, sulfated cellulose derivatives are much more soluble in water and the solubitily depends on the DS, the number of unreacted free hydroxyls and the degree of polymerization of the cellulose backbone.

There are many sulfation agents such as sulfuric acid, sulfur trioxide-pyridine, sulfur trioxide-dimethylformamide and chlorosulfonic acid-pyridine-formamide which can be used for sulfation. Though both SO_3 and chlorosulfionic acid are powerful sulfation agents, the major drawback of these reagents is the moisture sensitivity. Therefore, both reagents strongly react with water. In order to reduce risk during the synthesis, chlorosulfonic acid and SO_3 are used with organic bases such as triethylamine (TEA), pyridine (Py) or aprotic dipolar solvents such as dimethylformamide (DMF). Further, SO_3-DMF and SO_3-Py complexes are commercially available as white solids.

Most of the previous syntheses of cellulose sulfates have been carried out in either heterogeneous or homogeneous systems. Heterogeneous system starts with activated cellulose suspension and a major problem is the unequal approachability between the -OH groups in the amorphous regions and those in the crystalline regions. Bhatt & Gupta prepared cellulose sulfate from α-Cellulose isolated from *Lantana camara* by sulfation in a heterogeneous medium (Figure 2). According to the article an azeotrope of 19.8 – 34.2 N Sulfuric acid and 33 % 1-butanol containing 1.65 % ammonium sulfate (20 - 60 mL) was added slowly to cellulose powder (1 g) and stirred at -10 ^{0}C to 10 ^{0}C for 30 – 120 minutes to form viscous solution. Then that solution was poured in to 3 volumes of acetone to precipitate cellulose sulfuric acid ester. Next it was neutralized with 5% NaOH solution at 0 ^{0}C, precipitated, washed with acetone and dried to collect sodium cellulose sulfate ester. The optimized conditions to obtain cellulose sulfate ester with a DS of 0.392 were identified as 60 min reaction time at 0 ^{0}C aqueous sulfuric acid with the normality of 34.2 N.

$$H_2SO_4 + H_2O \longrightarrow HSO_4^- + H_3O^+ \quad (1)$$

$$(C_6H_7O_2)_x\,(OH)_{3x} \xrightarrow{HSO_4^-} (C_6H_7O_2)_x\,(OH)_{3x-a}\,(OSO_3H)_a$$

Cellulose Cellulose sulfate (2)

$$(C_6H_7O_2)_x\,(OH)_{3x-a}\,(OSO_3H)_a \xrightarrow{NaOH} (C_6H_7O_2)_x\,(OH)_{3x-a}\,(OSO_3^-Na^+)_a \quad (3)$$

Figure 2. Synthesis of sodium cellulose sulfate

In contrast, homogeneous system starts with partially substituted cellulose derivatives in an aqueous solution. In the homogeneous system, although the -OH groups are more accessible for reaction, the DS of product is often low because some -OH groups have already been substituted by other groups. The sulfation of un-substituted cellulose in a homogenous system with prior cellulose dissolution may overcome the drawbacks of both approaches. Currently ionic liquids (IL) are used for dissolution process, and 1-ethyl-3-methyl imidazolium acetate [EmimAc], 1-allyl-3-methylimidazolium chloride ([Amim]Cl and 1-butyl-3-methylimidazolium chloride ($[C_4$mim]Cl are common ILs reported in literature. Wang & Li have reported the homogenous sulfation of bagasse cellulose in an ionic liquid, in this research bagasse cellulose has been dissolved in an ionic liquid, 1-butyl-3-methylimidazolium ($[C_4$mim]Cl and then sulfated by using chlorosulfonic acid – dimethylformamide. The sulfated bagasse cellulose product had DS between 0.52 – 2.95 and possesed significant anticoagulation activity.

