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Polymer News

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Carboxymethyl Starch Based Excepients for Drug Delivery Applications

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Starch is a natural, cheap, renewable, and biodegradable polymer produced by many plants as a source of stored energy. It is the second most abundant biomass material in nature. It is found in plant leaves, stems, roots, bulbs, nuts, stalks, crop seeds, and staple crops such as rice, corn, wheat, cassava, and potato. Worldwide, the main sources of starch are maize (82%), wheat (8%), potatoes (5%), and cassava (5%). It has found wide use in the food, textiles, cosmetics, plastics, adhesives, paper, and pharmaceutical industries. In the food industry, starch has a wide range of applications ranging from being a thickener, gelling agent, to being a stabilizer for making snacks, meat products, fruit juices. It is either used as extracted from the plant and is called "native starch", or it undergoes one or more modifications to reach specific properties and is called "modified starch". Chemically, starch is polysaccharide consisting of anhydro-glucose units linked through α-D(1-4) glucocidic bonds. A schematic diagram of anhydroglucose units is shown in Fig.1.

Starch is composed of two major polysaccharides called amylose and amylopectin. Amylose is a linear polymer in which the anhydroglucose units are linked by α1-4 glucosidic bonds. The amylose chain is tending to assume a helical rearrangement. The characteristic deep blue color when iodine-iodine solution is added and it is believed to be due to complex between iodine and helical amylose. It may contain from 200 to 2000 anhydroglucose units. Amylopectin is a branched polymer of glucose. In addition to α-1,4 glycosidic linkage as in amylase branching takes place between C6 of 1

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Notice at a glance

- One day seminar for young researchers in October 2014.
- MACRO 2015,January 23-26, 2015 at Calcutta
- Silver jubilee celebrations of SPSI -January 2015 during MACRO 2015
- New Executive Committee formed.

In this issue:

From the President's Desk...

Dear Colleagues

I am happy to present to you the latest issue of Polymer News by SPSI, Thiruvananthapuram Chapter. The society has been serving the scientific fraternity, particularly the polymer community in the region for the past several years. We have been successful in organizing seminars, workshops, science awareness talks and motivational classes to the researchers and students. These were possible by the efforts of a dedicated and hard working team in the Society with the support of its active members. I am confident to state that, today, SPSI, Thiruvananthapuram Chapter is the most vibrant chapters of SPSI, India.

I am happy to take over as the new president of SPSI, Thiruvananthapuram, along with my new office bearers and executive committee. We are on the vantage side that, we are left with a good platform by our peers. We assure you that we will strive to take the society to further heights. We believe that we should have new programmes to create public awareness on the judicious use of polymers in the daily life and also focus more on nurturing young talents in research. For this purpose we are planning to have a one day seminar, exclusively for young Ph. D scholars, the details of which will be available on our website shortly. I request all of you to participate and support the programme. Also I would invite suggestions from the members for further improvement of our activities.

With all the Best Wishes,

Jai Hind

Ajayaghosh

Carboxymethyl Starch Based Excepients .....(contd. from Page 1)

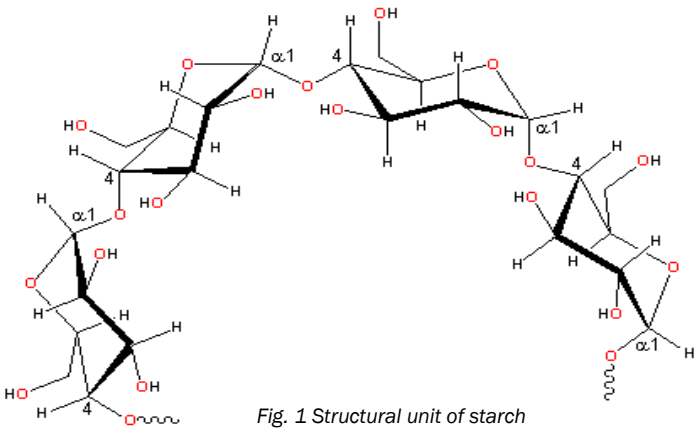

Fig. 1 Structural unit of starch

glucose unit and C1 of another. This 1,6 glycosidic linkage occur at interval of 20-30 anhydroglucose units. Because of its ability to form complex with iodine, starch has been used in treating iodine poisoning. Acute diarrhoea has also been effectively prevented or treated with starch based solutions due to the excellent ability of starch to take up water. In Pharmacy, starch appears indispensable; it is used as excipient in several medicines. Its traditional role as a disintegrant or diluent is giving way to the more modern role as drug carrier; the therapeutic effect of the starch-adsorbed or starch-encapsulated or starch-conjugated drug largely depends on the type of starch. Native starch may exhibit some drawbacks that restrict its use such as sensitivity to shearing and low pH, thermal resistance, high tendency towards retro gradation, brittleness and lack of specific functional groups that may interact with different groups or substances [3]. Therefore the chemical modification offers an interesting alternative to develop new materials, providing biodegradation properties. Chemical modification of starch involves reaction of the hydroxyl groups on the anhydroglucose units (AGU) and these have been used to produce starch derivatives based on carboxymethylation [4], oxidation [5], grafting [6], hydroxypropylation [7] and crosslinking [8,9]. It has been shown that, chemically modified starches have more reactive sites to carry biologically active compounds, they become more effective biocompatible carriers and can easily be metabolized in the human body [10]. Among these starch derivatives, carboxymethyl starch (CMS) has attracted a lot of attention in both research and industry [11]. The presence of functional group (CH_2COO^-) yields starch with many unique properties, such as low gelatinization temperature, excellent flexibility, improved paste storage stability and clarity [12].

Carboxymethyl starch is synthesized by reacting starch with monochloroacetic acid or its sodium salt after activation of the polymer with aqueous NaOH in a slurry of an aqueous organic solvent, mostly an alcohol. CMS is an example of esterified starch. The hydroxyl groups of starch molecules were etherified by carboxymethyl groups. In carboxymethylation, starch was reacted with sodium monochloroactate in the presence of sodium hydroxide. The efficiency of the reaction was determined by degree of substitution. The carboxymethylation of starch progressively increases water solubility. As the degree of substitution increases, the modified starch is more soluble in the cold water yielding a clear solution. Carboxymethyl starch acts as an anionic polyelectrolytic in an aqueous slurry or paste. The rate of swelling to reach peak viscosity and cooked out

"A new dimension for the use of polymeric materials as drug delivery devices involves incorporation of biodegradability into the system."

