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THE SCHOOL OF CHEMICAL SCIENCES
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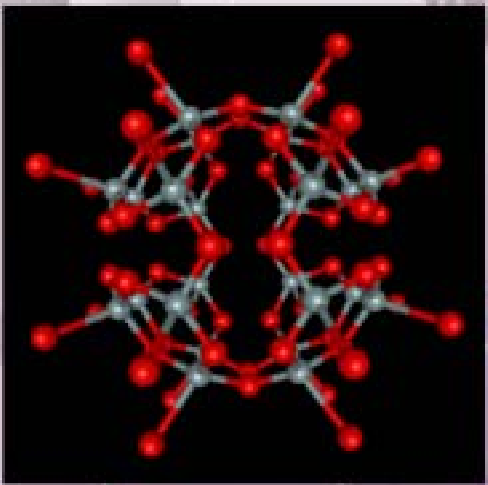
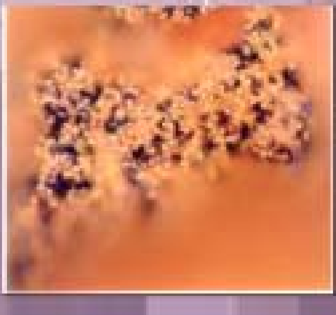
# KIMIA • USM





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# *From the Chief Editor*

## Prof. Lim Poh Eng

We are pleased to bring you another issue of the Chemistry Bulletin. This issue covers a wide range of topics including, among others, formulation of environmental-friendly drilling mud thinners, synthesis of liquid crystals from palm oil waste components and treatment as well as recovery of metals.

The first article by Dr. Wong Keng Chong reports the isolation and identification of some rare components from essential oils extracted from two plants, namely *Cyperus kyllingia* and *Pluchea indica*. As a good reflection of one of the main research areas in the School, there are a number of articles on synthesis work in this issue. The article by Prof. Poh Bo Long describes the efforts to synthesize receptors that can bind carbohydrates strongly in water. Synthetic carbohydrate receptors can be used to transport carbohydrates across cell membranes or as carbohydrate sensors. Dr. Wan Ahmad Kamil's article describes the preparation of organic-inorganic composites from natural rubber derivatives and inorganic alkoxides via the sol-gel techniques.

In terms of research groups in the School, Dr. Jamil and group presents the activities of the newly established Nanoscience Research Group (NsRG). Dr. Yeap and group describes the activities of their research group to synthesize palm liquid crystals from palm oil waste components and related natural products.

In polymer-related research, Dr. Jamil's article describes the melt morphology and interfacial reaction of new materials from poly(3-hydroxybutyrate) and epoxidized natural rubber. The article by Dr. Nasri presents the properties of plastic and polymeric foams.

Environmental-related research is another main area of research in the School. Specifically, formulation of environmental-friendly drilling mud thinners and development of cleaner process to recover metals from industrial effluents are the more focus of the articles by Drs. Mohamad Nasir and Norita, respectively. In terms of wastewater treatment, Dr. Ahmad presents the constructed wetland system as an alternative to conventional treatment systems in his article. Dr. Seng's article reports the removal of various metal species along the treatment path of a sewage stabilization pond system. The article by Dr. Md. Sani presents the results of a study to estimate the release of polychlorinated dibenzodioxin (PCDD)/ polychlorinated dibenzofuran (PCDF) in Malaysia. These data should serve as useful baseline information as the country is moving toward adopting incineration for the disposal of municipal wastes in urban centres.

Last but not the least, we also include in this issue an article by Prof. Teoh on the fundamental and applied aspects of tin chemistry.
As always, we look forward to your continuing support in the forms of contributed articles and constructive suggestions.

# *Message from the Dean*

### *Assoc. Prof. Jamil Ismail*

The School of Chemical Sciences takes pride in bringing you the second issue of Buletin Kimia. Thanks to all contributors whose support is a show of genuine commitment to strengthening research culture in the School.

The year 2002 has seen a series of achievements in research by our colleagues. Of merit mention are Dr. Mas Rosmal (Gold Medal Award at 30th World Invention Exhibition, Geneva 2002), Dr. Mohd Asri (Silver Medal ITEX- 2002) and Dr Mohd Noor Ahmad (Gold Medal Award, 30th World Invention Exhibition, Geneva 2002 and Gold Medal ITEX 2002). Also deserved mention is Dr. Wan Saime who received the Best Teaching Award 2002.

Research funding amounting to RM2.3m secured from various sources has definitely boosted research activity in the School with a record enrollment of 128 postgraduate students including forty-one newly registered and twenty- three graduated. Some of the research findings have been published in at least twenty-three articles in international journals. Meanwhile, the School continues its commitment to enhance research environment by providing new computer facilities for postgraduate students expected to be operational by early July2003.