Cellulose sulfate derivatives have important chem-

ical and physical properties such as solubility in water, high viscosity, outstanding compatibility with metal ions, enzyme resistance, shear resistance, temperature stability, suspension stability, film formation ability, protein reactivity, solvent tolerance *etc*. These properties will vary on the DS of cellulose sulfate and on the degree of polymerization (DP). Cellulose sulfates are used as a thickener in tertiary oil recovery, water-based paint, printing pastes in textiles, photographic applications and food industry. High viscosity, solubility, suspension stability and tolerance to organic solvents are desirable properties of sulfated cellulose which are useful in cosmetics. The formulations of toothpaste, hair conditioner and shampoo contain cellulose sulfate to control appearance, viscosity, flow characteristics and shelf life. In textile industry, it becomes not only a thickener but also a dye anti-migration agent in back-coatings. Moreover, cellulose sulfates are used in slurry explosives due to high viscosity and gel formation ability by crosslinks.

In addition, there are cellulose sulfate analogues with a range of bioactivities such as antiviral, antibacterial, anti-adhesive and anticoagulation. Heparin is a highly-sulfated glycosaminoglycan which is effectively used as an anticoagulant in medicine. According to a recent study carried out by the Research Institute of Chemical Engineering in China, the anticoagulation activity of sodium bagasse cellulose sulfate has a positive correlation with DS and some of the activity indexes exceed those of heparin.

Moreover, cellulose sulfate is used in biomedical applications for encapsulation of cells. The capsules have been prepared by precipitation technique using physiological sodium chloride solution (0.9 w/w). The cellulose sulfate was dissolved in NaCl solution and dropped into a cationic poly(diallyl dimethyl ammonium chloride) solution to form capsules. These encapsulated cells have been proposed to use in the Gene therapy to treat cancer. The therapy uses "suicide genes" encoding enzymes in donor cells which convert inactive pro-drugs into tumor-toxic metabolites.

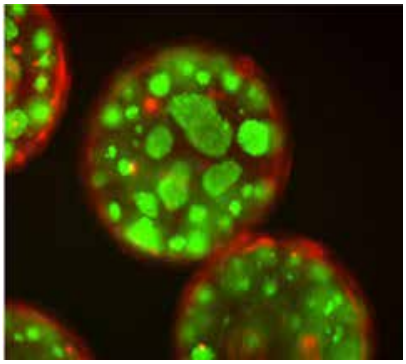


Figure 3. Fluorescence microscopic image of cells in sodium cellulose sulfate and poly(diallyl dimethyl ammonium chloride) microcapsules

According to the literature there is a wide range of applications of cellulose sulfates in different fields. If cellulose sulfate can be synthesised from agricultural and industrial wastes such as banana plant stems, pineapple leaves and cotton wastes in Sri Lanka, it can support our economy in future.

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47th Annual Sessions of the Institute of Chemistry Ceylon 2018

Theme:

Chemists' contribution towards National Policy Development

Date: June, 2018

CALL FOR ABSTRACTS AND EXTENDED ABSTRACTS

Last Date for receiving abstracts and extended abstracts is **15th February 2018**

AWARDS 2018

The following awards will be presented at the Annual Sessions 2018 of the Institute of Chemistry Ceylon.

- **Dr. C L de Silva Gold Medal Award**
  Awarded for an outstanding research contribution in any branch of Chemical Sciences and/ or the use of such research for National Development during the last five (5) years in Sri Lanka. Credit will be given for the utilization of local raw materials, and where the contribution has already resulted in (i) a publication in a Citation Indexed Journal or (ii) Registering a Patent or (iii) where the contribution has already resulted in a positive impact in the development and innovation in the industry.

- **INSTITUTE OF CHEMISTRY SILVER MEDALS**
  Devanathan Memorial Award
  Awarded for an exceptional research contribution of an original nature in the field of Physical Chemistry and or related areas, such as Physical-Inorganic, Physical-Organic and Biophysical Chemistry.

  Chandrasena Memorial Award
  Awarded for an exceptional research contribution of an original nature in the field of Organic Chemistry and/or related areas such as Biochemistry, Pharmacognosy, Molecular Biology and Bioactivity studies.

  Ramakrishna Memorial Award
  Awarded for an exceptional research contribution of an original nature in the field of Inorganic and/or Analytical Chemistry and/or related areas such as Bio-inorganic Chemistry or Bio- analytical Chemistry.