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All-in-one Super Strong Crack Resistant Self- healing Recyclable Polymer through Computational Chemistry!

If you are looking for a single polymer meeting challenging and conflicting industrial as well as environmental requirements, scientists at IBM research have the solution. With the help of computational chemistry, they synthesized a polymer which is crack resistant, having strength higher than that of bone, solvent resistant, reform to their original shape (self-heal), at the same time recyclable back to the starting material. IBM scientists used computational chemistry approach to speed up the material discovery process where new polymer forming reactions were modeled using high performance computers.

A simple one-pot, low- temperature polycondensation between paraformaldehyde and 4,4'-oxydianiline (ODA) resulted in this wonderful material which is a strong thermoset polymers having Young;'s modulus up to ~14.0 GPa, excellent solvent and environmental stress cracking resistances. These polyhexahydrotriazines (PHT) can remain intact when it is exposed high pH, but decomposes when exposed to very low pH of ~2 to recover the bisaniline monomers. That is, these polymers are recyclable .

"A simple one-pot, low- temperature polycondensation between paraformaldehyde and 4,4'-oxydianiline (ODA) resulted in this wonderful material."

The condensation of paraformaldehyde with bisanilines when more oxygenated, produces self-healing elastic organic gels as well which are stronger than conventional polymers and at the same time maintaining their flexibility because of the entrapped solvents, which enable them to stretch like rubbers. The self-healing ability of these organogels is due to the hydrogen bonding interactions in the hemiaminal polymer network. On the other hand, PHTs, become super strong due to a rearrangement of covalent bonds (cyclization) and loss of the solvent that is trapped in the polymer when subjected to high temperatures. When reinforced with carbon nanotubes and heated to elevated temperatures, their strength further increased making them ideal candidate for industrial and aerospace applications.

Read more at: http://phys.org/

Courtesy: Dr. R. S. Rajeev

Carboxymethyl Starch Based Excepients .....(contd. from Page 2)

viscosity of modified starch is higher than the native starch. CMS paste is more cohesive and tendency to gel. The retrogradation is greatly diminished.

Drug Delivery Applications

In the advancement of drug delivery technology, polymers have played an integral role by providing controlled release of therapeutic agents in constant doses over long periods, cyclic dosage and tunable release of both hydrophilic and hydrophobic drugs. The International Pharmaceutical Excepient Council (IPEC) defines excepients as substances, other than the active pharmaceutical ingredient (API) in finished dosage form, which have been appropriately evaluated for safety and are included in a drug delivery system to either aid the processing or to aid manufacture, protect, support, enhance stability, bioavailability or patient acceptability, assist in product identification, or enhance other attributes of the overall safety and effectiveness of the drug delivery system .The application of polymeric materials for medical purposes is growing vastly as modern advances in drug delivery are now predicted upon the rational design of polymers tailored to exert distinct biological functions. A new dimension for the use of polymeric materials as drug delivery devices involves incorporation of biodegradability into the system. Carboxymethyl mungbean starch (SCMMSs) exhibited the ability to form a clear, thin film with greater flexibilty and strength than that of native starch which makes it potential for use as tablet film coating agent [13].

In vitro and in vivo evaluation of high-amylose carboxymethyl starch matrices for oral and sustained release of acetaminophen was conducted [14]. Masicotte et al, reported the structural insights of pancreatic enzymes with carboxylated high amylose starch as a pharmaceutical excepient. Polymeric material based on Carboxymethyl starch and the controlled release of Aspirin was conducted where the matrix released the enclosed drug at a much faster rate in neutral and alkaline pH than in acidic pH, thus holding the promise of the targeted delivery of the drug to the gastrointestinal tract [15]. Chitosan- Carboxymethyl starch nanoparticles were developed by complex coacervation process for the controlled release of 5-aminosalicylic acid.

Adding bulky functional groups like carboxymethyl group reduces the tendency of starch to recrystallize and makes it less prone to damage by heat and bacteria. Carboxymethylation results in the modification of starch due to the introduction of carboxylate groups that disturb the ordered structure of native starch, increase solubility in water and lead to higher storage stability. An Interpenetrating Polymer Network (IPN) is a polymer comprising two or more networks which are atleast partially interlaced on a molecular scale but not covalently bonded to each other and cannot be separated unless chemical bonds are broken where as a Semi-IPN is a polymer comprising one or more networks and one or more linear or branched polymer(s) characterized by the penetration on a molecular scale of at least one of the networks by at least some of the linear or branched macromolecules. The previous investigations are mainly focused on the Semi-IPN systems of organic components [16]. However, the studies on organic-inorganic hybrid Semi-IPNs remain largely unexplored. Organic-inorganic hybrid Semi-IPNs combine the advantages of organic materials with those of inorganic polymers. Montmorillonite is a very soft phyllosilicate mineral that typically forms in microscopic crystals, forming clay. Montmoillonite, commonly known as medical clay swells with the addition of water. However, some montmorillonite expands considerably more than other clays due to water penetrating the interlayer molecular spaces and concomitant adsorption. The amount of expansion is due largely to the type of exchangeable cation can result in the clay swelling to several times its original volume.

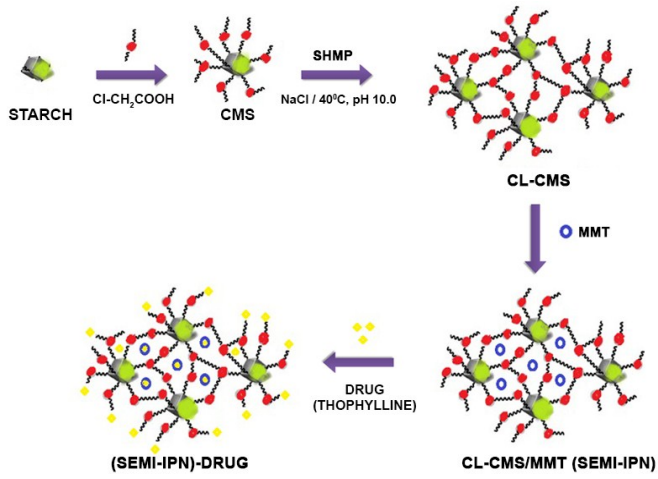

Fig. 2 Proposed Reaction Mechanism for the formation of Semi-IPN

As carboxymethyl starches also possess the tendency of aggregation similar to native starches, our research group mainly focused attempts to crosslink CMS with sodium hexa meta phosphate and a novel semi-IPN drug delivery system comprising crosslinked carboxymethyl starch and Montmorillonite (CL-CMS)/MMT for the controlled release of Theophylline [17]. It is designated to assess the effectiveness of the drug delivery vehicle in the encapsulation of Theophylline. Theophylline, known as dimethylxanthine, is a methylxanthine drug used in therapy for respiratory diseases such as COPD and asthma under a variety of brand names. As a member of the xanthine family, it bears structural and pharmacological similarity to caffeine. The main actions of theophylline involve relaxation of bronchial smooth muscles and increasing heart muscle contractility and efficiency. The use of theophylline is a bit complicated because of its interaction with various drugs and that it has a narrow therapeutic index. So the controlled and sustained delivery of theophylline is administered as effective medication to treat asthma and other respiratory diseases.