As a science school, we ought to show strength in leading the fundamental research at the national and regional level. While recognizing that the much-emphasized applied research brings about more prospects and opportunities, we must realize that a sound fundamental research will provide the solid base crucial to the success of applied research. Any tendency towards imbalance needs to be checked and addressed consistently.

Multidisciplinary approach is the norm in modern day scientific research. Indeed, the newest and exciting area of research in advanced materials, for example Nonlinear Optics, demands cooperation among polymer scientists, chemists, physicists, and materials scientists. Other examples can be found in molecular and cell biology, chemical biology and molecular biophysics. USM has taken a similar approach in its stride to become a full-fledged research university with identified core and strategic research programmes. In this context, the School needs to reposition itself in order to prepare for and participate in the upcoming university's multidisciplinary research programmes besides continuing with our existing research programmes.

# Isolation And Identification Of Some Rare Compounds From Essential Oils

**Assoc. Prof. Wong Keng Chong**

In Malaysia there are numerous plants which yield interesting essential oils with the potential of being exploited as cheap sources of aroma chemicals. In our recent investigation of essential oils, we have come across several which contain as major components some rare sesquiterpenoids. We wish to report on two of these oils here. The oils were obtained by hydrodistillation of the plant parts of interest, and the major components were isolated by preparative GC and identified by MS, UV, FTIR, $^{1}$H- and $^{13}$C-NMR spectroscopy including modern techniques such as DEPT, HMQC, 2D-COSY and 2D-NOESY techniques. Relative retention indices were also determined for further confirmation of the identity of the compounds.

*Cyperus kyllingia* Endl. (Cyperaceae), a weed commonly found throughout Malaysia, is used in traditional medicine for treating dysentery and other ailments.[1] The plant is somewhat aromatic, particularly the rhizomes and roots. Hydrodistillation of the fresh rhizomes and roots yielded an essential oil with 0.14 % yield. The oil contains 88 % sesquiterpenoids among which 7±-9, 11-eremophiladien-8-one (**1**) and 7(11), 9-eremophiladien-8-one (**2**) were clearly dominant, the two accounting for greater than 50 % of the oil. These two compounds gave overlapping GC peaks on both polar and non-polar columns, with the larger component, (**1**), eluting first. Pure (**1**) could be isolated by preparative GC but attempts to obtain a sample of (**2**) with the same technique always yielded a mixture of (**1**) and (**2**). Compound (**2**) of 98 % purity, however, could be obtained by heating (**1**) at 176 °C in the absence of air for 8 hours, indicating that (**2**) was probably an artefact produced during hydrodistillation of the plant material. We were unable to detect the presence of ±-cyperone, a sesquiterpenoid which was reported by Komai and Tang to be the most abundant constituent of the essential oil of Hawaiian *C. kyllingia*.[2] In contrast, the Hawaiian plant did not yield (**1**) or (**2**). When tested for antimicrobial activity, (**1**) and (**2**) showed significant activity against Gram-positive bacteria (*Bacillus subtilis*, *Staphyloccocus aureus*).

The next oil we investigated was from *Pluchea indica* Less. (Compositae), a small shrub found all round the coasts of the Peninsula. The leaves, which are aromatic, are eaten as a flavouring. These plant parts are also used in native medicine for fevers,

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dysentery and various complaints.[1] Hydrodistillation of the fresh leaves gave an oil with 0.11% yield. The dominant chemical group was the sesquiterpenoids, accounting for 82 % of the oil. The major components were $^{2}$-caryophyllene (21.6 %), 7$^{2}$H-5-silphiperfolene (20.1 %) (**3**) and 3(15), 7(14)-caryophylladien-6-one (15.2 %) (**4**). The detection of (**3**) and (**4**) in *P. indica* is particularly interesting. The first compound is a rare tricyclic sesquiterpene found previously in *Siliphium perfoliatum*,[3] while the second, to our knowledge, has not been reported from a plant before. The co-occurrence of (**3**) and $^{2}$-caryophyllene in high concentrations in the essential oil of *P. indica* is noteworthy as it has generally been recognized that the second compound is the probable biogenetic precursor of (**3**).[3]

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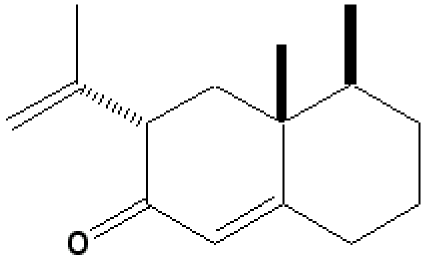