- **INSTITUTE OF CHEMISTRY BRONZE MEDALS**
  Kandiah Memorial Awards
  Awarded for the best research contribution in Chemistry carried out by a postgraduate student registered for a post-graduate degree by either course work or/ and research at a Higher Educational Institute in Sri Lanka and for work carried out in Sri Lanka, with the exception of special analysis that cannot be done in the country. Such results should be less than 20% of the findings from the work. Sandwich programs carried out partially abroad do not qualify for the award.

  Kandiah Award for Basic Chemistry
  For research predominately in basic Chemistry (Organic, Inorganic, Physical, and Analytical).

  Kandiah Award for Applied Chemistry
  For research in Chemistry related areas such as polymer, food, biochemistry, biotechnology, where interdisciplinary research is involved and provided that chemistry has a central role and comprises at least 50% of thecontent.

  Kandiah Memorial Graduateship Award
  For the best piece of research in the Chemical Sciences carried out by a Graduate Chemist of the College of Chemical Sciences/Institute Chemistry Ceylon registered with a Higher Education Institute for a Post Graduate Degree.

- **Professor M. U. S. Sultanbawa Award for Research in Chemistry**
  Awarded for the best research paper presented at the Annual Sessions of the Institute of Chemistry Ceylon, for work carried out and completed in Sri Lanka.

Closing date for receiving applications/nominations for the above awards: **28th February 2018**

Further information could be obtained from the Registrar, Institute of Chemistry Ceylon or www.ichemc.edu.lk

Call for Nominations for Institute of Chemistry Gold Medal 2018 by 31st March *(Under Revised Rules)*

This Gold Medal was the very first of such awards to be donated to the Institute and was made possible through a generous donation made by **Mascons Ltd** in memory of their founder, **Mr A Subramanium** in 1978/79. It recognised contributions made to National Development through research and development involving Chemical Sciences. The Gold Medal Fund was supplemented recently through a further contribution from Mascons Ltd. This criteria governing the award were changed in 2011 since there were no applicants since 2007 in order to enable the award to be made to a mid-career Chemist in recognition of honorary services to the Institute.

Nominations are now being invited for the 2018 Award from amongst **Corporate Members** of the Institute who have fulfilled the following minimum criteria;

Nominees should be not more than 55 years of age and should have been Corporate members of the Institute for at least 10 years on 1st of June 2018

Nominees should have made significant contributions towards the activities of the Institute through yeoman services in an honorary capacity during the period of membership. These activities could include holding office, membership in committees, coordination of events such as workshops, social events *etc*.

Nominations could be made by any **Corporate Member** of the Institute and should include the consent of the nominee and details of the contributions made by the nominee in accordance with the above guidelines. The Award will be presented at the 47th Annual Sessions.

(**Nominations should be forwarded to reach the Hony. Secretary, Institute of Chemistry Ceylon not later than 31st March 2018**.)

Seminar on Untapped potential of Sugar Industry on National Development

The above seminar was organized by the Institute of Chemistry Ceylon on 11th September 2017 at the P. P. G. L. Siriwardena Auditorium, Adamantane House, Rajagiriya. The seminar was sponsored by the Islandwide Marketing Services. The focus of this seminar was to discuss the current status of the Sugar Industry in Sri Lanka and to provide awareness of the potential it holds in national development. The manufactures of sugar products and their effects on health was also addressed. Resource persons included, Professor R. N. Pathirana, Dr. A. P. Keerthipala, Dr. M. W. N. Dhamawardena, Prof. Kapila Gunasekera, Mr. Luxman Siriwardena, Ms. Wathsala Mudalige and Mr. N. M. S. Hettigedara. Participants from industries, institutes, universities and IChemC staff, and CCS academics participated in this event. The event was coordinated by Dr. Lakshmi Arambewela, Mr. E. G. Somapala, Mr. J M Ranasinghe Banda, Mr. A. M. Jayasekara and Mr. C.W. Jayasekera.