The preparation procedures of Crosslinked Carboxymethyl starch (CL-CMS) utilized non-toxic, aqueous-alcoholic solvents

Carboxymethyl Starch Based Excepients .....(contd. from Page 3)

and generated no waste other than Sodium chloride salt from the neutralization step which was further eliminated. The cross linking agent (SHMP) used was also classified as GRAS (Generally Recognized as Safe) material. Higher moisture content suggested that CL-CMS was more hygroscopic compared to native starch, which could be a result of the improved ability to take up water. The flow ability

"The use of natural polymers as drug carriers has received much attention in the pharmaceutical field due to their biocompatibility and safety. . "

was not much affected as per Carr's index and Hausner ratio. CL-CMS was obtained as fine, off -white, poor-flowing powder, similar to the two standard disintegrants used. The reaction efficiency was 61.8%. The phosphate content was 0.59±0.01%, which was equivalent to a degree of crosslinking (DCx) of 0.063. Carboxymethylation followed by crosslinking modification of starch and reaction with a comparatively small amount of medical clay MMT results in the formation of a Semi-IPN where the drug molecules could be encapsulated inside the crosslinked networks, COO- groups on the surface and the clay layers trapped inside which facilitates effective encapsulation. The % encapsulation efficiency showed a dependence on the extent of crosslinking and % drug loading. Formulations containing 25% drug loading exhibited high particle sizes as compared to the formulations containing 5% drug loading. With increasing the amount of MMT content, the swelling ratios of the Semi-IPN hydrogels are found to increase. The crosslinked CMS forms networks and the clay molecules are trapped inside the crosslinkings. Moreover MMT has high swelling capacity, which enhances the swelling degree of Semi-IPN hydrogels. The ionization of the carboxymethyl groups occcurs as the solution becomes less acidic, resulting in the electrostatic repulsion between the ionized groups which cause swelling degree of the hydrogel to reach to a relatively large value. This characteristics behavior of a pH sensitive controlled release system is desirable and effective as the pH of stomach is acidic where as that of intestine is basic. The swelling degree of the semi –IPN hydrogels in saline solutions is appreciably reduced when compared with the values measured in deionized water. Owing to the high swelling capacity, MMT accounts for the enhanced swelling degree, even if it is trapped inside CL-CMS. The release rate is high in case of formulations containing high amount of drug and the matrix releases drug at a much faster rate in simulated intestinal fluid (pH 7.4) than in simulated gastric fluid (pH 1.2).

Conclusions

Controlled drug delivery devices that utilize biodegradable polymers are enjoying high resurgence of interest, as there is no need for the surgical removal of the device. The use of natural polymers as drug carriers has received much attention in the pharmaceutical field due to their biocompatibility and safety. Biodegradable natural polymers as drug carriers possess many advantages including good biocompatibility, non toxicity and controlled release properties. . The actual tendency is directed to the development of materials that are assimilated by the organism producing minimum collateral effects. Controlled or sustained release drugs provide many advantages in comparison with conventional forms such as reducing side effects, keeping drug concentration at effective levels in plasma, improving utilization of the drug and decreasing the dosing. The results of the preliminary investigations revealed that the CMS/Clay composite based semi-IPN can be customized to act as good candidates in drug delivery systems. CMS based excepients for drug delivery applications is still in its early years as it will take more time to obtain relevant results. Drug delivery applications using CMS based semi-IPN have also just begun. However, more studies are required to further investigate the capability of the Crosslinked CMS/Clay composite based semi-IPN as potential valid vehicles for controlled delivery of drugs to the respiratory organs in vivo and also to obtain outstanding results that will completely revolutionize the clinical treatment of respiratory diseases.

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Smartphone Technology and Chemistry: From Learning to Lab-on-Chip Diagnostics

Dr. Mahesh S. Indian Institute of Space Science and Technology, Thiruvananthapuram

The worldwide advancements in smartphone-type technology embodies a potentially transformative opening for the deployment of learning and lab-on-chip technology. The fact that most individuals in the world carry around, or at least have access to, a robust, intuitive to use, and incredibly powerful imaging, computation, communication, and social networking device should be accounted for in the development of future learning

"Smartphones can serve as powerful and convenient educational tools on a mobile platform, which potentially encourages learning."

or lab-on-chip devices. With the drop in prices and ever-increasing computing ability and video processing power, smartphones are becoming widespread among high school and college students. Nielsen (leading global information and measurement company, provides market research reports) that between 2009 and 2013 smartphone ownership in urban India has taken off and it looks like the sky is the limit.[1]. A whopping 51 million people in urban India were using smartphones in 2013—outpacing the initial estimate of 45 million—up from 27 million in 2012. Within one year, the share of smartphones in the mobile market of urban India basically doubled—jumping from 9 percent in 2011 to 17 percent in 2012. In the metro areas, more than one in five (23%) people now carry a smartphone.

Smartphones can serve as powerful and convenient educational tools on a mobile platform, which potentially encourages learning. Collaboration through the interconnection of multiple chemistry apps was recently demonstrated as a new chemo informatics tool to increase work efficiency, which can be utilized to raise the chemistry learning experience to a new level [2]. Simultaneously, Smart phone technology has become a major technical achievement in lab-on-a-chip technology leading to incredible new biochemical sensors and molecular diagnostic devices. Despite these advancements, the uptake of lab-on-a-chip technologies at the consumer level has been somewhat limited. I believe that the widespread availability of smartphone technology and the capabilities they offer in terms of computation, communication, social networking, and imaging will provide transformative opportunities for the deployment of lab-on-a-chip type technology both in the developed and developing world. Here in this write-up I would like to focus on two aspects: learning of Chemistry and lab-on-a-chip technology with smart phones.