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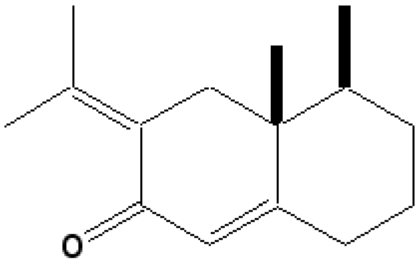

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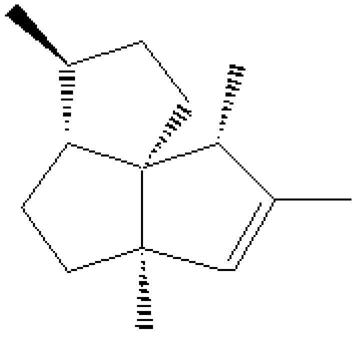

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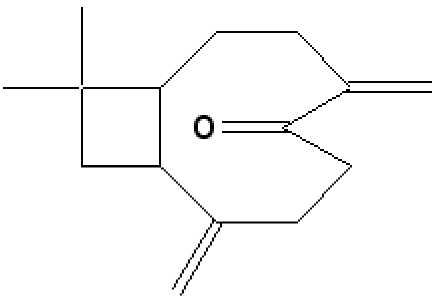

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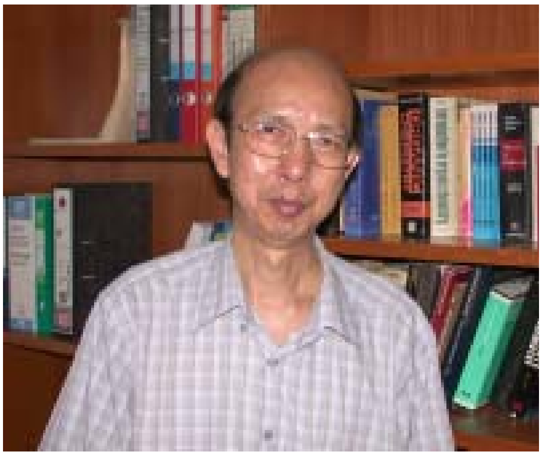
# Synthetic Carbohydrate Receptors

**Prof. Poh Bo Long**



Carbohydrates, through their interactions with proteins, play key roles in a wide range of biological processes such as cell-cell recognition and immunological response [1-3]. X-ray crystal structures of carbohydrate-protein complexes have revealed that the carbohydrate molecule is non-covalently bonded to the binding site of the protein – the polar groups are bound by hydrogen donor and acceptor groups and the hydrophobic parts by nonpolar surfaces [4].

In recent years there is a great interest to synthesize receptors for carbohydrates for both practical and theoretical reasons. Synthetic carbohydrate receptors could be used to transport carbohydrates across cell membranes or as carbohydrate sensors. They also could be used to gain an understanding of how a receptor can recognize a carbohydrate molecule.

Searching for receptors that can recognize carbohydrates in water is a very challenging problem. The reason being that the receptor must expel a cluster of water molecules from its binding site before it accepts the carbohydrate molecule which practically resembles a water cluster (except for the presence of small patches of hydrophobic surfaces)! So far, only a handful of such receptors have been reported. Our laboratory has reported three of them.

Cyclotetrachromotropylene (**1**), possessing a cavity, gives significant binding constants [5] in water to monosaccharides like methyl α-D-glucopyranoside (28 $M^{-1}$), methyl β-D-glucopyranoside (6 $M^{-1}$) and methyl α-D-mannopyranoside (75 $M^{-1}$). It binds the cyclic polysaccharides such as α, β, and γ-cyclodextrins even more strongly (stability constant from 85 to 140 $M^{-1}$) [6].

Calcichrome (**2**), creating a cavity through its folding, is even a better receptor for α, β, and γ-cyclodextrins in water (stability constant from 380 to 570 $M^{-1}$) [7].

The molecule, disodium 1,8-disulfonato-3,4,5,6-acridinetetracarboxylic acid (**3**) in its dimeric form, has a V-shape cavity that can encapsulate α, β, and γ-cyclodextrins [8].

Very little has been accomplished in the search for synthetic receptors that can bind carbohydrates strongly in water. Much are still to be done.