Seminar on Frontiers in Agrochemicals

The above seminar organized by the Institute of Chemistry Ceylon, will be held on 12th February 2018 at the P P G L Siriwardena Auditorium, Adamantane House, Rajagiriya. The seminar will cover following areas.

Agrochemicals in 21st Centuary	- Dr. Sameera Gunatilake
Glyphosate herbicide	- Prof. Ayanthi Navaratne
Fertilisers: Use and their Impacts on the Environment	- Dr. Saman Hettiarachchi
Impact of Agrochemicals on Human Health and Remedial Measures	- Dr. A.C.M. Fahim
Pesticide Management in the Country	- Mr. Lasantha Ratnaweera
Organic Fertilizers	- Ms. Renuka Silva
Biopesticides for Sustainable Agriculture; Prospects and Constraints	- Prof. Priyani Paranagama
Role of Nano fertilizer and Nanopesticides in Agriculture	- Dr. Surani Chathurika
Analytical Techniques for Pesticide Residue Analyses	- Mr. M.N.A.Mubarak

Corrections to the Presidential Address of the 45th Annual Sessions

Mr. J M Ranasinghe Banda has served as a DLTC coordinator from 2005 to 2010. His name has been inadvertently not included as one of the coordinators in the Presidential Address of the 45th Annual Sessions.

GRADUATESHIP EXAMINATIONS IN CHEMISTRY, 2017

LEVEL 1 - OVERALL AWARD LIST

First Prize and Nandawathie Jayaweera Memorial (Open) Scholarship – Ms. N D Lokuge
Second Prize and Charles Jayaweera Memorial (Open) Scholarship – Ms. S M V S K Samarakoon
Third Prize and Professor R.S. Ramakrishna Memorial Scholarship – Ms. H N Disanayaka
Fourth Prize and Dr. Dilanjan and Mrs. Gowrie Soysa Scholarship – Ms. G G V V Gamage

Merit Bursaries *(in order of merit)*
Not Awarded

Second Charles Jayaweera Memorial (Southern Province) Scholarship – Ms. N D Lokuge
Second Nandawathie Jayaweera Memorial (Southern Province) Scholarship – Mr. P H L Sandaruwan

Subject Prizes for Best Performances
Dr. Infas and Family Prize for Basic Concepts – Mr. B G C Chathuprabha
Graduate Chemist Alumni Prize for General & Inorganic Chemistry – Ms. J A D I Ranasinghe
Emerine Fernando Memorial Prize for Principles of Physical Chemistry – Ms. L P L Jayasinghe
Bennett Prize for Mathematics for Biological Science Students – Ms. M A S I Kularathne
Somawathi Mathew Memorial Prize for Biology for Physical Science Students – Ms. Y H Ranasinghe
Professor & Mrs. S Sotheeswaran Prize for Principles of Organic Chemistry – Ms. N D Lokuge
Mr. & Mrs. J M Ranasinghe Banda Prize for Application of Mathematics – Ms. N D Lokuge
Abdul Salam Memorial Prize for Fundamentals of Physics for Chemists – Ms. N D Lokuge
Dr. M N Kaumal Prize for Analog and Digital Electronics for Chemists – Mr. B G C Chathuprabha

LEVEL 2 - OVERALL AWARD LIST

First Prize & W F Peiris Memorial Trust Scholarship - Ms. C J Lekamwasam
Second Prize & Professor W Pearlyn D Pereira Commemoration Trust Scholarship - Mr. P L Y V Alwis
Third Prize & Professor G C N Jayasuriya Memorial Scholarship - Ms. U P Welikala
Forth Prize & Family Leelarathna Scholarship - Ms. A N Wethalawe

Merit Bursaries (in order of merit)
Ms. F J Saneer, Ms. P G H Pupulewatte, Ms. H K Medagedara, Ms. G A C D Perera