1. Chemistry Apps on Smartphones

With this small write up, I would like to cover a short range of free apps that are easily accessible and that could make a broader impact.

1a. Molecular Viewer Apps

During the last few decades there has been a dramatic improvement of graphics and CPU computing power on smartphone devices. The rotation and rendering of three-dimensional (3-D) molecular structures can be easily and effortlessly realized on iPhone,

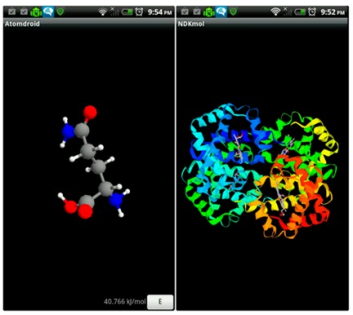

Fig. 1. Examples of the 3-D molecular structures on"Atomdroid"and "NDKmol"

iPod touch, and Android phones with the one-finger pilfering or two-finger zooming motions. Five years ago, these functions were reserved for high-end graphics processing workstations with sophisticated software engines costing thousands of rupees.

Today apps such as "Atomdroid"-12 (Android, by CCB Gottingen) and "Molecules" (iOS, by Sunset Lake Software) can create fabulous and interactive 3-D executions of molecular structures. Both apps show ball-and-stick models of energy-minimized 3-D structures as default. Besides ball-and stick models, "Atomdroid" (Figure 1 left) can also display skeletal models along with calculated total energy. Many of the display parameters can be fine-tuned to optimize the presentation and maneuvering speed. Several Android apps such as "Atomdroid", "Molecular Viewer 3D" (Android, by Adam Hogan), "ESmol", and "NDKmol" (Figure 1 right, Android, both by Biochem_fan) can download protein files from PDB and display the complex protein structures with stunning detail. This could be a valuable tool for teaching protein structures and interactions between small molecules and protein. "ESmol"can convert polymer structures into beautiful ribbon models. It is also able to show nucleic acids in strands, ladder, or skeletal models. Besides biomolecules such as DNA, RNA, and proteins "ESmol" can display polymers and crystals in packing mode. Equipped with the molecular viewer apps, students can access simple or complex structures from a device in their pockets and manipulate the structures to better understand bonding and steric effects. The convenient viewing can be used to assign NMR chemical shifts and to study the reactive sites for organic chemistry.

"A general chemistry student studying for an exam can pull out a smartphone and use "W Chemistry Handbook" quickly review the basic concepts such as common inorganic cations and anions covered in general chemistry. . "

1b. Reference and Study Guides Apps

Heavy weight textbooks, chemistry vocabularies, and reference books such as the CRC Handbook are swiftly becoming history as hand-held devices such as smartphones are changing the way students study, memorize, review, and utilize chemical knowledge. Numerous apps address the need for portable devices as study guides or easy chemistry helpers. For instance, a general chemistry student studying for an exam can pull out a smartphone and use "W Chemistry Handbook" (Android, by Dilthiumlabs) to quickly review the basic concepts such as common inor-

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Smartphone Technology .....(contd. from Page 5)

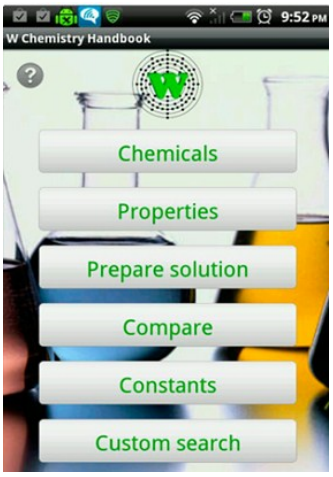

Fig. 2. Screen view of the "W Chemistry Handbook" apps

ganic cations and anions covered in general chemistry. The student can also promptly check the virtual handbook in a general chemistry lab to retrieve a pKa value, a molecular weight, or a density for experimental calculations. "Chemistry Cheat Sheets Free" (Android, by NadsTech.-com) covers the important topics in general chemistry and organic chemistry in a concise fashion with many summary tables and figures. "Chemistry by Design"[3] (Android & iOS) summarizes the total synthesis routes of 337 compounds, most of which are of pharmaceutical interests. The routes are categorized by name, author, year, and drugs can be searched within the app. Other apps such as "Chemistry Helper" (Android, by Adam Hogan) have similar functions with expanded capabilities such as IR and NMR tables for organic functional groups, calculation and conversion tools for analytical chemistry and physical chemistry, solubility rules for inorganic chemistry, reduction potentials for electrochemistry, and so forth.

"Besides "Chemistry Helper" and "Chem Mobile", there are several dedicated periodic table apps on both iOS and Android. "

1c. Structure Drawing Apps and Periodic Table Apps

Using the touch screen on smartphones, 2-D molecular structures can be drawn to accuracy with one or two fingers. Small molecules can be drawn on "MolPrime" (iOS, by Molecular Materials Informatics, Inc.) [4] and "ChemDoodle Mobile" (iOS & Android, by iChemLabs, LLC). "ChemDoodle Mobile" easy tool for sketching molecules to show energy-minimized 2-D structures and to calculate simple NMR spectra. NMR and property predictions work very well for small molecules containing organic elements. The drawn structures can be saved in the paid version of the app

Besides "Chemistry Helper" and "Chem Mobile", there are several dedicated periodic table apps on both iOS and Android. "EMD-PTE" (by Merck KGaA), a highly rated app, works on both iOS and Android. "iElements" (by SusaSoftX) and "The Chemical Touch Lite" (by Christopher J. Fennell) are two popular iOS apps while "Periodic Droid" (by DroidLa) and "Periodic Table" are Android exclusive. "EMD-PTE" stands out with clean HD resolution and rich functions. It carries a calculation tool of atomic weight percentage within a compound. Every element has a history of discovery. The accompanied atomic property data are most comprehensive among all periodic table apps. A small drawback is that the small buttons could be hard to touch correctly on a smaller screen. Overall this app has the highest rating.

1d. Research Apps

There are several chemistry reference apps beyond the simple study guides mentioned above. As stated before, "Chemistry Helper" and "Chemistry Mobile" can be used as reference books for chemistry students. There are also powerful search engine apps such as "PubChem Mobile" (Android, by CRinUS.) which leads to a plethora of chemical information that could easily exceed the physical limit of a chemistry handbook or encyclopedia. ACS Mobile" (iOS and Android, by American Chemical Society or ACS) leads the user to ACS resources and literature database with links to the latest ASAP articles. "ChemSpider"(by Molecular Materials Informatics, Inc.), a powerful compound search engine, can be used as an app on iOS devices to discover structural information, properties, MSDS, related literature, and vendors of chemicals [5].