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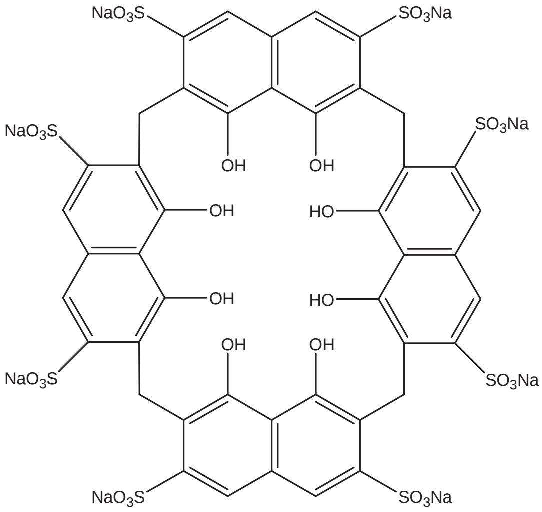

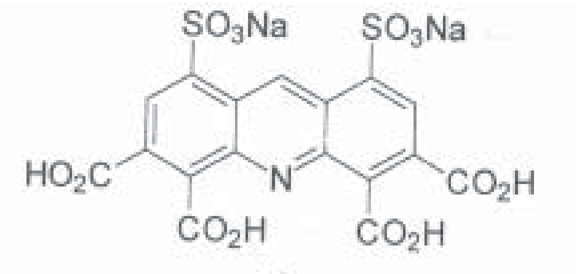

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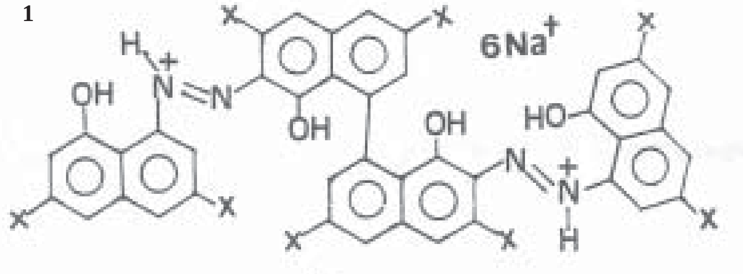

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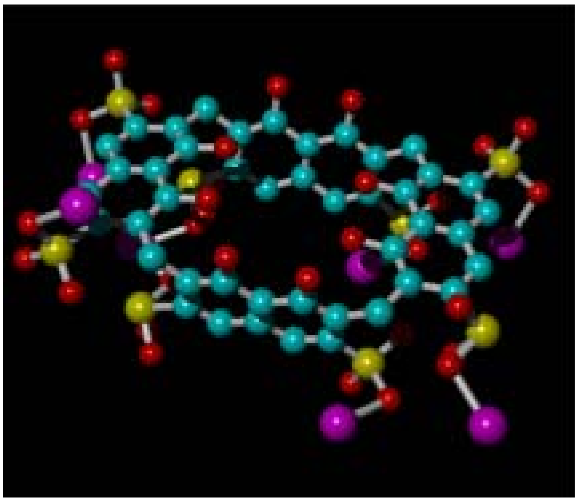

# Organic-Inorganic Composites from Liquid Natural Rubber and Metal Alkoxides

**Assoc. Prof. W.A. Kamil Mahmood**

My interest in the preparations and synthesis of **O**rganic-**I**norganic **C**omposites(**OICs)** is a consequence of various work that have been carried out by other researchers on **O**rganically **M**odified **S**iloxanes(**Ormosils**) and **Cera**mic Poly**mers** (**Ceramers**). While other research groups have used synthetic and modified organic polymers, our group has been the only one able to incorporate **L**iquid **N**atural **R**ubber and other derivatives of natural rubber into the inorganic glass matrices or vice-versa. Currently, the thrust of this research group is in the preparation of OICs from natural rubber derivatives and inorganic alkoxides (the precursor to inorganic glass) via the sol-gel techniques. Various natural rubber derivatives have been synthesised and prepared in our laboratories, viz. liquid natural rubber(LNR), 50% epoxidised natural rubber(ENR-50) and modified natural rubber.

We have been successful in incorporating either titania, zirconia, chromium, tungsten, or their combinations thereof into liquid natural rubber and other derivatives of natural rubber. The **OIC** materials have been prepared by sol-gel process from metal alkoxides such as $Ti[O(CH_2)_3CH_3]_4$ and mixture of $Ti(OR)_4$ and $Zr(OR)_4$ with epoxidised natural rubber (ENR-50). Sol-gel technique has proved to be most useful in the preparation of such hybrid material which requires lower processing temperature. Our research over the years has enabled us to resolve the optimum reaction conditions and compositional aspects in order that the compatibility of the **LNR** and metal alkoxides can result in coloured transparent films. *In situ* polymerization of $Ti[O(CH_2)_3CH_3]_4$ in the matrices of **LNR** and **E**poxidised **N**atural **R**ubber (**ENR-50**) have been successful in producing lightly coloured, new transparent flexible materials. The materials obtained showed good macroscopic and microscopic homogeneity. Likewise, we have been able to incorporate up to 25% of LNR into silica alkoxides. More recently, we have also been successful in preparing combination of Cr with Ti, and W with Ti in the **LNR** matrices. Some of the materials prepared have successfully been coated onto silica glass materials.