Subject Prizes for Best Performances
Professor J.N. Oleap Fernando Prize for Physical Chemistry – Ms. C J Lekamwasam
Professor Samitha P. Deraniyagala Prize for Inorganic Chemistry – Mr. P L Y V Alwis
Professor Siromi Samarasinghe Prize for Organic Chemistry I – Ms. C J Lekamwasam
Mrs. Deepika Senaviratne and Family Prize for Titrimetric and Gravimetric Methods of Analysis – Mr. P L Y V Alwis
Professor Jayantha Welihinda Prize for Biochemistry – Ms. F J Saneer
Nureshan Dias Prize for Principles of Quantum Chemistry and Molecular Spectroscopy – Ms. H K Medagedara & Ms. J K S Jayawardena
Mrs. Yasawathie Satharasinghe Memorial Prize for Organic Chemistry II – Ms. C J Lekamwasam
Mikhail Tswett Prize for Separation Method and Applications of Spectroscopic Methods in Analysis – Mr. M S V Costa
Henry Ashmore Pieris Memorial Prize for Introduction to Management, Economics and Finance – Ms. C J Lekamwasam

Diploma in Laboratory Technology in Chemistry (DLTC), 43rd Batch (2015/17)

CLINICAL LABORATORY TECHNOLOGY (CLT)

Honours (10)

Mr. K I S Piries, Ms. D K S M Perera, Mr. W M S K Abeyrathne, Ms. K Krishani, Ms. M N F Nisrin, Ms. A G F Saajitha, Ms. W A S B Wanigasuriya, Ms. G B Jaliel, Ms. T W A E N Kumari, Mr. W C Wimalasiri

Merit (56)

Ms. M N F Nifla, Ms. T H H Amal Maryam, Mr. S A S P Silva, Ms. T D G N L Weerasekara, Ms. V Subramaniam, Ms. K Vishalenee, Ms. D M M N R Andradi, Mr. E B Amarasinghe, Ms. M S F Zaneera, Ms. A L U Rodrigo, Mr. W S D Fernando, Ms. W H M Fernando, Ms. S Sugarniya, Ms. S I Banu, Ms. M N Madushani, Mr. M B M Raseem, Ms. K R F Azama, Ms. J A D M K Jagodaarachchi, Mr. L P C P Perera, Ms. M M F Sajidha, Mr. D K D R Chaminda, Ms. M A Y Savindi, Ms. T Rekha, Ms. G A P Belinda, Ms. K Kirushanthy, Ms. S Sivarathani, Mr. B K C P Rodrigo, Mr. R A T A Ranasinghe, Ms. W C M A Fernando, Mrs. M A E N Muthugala, Ms. T A N Sanjeewani, Ms. W G H C Darshani, Mr. H S T Soysa, Ms. B G A Priyadarshani, Mr. K G C Leelarathna, Ms. J M S Jayasinghe, Mr. S A D Chandrasiri, Mr. M A A M Behshad, Mr. M I M Ishak, Mrs. N M S I Hettigedara, Mr. U Liyanage, Mr. W A D M Gunasekara, Ms. W S Sewwandi, Mrs. B B M Rajitha, Ms. M S F Shakila, Ms. L U A U C Jayasekara, Mr. M A M Haafil, Mrs. G E N Chathurika, Mr. R M A Sandaruwan, Ms. S Ratnasingam, Ms. H V P Nisansala, Mr. S M Nawsadh, Mr. E R K De Silva, Ms. D L Danthanarayana, Ms. H D D Hansamali, Ms. R K Y Shanika

Ordinary (49)