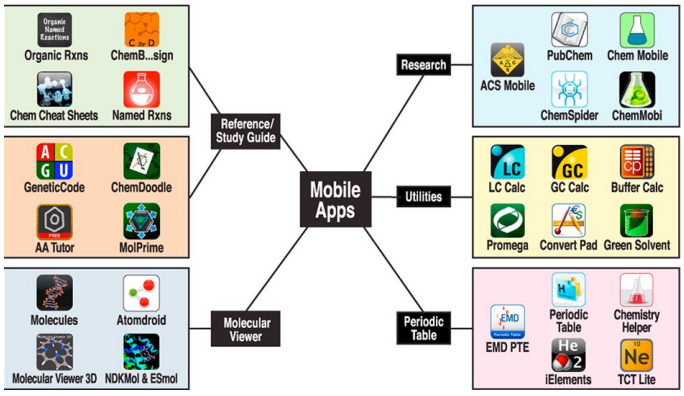

Fig.3. Summary of all logos of chemistry applications in smart phones

2. Smartphone Based Lab-On-Chip Diagnostics

So far we have seen that the smart phones can be used for learning of Chemistry using various applications either in Android or iOS. The smart phones can also be used for diagnostics purposes. Even though the concept of lab-on-a-chip based diagnostics originated more than 20 years ago, far fewer commercial successes have come from lab-on-chip technology that has transitioned to the consumer diagnostics market. There are, of course, numerous reasons for this, however it seems unlikely that the major roadblocks are technological in nature.

"Significant opportunity also exists in the development of smartphone-based lab-on-chip diagnostics for communicable and non-communicable disease diagnostics in limited resource settings. . "

As we have already discussed, the extreme societal penetration of the smartphone and its ubiquity, familiarity, and functionality, can fundamentally alter this difficulty. These devices are commonly used by everyone, from the elderly to the pre-school children. This familiarity can dramatically reduce the need of training requirements and potential user errors during testing using smartphones. As many research groups have demonstrated, the majority of the

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Smartphone Technology .....(contd. from Page 6)

functionality required to make and interpret a quantitative in vitro measurement is already embedded in smartphones. Recognizing the potential for smartphone-based health monitoring, a number of health-related systems have recently been developed. The field is advancing rapidly, though as of the writing of this article the commercial state-of-the-art in the area includes fitness applications and smartphone accessories that record basic healthcare information such as blood pressure and body mass index

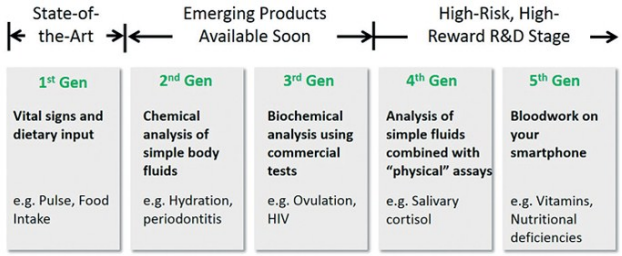


Fig. 4 . Smartphone based lab-on-chip technology roadmap. Image illustrates the possible technological progression of smartphone based lab-on-chip technology from the existing product state to likely areas of high-reward R&D

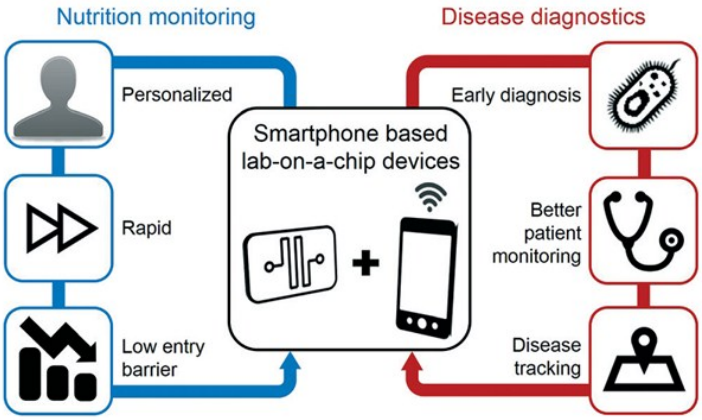


Fig. 6. Smartphone based LOC technology could provide a number of important advantages for health monitoring and diagnostics.

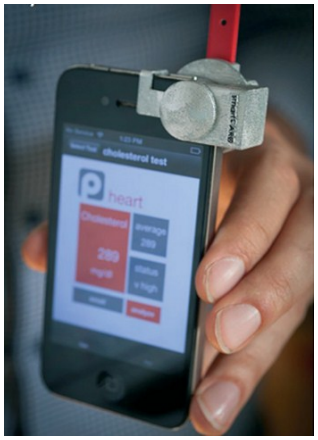


Fig. 5. Smartphone based microfluidic and lab-on-chip technology: colorimetric analysis for serum cholesterol detection

2a. Nutrition and micronutrient monitoring

2.6 M people died from the consequences of high cholesterol in 2004 [6] and nearly 30% of all cancers in the worldwide have been estimated to be a result of poor diet [7]. A third of the world's population is estimated to suffer from micronutrient deficiencies, with vitamin A and zinc deficiencies alone thought to be responsible for more than 1 M deaths each year worldwide. Many nutrition problems can be controlled through changes in diet by taking supplements or other therapeutics (e.g. statins for cholesterol) or behaviour modification. In the absence of a simple feedback mechanism it is difficult for an individual to judge how well any of these interventions are working. Current procedures in India or abroad typically involves drawing blood at a phlebotomist (Person who collects blood) visit, sending the sample to a centralized lab for analysis, and receiving the results weeks later at a physician's visit. Determining if interventions (i.e. supplements or changes in diet) have made any difference has to wait until the next visit to a physician. This feedback cycle can be expensive, slow, and lead to lower compliance. Addressing this problem fits well into the advantages of smartphone based lab-on-chip diagnostics for a number of reasons. Firstly, the healthy ranges of most markers (e.g.cholesterol) are typically well defined and broadly accepted. Secondly, while deficient/non-deficient or low/good/high type non-quantitative feedback is useful, precise quantification of levels is clearly more valuable in terms of tracking outcomes. Thirdly, while the current feedback loop may be too long, it is rare that a given nutrition marker will require anything beyond periodic monitoring

2b. Disease diagnostics

Significant opportunity also exists in the development of smartphone-based lab-on-chip diagnostics for communicable (e.g. the flu) and non-communicable (e.g. certain cancers) disease diagnostics in limited resource settings. The relatively low level of infrastructure required for mobile phone networks combined with low cost mass manufacturing of handsets and relatively flexible licensing terms for some operating systems (e.g. Android) has led to relatively broad access to smartphone technology in these settings [8]. Both developed and less developed countries are likely to have regions that have limited access to what might be considered routine healthcare or diagnostic services elsewhere in the country. In this context there exists many advantages that smartphone based lab on-chip diagnostics can offer in a place with limited resource settings:(1) facilitating early-stage accurate diagnosis, (2)maintaining better communication and monitoring of patients, and (3) enabling better tracking of disease outbreaks. One of the key advantages of lab-on-chip and biosensor technology is that they can produce diagnostic sensitivities and specificities that are comparable to those obtained with centralized testing without, in principle, having to go to a centralized facility. By linking the diagnostic test to a smartphone, even if the test itself cannot be interpreted immediately and must be verified by a remote specialist, it should be easier to get back in touch with the pa-

> *"By 2016 there will be 50% population in India accessing smartphones. . . "*

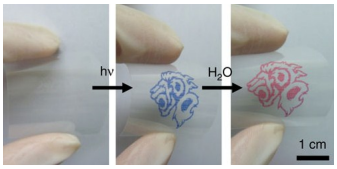
Contd. in Page 8

Human Sweat Pore Mapping using Hydrochromic Conjugated Polymers

Hydrochormic materials sense humidity and measure water content in organic solvents. These materials change colour according to the amount of water they detect. Scientists at the Hanyang University, Seoul introduced a hygroscopic element into a supramolecularly assembled polydiacetylene (PDA) resulting in a hydrochromic conjugated polymeric sensor, which is suitable for mapping human sweat pores. The sub-nanolitre quantities of water secreted from sweat pores are sufficient to create an instantaneous colorimetric transition of the polymer. Thus the sweat pores in the fingertips can be mapped using the sensor which will be a boost to both the fingerprint analysis and clinical diagnosis of malfunctioning of sweat pores.

In the present report, the sensor changes colour from blue to red upon exposure to water. The response time is less than 20 microseconds, making it very fast for detection. Conjugated polymers are the most common stimulus responsive colourimetric materials due to their unique optical properties associated with the extensively delocalized pi electron networks. PDAs possess structural features different from the conventional conjugated polymers. The supramolecular aggregation of PDAs enable extensive p-orbital overlap resulting in absorption maximum at 650 nm which corresponds to blue colour. Upon exposure to appropriate solvent, due to the free rotation of side chains, colour transitions occur, depending on the extent of solubility.

More information on the article can be obtained in the April 2014 online issue of Nature Communications. Please visit http://www.nature.com/ncomms/2014/140429/ncomms4736/full/ncomms4736.html#compounds



Photographs of PDA ink solution printed on a PET film: immediately after printing (left); after exposure for 30 sec to 254 nm UV irradiation (middle) and and after exposure to water (right). Image courtesy: http://www.nature.com/ncomms/2014/140429/ncomms4736/fig_tab/ncomms4736_F2.html

Courtesy: Dr. C. P Reghunadhan Nair

Audi Plans to use Polymer Composite Springs for their Luxury Cars

"Though 4.4 kg seems a meager number, its significance is that the weight saving occurs at the crucial part of the chassis of the car. "

A recent report published in many news portals says that the car giant Audi plans to use glass fiber reinforced polymer (GFRP) springs in their forthcoming luxury cars. These GFRP springs will replace the conventional steel springs resulting in much weight saving because these springs are up to 40 percentage lighter than their metallic counterparts. When a steel springs weighs approx. 2.7 kg, the GFRP spring will weigh only 1.6 kg. The four springs in the car together can reduce around 4.4 kg weight of the car. Though 4.4 kg seems a meager number, its significance is that the weight saving occurs at the crucial part of the chassis of the car, resulting in more precise driving with enhanced vibrational comfort. The composites are epoxy based with long glass fibers twisted together. These composites do not corrode and requires less energy intensive processing steps compared to steel springs.

News courtesy: various news portals. Image courtesy: http://www.zigwheels.com/

Courtesy: Dr. R. S Rajeev

Smartphone Technology .....(contd. from Page 6)

tient to relay the results and provide instructions for further treatment.

In conclusion the availability of Chemistry apps on smartphones and other portable electronic devices affords students of Chemistry and Chemical professional's powerful and compact tools to solve problems conveniently with reduced burden from conventional media, heavy books, and bulky computers [9]. The rapid expansion of mobile technology is transforming the biomedical landscape also. By 2016 there will be 50% population in India accessing smartphones. This enables to run health accessories and software"apps" for the benefit of the common people [10] .

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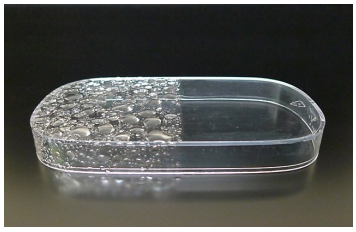
Safe Driving on Rainy Days

No more impaired visibility while driving your car in rainy seasons. The visibility while driving in rain gets affected because water droplets falling on the windshield often foam beads due to the water repellant characteristics of the surface. The new coating developed by Sanghoon Kim and team of ARS National Center for Agricultural Utilization Research in Peoria, Illinois USA developed a transparent, nanoparticle-based coating which can quickly change surfaces from hydrophobic to hydrophilic, so that water droplets doesn't bead up, and your visibility isn't impaired.

The nanoparticles were produced by reacting ethyl cyanoacrylate, a major component of "super glue" with bovine serum albumin, a cattle industry co-product. in a solution of acidified ethanol. Removal of the reaction byproducts by centrifuging resulting in nanoparticles suspended in the solution which



Right side of the plastic container is coated with the new coating showing no beading of water

can be applied on the surface by spraying followed by rinsing with water.