Mr. J A P A Jayasingha, Mr. G K C S Rathnasiri, Ms. M R F Rizna, Ms. K R L Eshwaree, Mrs. W K I R Subhashani, Mr. R M D P Rathnayake, Ms. M A Asra, Mr. W C S Alwis, Mr. M G M H S K Jayakodi, Mr. M U N Ahamed, Ms. K G H Sithara, Mr. S Kapilan, Ms. T Kunthavai, Mrs. H M F Nuskiya, Mr. A T Dilshan, Mr. G A A S P Ganepola, Ms. H K Liyanage, Mr. S P Jananga, Ms. K B N D K Kariyawasam, Ms. N M D D Karunarathne, Mr. K G R Siriwardena, Ms. I W M D C I Alahakoon, Ms. S Thanuja, Mr. H M A N B Herath, Mr. T Dishan, Mr. Y B A G M Amhar, Ms. A K S Amarawansha, Ms. S H G Nayanamali, Mr. M A Sabreen, Ms. A F Ashfa, Ms. M J Asfa, Ms. J A D S Nisansala, Ms. D D U Wijayathunga, Ms. P I Helanka, Ms. S A M Sanjeewani, Mr. N S Kumara, Mrs. W V P Sujani, Ms. S K Kasthuriarachchi, Ms. D A S D Weerasinghe, Ms. D P Mihisarani, Mr. G K E K Sumathipala, Ms. T M I A Rathnemali, Mr. D M I N Dunukara, Mr. I K S Wanniarachchi, Mr. K D Prasad, Mr. A P H Assella, Mr. N S Liyanapathiranage, Sr. M Stanislaus, Ms. W S C K Wickramasinghe

INDUSTRIAL & FOOD CHEMISTRY (IFC)

Honours (02)

Ms. A R M S Ramanayaka, Ms. M A N A Silva

Merit (04)

Ms. S Dilani, Ms. M A G Anjali, Mr. M S Irshad, Ms. U D M Wijesinghe

Ordinary (04)

Ms. W S S Widanapathirana, Mr. M K Y U Karunarathne, Mr. W L Yalagala, Ms. M B Eeswara

AWARDS LIST

First in Batch Dr. G C N Jayasuriya Award - Mr. K I S Piries

Second in Batch Dr. Shentheshanmuganathan Appreciation Award - Ms. D K S M Perera

Third in Batch MicroChem Laboratories (Pvt) Ltd. Award - Mr. W M S K Abeyrathne

P D Lukmal De Zoysa Memorial Prize for the Best Performance in Clinical Lab Technology - Mr. K I S Piries

Rohan K Fernando Prize for the Best Performance in Industrial and Food Chemistry - Ms. A R M S Ramanayaka

Diploma in Laboratory Technology in Chemistry Award for Overall Outstanding Performance

First Place : Ms. D K S M Perera Second Place : Mr. W M S K Abeyrathne, Mr. K I S Piries

Graduate Chemists Welfare Fund

This fund has been established with effect from 1-1-2012. The principal benefits towards CCS Graduate Chemists would be,

I. To provide partial assistance towards international travel of those proceeding abroad for PG degrees (once a life time). Assistance for
Active Graduate Chemists : Rs. 60,000 Passive Graduate Chemists: Rs. 30,000

ii. To provide partial assistance towards registration fees in respect of IChemC /CCS events such as international Conferences.

iii. To provide assistance towards registration fees for IChemC /CCS training seminars etc.

iv. To provide partial assistance towards activities of the Alumni Association.

Note : Depending on the demand, Graduate Chemists who maintain positive contact and participate in IChemC/ Alumni activities will get preference for the above mentioned assistance scheme.

Benevolent Fund Benefits for Members

i. Long life benefits:
Amount provided will be as follows:
a. Over 70 yrs : Rs. 12,000 b. Over 75 yrs : Rs.18,000 c. Over 80 yrs : Rs. 25,000.

ii. Critical illness benefits: up to Rs. 60,000

iii. International travel for conferences (with presentation of a paper):
a. Passive members : Rs. 30,000 (international travel only)
b. Active members : Rs. 60,000 (international travel and/or accommodation).

Any member who has paid membership fees for life (after 3 years of such payment) is entitled for these benefits. All members are advised to pay the membership fee for life and become beneficiaries.

Australian National Chemistry Quiz (ANCQ)

The results of the Australian National Chemistry Quiz was released and label pins were awarded to 53 students who have performed well in the examination. Two students, **Ms. Pamodia Wijenayake** from Sangamitta Balika Vidyalaya, Galle and **Mr. Azhar Mansoor** from Zahira College, Matale answered all 30 questions correctly and will be awarded scholarships to follow the Graduateship programme in Chemistry at CCS.

The award ceremony will be held on **4th April 2018** at Adamantane House and the occasion will be graced by **Dr. Janaka Dias** as the Chief Guest, who was one of the Australian Chemistry Quiz scholarship winners.