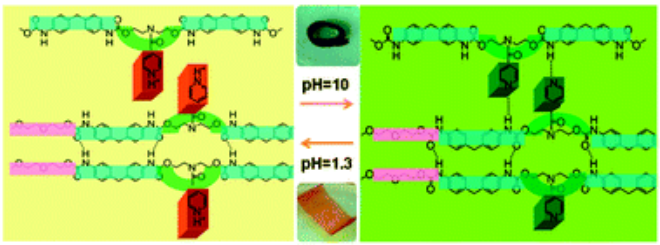
Read more at: http://phys.org/news/2014-07-nanoparticle-based-coating-beading.html#jCp

Courtesy: Dr. R. S Rajeev

pH Sensitive Polyurethanes

Scientists at China have developed pH sensitive polyurethanes by introducing pyridine rings into the backbone of polyurethane.The mechanism of pH sensitivity, studied by using FT-IR and NMR followed by theoretical calculations, is the formation of a hydrogen bonding between the N atom of the pyridine ring and the H-N of urethane in neutral or alkaline environments which is disrupted under acidic conditions due to the protonation of the pyridine ring . This pH-sensitivity can be used as a switch to control shape memory and drug release. Since the shape memory property here is temperature independent, these materials can be designed for developing multifunctional materials for drug delivery and related applications.

Read more at: Polymer Chemistry, 2014, Advance Article DOI: 10.1039/C4PY00474D



Proposed mechanism of pH sensitivity of polyurethane in presene of pyridine rings. Image courtesy– Polymer Chemistry, RSC

Courtesy: Dr. C.P Reghunadhan Nair

In Lighter Vein.....

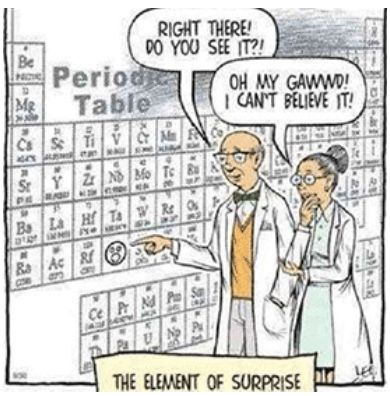
RULES OF THE LAB

1. When you don't know what you're doing, do it neatly.
2. Experiments must be reproduceable, they should fail the same way each time.
3. First draw your curves, then plot your data.
4. Experience is directly proportional to equipment ruined.
5. A record of data is essential, it shows you were working.
6. To study a subject best, understand it thoroughly before you start.
7. To do a lab really well, have your report done well in advance.
8. If you can't get the answer in the usual manner, start at the answer and derive the question.
9. If that doesn't work, start at both ends and try to find a common middle.
10. In case of doubt, make it sound convincing.
11. Do not believe in miracles--rely on them.
12. Team work is essential. It allows you to blame someone else.
13. All unmarked beakers contain fast-acting, extremely toxic poisons.
14. Any delicate and expensive piece of glassware will break before any use can be made of it.

From: http://jcdverha.home.xs4all.nl/scijokes/

- Did you know that you can cool yourself to -273.15˚C and still be OK?
- Have you heard the one about a chemist who was reading a book about helium?
  He just couldn't put it down.
- Q: What is the chemical formula for "coffee"?
  A: CoFe2
- Q: What is the chemical formula for "banana"?
  A: BaNa2
- Q: What do you do with a sick chemist?
  A: If you can't helium, and you can't curium, then you might as well barium.
- Two chemists go into a restaurant. The first one says "I think I'll have an H_2O."
  The second one says "I think I'll have an H_2O too" -- and he died.

From: http://www.cagle.com



From: http://www.inorganicventures. com/

Jokes collected by Dr. R. S Rajeev

Chapter News

AGM and Formation Day Lecture

Formation Day Lecture by Dr. Suresh Das, Director, NIIST

Release of Polymer News

A view of the audience

The Annual General Body Meeting of the Chapter was held on 19th January 2014 at Hotel Capital, Thiruvananthapuram. As done in previous years, the selected papers for the SPSI Best PhD Paper Award were presented by the contestants. There were three technical presentations for the Award. Dr. S. Sandeep, who presented his work on "Stimuli-responsive drug delivery systems was awarded the Best PhD paper Award.

The presentations were followed by Formation Day Lecture. This year's lecture was given by Dr. Suresh Das, Director, National Institute of Interdisciplinary Science and Technology (NIIST), Trivandrum. He gave an interesting talk on photoresponsive polymers and their applications. The lecture invited a lot of discussion and interaction among the members.

The latest edition of Polymer News was released during the function by Dr. Suresh Das, by handing over a copy to Dr. C. P. Reghunadhan Nair, Chapter President. Dr. Das and Dr. Nair congratulated the team behind the newsletter and requested all the members to contribute immensely to Polymer News.

Followed by the Formation Day Lecture, new office bearers for 2014-2016 were elected. Shri. V.P. Balagangadharan, former President of the Chapter was the presiding officer. All the office bearers were elected unanimously. Dr. A. Ajayaghosh, NIIST was elected as the President and Prof. (Dr.) T.S. Anirudhan, University of Kerala, was elected as the Vice President. The details of the office bearers are given in the last page of the newsletter.

The first Executive Committee Meeting of the newly elected members were held after the AGM.

Our New President

Dr. A. Ajayaghosh, Outstanding Scientist, CSIR – National Institute for Interdisciplinary Science and Technology (NIIST) is the new President of SPSI Thiruvananthapuram Chapter. Dr. Ajayaghosh has several awards and honors in his credit including the prestigious Infosys Prize for Physical Sciences. It is sure that the Chapter will reach new heights during his tenure.

Congratulations, Dr. Ajayaghosh

Dr. S. Sandeep bags the Best Ph.D Paper Award

Judging committee evaluating the presentations

Dr. Sandeep receives certificate and gold medal for the Best Ph.D Paper of 2013 from Dr. Suresh Das

As in the previous years, SPSI Thiruvananthapuram Chapter conducted competition for the Best Ph.D Paper Award during the AGM Day. A large number of students responded to the announcement. The screening committee selected 3 best papers by Dr. R. Reshmy, Dr. Priya A Nair and Dr. S. Sandeep for the presentation. The technical presentations were delivered before the commencement of the Annual General Body Meeting on 19th January 2014.

Dr. R. Reshmy gave a presentation on her Ph.D thesis, "5-Heteroyl thiazoles-Microwave assisted synthesis, crystal growth and Industrial Applications". The topic of presentation of Dr. Priya A Nair was "Synthesis and characterization of calcium containing polyurethanes intended for biomedical applications". Dr. S. Sandeep's presentation was based on the topic "Stimuli-responsive drug delivery systems derived from clay, chitosan and superparamagnetic iron oxide nanoparticles: synthesis, characterization and in-vitro drug release studies.

The quality of all the presentations were excellent which gave a tough time for the judging committee to select the Best Paper. The judging committee consisted of Dr. C. P. Reghunadhan Nair (VSSC), Dr. C. Gouri (VSSC) and Dr. J.D. Sudha (NIIST). All the students faced tough questions from the judges and they answered the questions well. After detailed deliberations, the judging committee selected the paper presented by Dr. S. Sandeep as the Best Ph.D paper for the year 2013. Dr. Sandeep did his Ph.D under the guidance of Prof.(Dr.) T.S. Anirudhan at Department of Chemistry, Kariavattom Campus, University of Kerala. Dr. Suresh Das, Director NIIST presented the gold medal and certificate to Dr. Sandeep.

Congratulations, Dr. Sandeep!

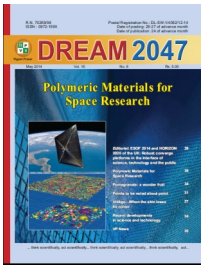
Awards and Honors (January 20-June 30, 2014)

- Dr. A. Ajayaghosh is elected as Fellow, Royal Society of Chemistry, London. He is also elected as member of the Editorial Board of the journal, Chemistry- An Asian Journal, Wiley-VCH (Ongoing)). He is serving as the senior editor of the journal, Bulletin of the Chemical Society of Japan.
- Dr. E. Bhoje Gowd was awarded with IUSSTF Research Fellowship, Indo-US Science and Technology Forum (2013-2014)

Academic and Technical Contributions of Chapter Members (January 20-June 30, 2014)

Publications in international journals

- Dr. C. P. Reghunadhan Nair and team have published 7 papers in international journals
- Dr. Ajayaghosh and team have published 9 papers in international journals.
- Dr. J.D. Sudha and team have published 8 papers in international journal
- Thakur S. K. Raunija and team published on journal in Carbon Letters and another paper accepted for publication in the same journal. The team has also filed one Indian patent for the invention of fiber milling equipment



Popular article

- Dr. C.P.Reghunadhan Nair authored a popular article titled “Polymeric Materials for Space Applications” in the May 2014 issue of , DREAM2047, a monthly newsletter of Vigyan Prasar, an autonomous organization under Department of Science and Technology, Government of India.

Book Chapter:

- E. Bhoje Gowd, and C. Ramesh wrote a chapter, “Crystallization and polymorphism behaviour of nylon-clay nanocomposites” in the Handbook of Polymer Nanocomposites: Processing, Performance and Application, edited by J.K. Pandey, K. R. Reddy, A. K. Mohanty and M. Misra and published by Springer: New York.

The list is incomplete. Please provide details of the awards, honors, achievements and publications of Chapter members to publish in the Newsletter. Please send the details to spsitvm@gmail.com.

Dr. C.P. Sharma Felicitated

SPSI Thiruvananthapuram Chapter gave a warm felicitation to Dr. C. P. Sharma, former President of the Chapter, who superannuated from service at Sree Chitra Tirunal Institute for Medical Sciences and Technology (SCTIMST), Thiruvananthapuram in February 2014. The function was held on 27th June 2014 at Hotel Nandanam Park, Thiruvananthapuram.

Dr. Sharma was the second President of the Chapter which reached new heights during his tenure. The function was blessed with the presence of senior members and former Presidents of the Chapter including Dr. V. N. Krishnamoorthy , Dr. K. N. Ninan, Dr. C.K.S Pillai and a host of other members. Dr. Ajayaghosh welcomed the gathering and cherished his long-term associationship with Dr. Sharma. Dr. C.K.S. Pillai, in his speech remembered how Dr. Sharma started his career in Thiruvananthapuram and his professional and personal relationship with him. Dr. K. N. Ninan and Dr. V. N. Krishnamoorthy spoke of the active role Dr. Sharma has played during the early years of the formation of the Society and how his vision helped in shaping the future of the Thiruvananthapuram Chapter. Dr. Roy Joseph, Joint Secretary of the Chapter also felicitated Dr. Sharma.

In his reply speech, Dr. Sharma thanked the organizers and members for their love and affection and remembered the days when he was appointed in SCTIMST in its formation time with the appointment letter sent by none other than Dr. M. S. Valliathan. He told that he was happy to be associated with the Society and thanked the members for their support.

Two technical talks were organized as an appropriate gesture to Dr. Sharma’s scientific and technical contributions. The talks were given by Dr. C. Vijayakumar, CSIR-NIIST and Dr. S. Mahesh, IIST. The function was a grand success with participation of many members.

Dr. A. Ajyaghosh handing over a memento to Dr. C. P. Sharma

Dr. C.P.Sharma gives the reply speech

A newsletter of the Society of Polymer Science, India, Thiruvananthapuram Chapter

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muralivssc@gmail.com

Please visit our website at www.spsitvm.org for updated information on Chapter activities, latest research findings on polymers etc.

Seminars/talks organized during January 2014-June 2014

- "Polymer Nanostructures and Functionalities at surfaces" by Prof. Manfred Stamm, Leibinz-Institute fur Polymer-forsschung, Dresden, Germany, Monday ON 17th February, 2014.
- "Characterization of Semiconducting Polymers by Time-Resolved Microwave Conductivity Technique" BY Dr. C Vijayakumar, CSIR-NIIST, Thiruvananthapuram on 27th June 2014.
- "Functional Nanostructures: Unravelling the Nano world through STM and AFM" by Dr. S. Mahesh, IIST, Thiruvananthapuram on 27th June 2014

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Congratulations!

SPSI Thiruvananthapuram Chapter congratulates Team ISRO for the successful launch of PSLV C-23/SPOT-7.

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SPSI Thiruvananthapuram Chapter
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Vice President	:	Prof. (Dr.) T.S. Anirudhan (University of Kerala)
Secretary	:	Shri R. Muraleekrishnan (VSSC),
Treasurer	:	Dr. R.S. Rajeev (VSSC),
Joint Secretaries	:	Dr. Roy Joseph (SCTIMST) and Dr. J.D. Sudha (NIIST)
Executive Committee	:	Dr. C.P. Reghunadhan Nair, VSSC; Dr. C. Gouri, VSSC; Dr. Kuruvila Joseph, IIST; Dr. Santhosh Kumar, RGCBT; Dr. Bhoje Gowd, NIIST; Dr. Benny K George, VSSC; Dr. Satheesh chandran, VSSC; Dr. M Sreejith, VSSC; Dr. Abhi Aprem Santhosh, HLL; Shri Thakur S Raunija, VSSC

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