Thirteen coordinating teachers of exam centers, who have served as Assistant Supervisor for more than five years will also be awarded certificates as a symbol of gratitude for the service rendered.

Fourteenth CCS Convocation

The fourteenth convocation of the College of Chemical Sciences will be held on **Monday, 26th February 2018** at the Bandaranaike Memorial International Conference Hall (BMICH), Colombo. **Professor Ananda Jayawardena**, Former Vice Chancellor, University of Moratuwa, Senior Professor of Civil Engineering will grace the occasion as the Chief Guest. The Guest of Honour of the occasion will be **Dr. Sarath Paranavitane**, Chairman, Lanka Hospitals. The 35th batch of the Graduate Chemists and 43rd batch of DLTC Diplomates will receive their awards and certificates at the convocation.

PUBLICATIONS OF THE INSTITUTE OF CHEMISTRY CEYLON

Monograph	Title	Author	Price
01	Textile Fibers	Mr T Rajasekeram	Rs. 50/-
02	Principles of Food Preservation	Prof U Samarajeewa	Rs. 75/-
03	Biotechnology	Prof C P D W Mathew	Rs. 75/-
04	Recombinant DNA Technology	Prof J Welihinda	Rs. 75/-
05	*Natural Toxins in Foodstuffs	Prof E R Jansz & Ms A S Perera	Rs. 50/-
06	Fat Soluble Vitamins	Prof E R Jansz & Ms S Malavidana	Rs. 50/-
07	Nucleic Acid and Protein Synthesis	Prof J Welihinda	Rs. 75/-
08	Extraction of Energy from Food	Prof J Welihinda	Rs. 50/-
09	Corrosion of Materials	Dr A M M Amirudeen	Rs. 75/-
10	Vitamin C-Have all its mysteries been Unravelled ?	Prof E R Jansz & Ms S T C Mahavithanage	Rs. 75/-
11	*Environmental Organic Chemistry	Prof S Sotheeswaran	Rs. 150/-(US $3)
12	Enzyme Kinetics and Catalysis	Prof (Mrs) S A Deraniyagala	Rs.1 00/-
13	Insecticides	Prof (Mrs) Sukumal Wimalasena	Rs. 95/-
14	Organotransition Metal Catalysts	Prof S P Deraniyagala & Prof M D P De Costa	Rs. 110/-
15	Some Important Aspects of Polymer Characterization	Prof L Karunanayake	Rs. 75/-
16	*Hard & Soft Acids & Bases	Prof (Mrs) Janitha A Liyanage	Rs.100/-
17	Chemistry of Metallocenes	Prof Sarath D Perera	Rs. 65/-
18	Lasers	Prof P P M Jayaweera	Rs. 65/-
19	*Life and Metals	Prof (Mrs) Janitha A Liyanage	Rs.110/-
21	*Silicones	Prof Sudantha Liyanage	Rs. 65/-
22	*Pericyclic Reactions: Theory and Applications	Dr M D P De Costa	Rs. 100/-
23	Inorganic NMR Spectroscopy	Prof K S D Perera	Rs. 65/-
24	Industrial Polymers	Prof L Karunanayake	Rs. 75/-
25	*NMR Spectroscopy	Dr (Mrs) D T U Abeytunga	Rs. 65/-
26	Mosquito Coils and Consumer	Ms D K Galpoththage	Rs. 100/-
27	*Atomic Absorption Spectrometry	Prof K A S Pathiratne	Rs. 100/-
28	Iron Management on Biological Systems	Prof (Ms) R D Wijesekera	Rs. 100/-
29	Nutritional Antioxidants	Prof. (Mrs) Sukumal Wimalasena	Rs. 100/-
30	*f-Block Elements	Prof Sudantha Liyanage	Rs. 65/-
31	*Scientific Measurements and Calculations	Prof (Mrs) S A Deraniyagala	Rs. 120/-
32	Applications of Organometallic compounds in Organic Synthesis	Dr. (Mrs.) Chayanika Padumadasa	Rs. 60/-
33	Organosulfur Compounds in Nature	Prof. S Sotheeswaran	Rs. 200/-
34	Chemistry in the Kitchen	Prof. S Sotheeswaran	Rs. 200/-

** - Second Edition /new print published on popular demand*

CCS PUBLICATIONS

01	Functional Group Analysis in Organic Chemistry	Prof A A L Gunatilake & Prof S Sotheeswaran	Rs. 175/-
02	Zinc Metalloproteins	Prof (Ms) R D Wijesekera	Rs. 175/-
03	Conformational Analysis and Reactivity of Organic Molecules	Prof S Sotheeswaran & Dr. (Ms) H I C de Silva	Rs. 175/-
04	Marine Organic Chemistry	Prof S Sotheeswaran	Rs. 175/-
05	Molecular Rearrangements in Organic Synthesis	Dr. (Mrs.) Chayanika Padumadasa	Rs. 175/-
06	Principles of Classical Titrimetry - Volume I Acid-Base Titrimetry	Prof. H D Gunawardhana	Rs. 175/-
07	Principles of Classical Titrimetry - Volume II Complexometric Titrimetry	Prof. H D Gunawardhana	Rs. 175/-

GENERAL PUBLICATIONS

- ★ Historical Accounts of the Educational Activities (1972 - 2004) (Rs.350/-)
- ★ Polymer Industries of Sri Lanka (Rs. 200/-)
- ★ Industry & Environment (Rs. 200/-)
- ★ Herbal Medicine Phytopharmaceuticals and Other Natural Products: Trends and Advances (Rs. 500/-)
- ★ Chemistry in Sri Lanka (Rs. 150/-)

RSC NEWS

THE ROYAL SOCIETY OF CHEMISTRY SRI LANKA SECTION

1. Membership

According to the records sent to us from the parent body, a breakdown of the membership is as follows:-

Category	Number
CChem, FRSC	09
FRSC	03
Chem, MRSC	07
MRSC	27
AMRSC	18
Affiliate /Under Graduate.	10
Total Membership as at July 2017	74

2. Committee of Management

The following were elected to the Committee at the 56th Annual General Meeting held in July 2017.

Hony. Chairman - Mr. I M S Herath
Hony. Secretary - Dr W G Piyal Ariyananda
Hony. Treasurer - Dr. P Iyngaran

Committee Members
Mr. R M G B Rajanayake
Prof. Sudantha Liyanage
Dr. Poshitha Premarathne
Dr. M Sirimuthu
Mr S Perasiriyan
Mr. Sulith Liyanage
Mr. Wasantha Samarakoon
Mr. Viraj Jayalath
Mr. R Abeywickrama
Ms. Subodika Hemathilake

Co opted Members
Dr. M.K. Deeyamulla
Prof. W S Fernando
Mr. T M Kumara

3. Activities

3.1 Contributions to Activities of the Institute of Chemistry Ceylon
(a) Full page advertisement of "Chemistry in Sri Lanka".
(b) Contribution for the Interschool Chemistry Quiz
(c) Award for the Best Performance at the Graduateship Examination in Chemistry Levels 3/4 Theory Examination

3.2 All - Island Inter School Chemistry Essay Competition.
3.3 Inter University Chemistry Essay Competition
3.4 Book donation programme
3.5 A/L Teacher training workshop
3.6 Advanced Level Chemistry Seminar
3.7 Industrial Visit for B.Sc. Special degree students, M.Sc. students and RSC Members
3.8 Collaboration with SLAAS E-2 workshop and seminars
3.9 Supporting Chemical Societies of Universities in Sri Lanka

Dr Piyal Ariyananda
Hony Secretary

Inauguration of the New DLTC Programme

The inauguration of the 45th batch of the DLTC programme was held on the 12th of January 2018, at the Adamantane House. **Dr. (Mrs.) Samanthi de Silva**, Director Operations of Asiri Surgical PLC and Asiri Hospital Holdings was the chief guest of the occasion.

Hony. Rector

Chief Guest, Dr. (Mrs.) Samanthi de Silva delivering her address

DLTC Coordinator