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Other related work that we are currently pursuing are in the areas of (i) chemically modified pectin, also for the preparations for **OICs,** (ii) the esterification of locally produced starch with long aliphatic chains, for use as an alternative to biodegradable polymers and with potential use for liquid crystal materials and (iii) other works such as the synthesis and preparation of metals as nanomaterials.

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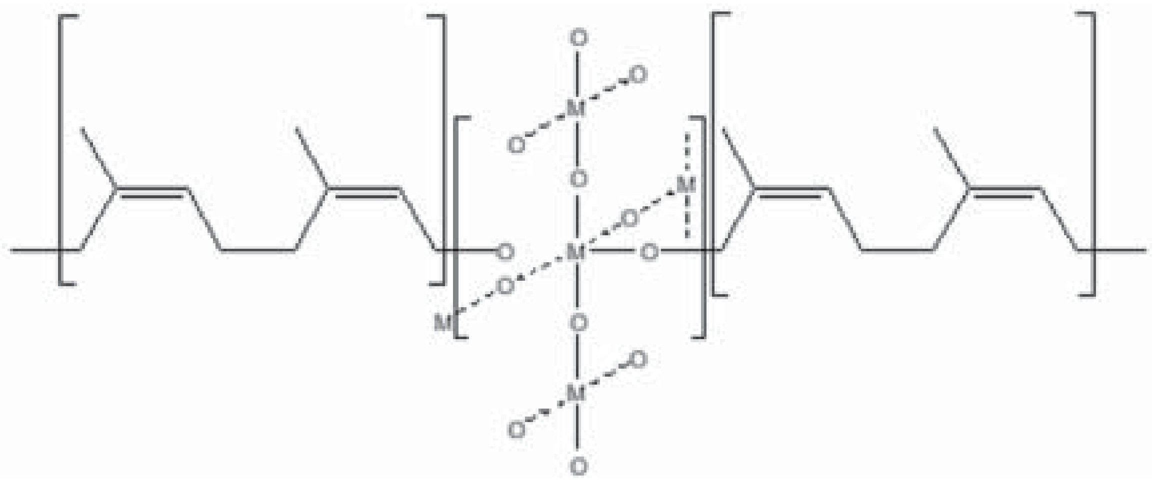
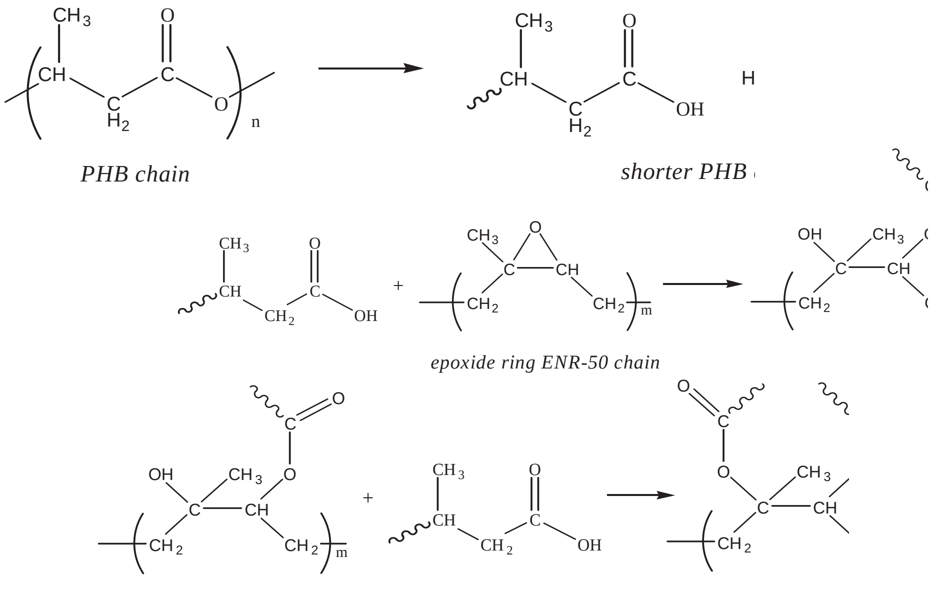


# New materials from poly(3-hydroxybutyrate) and epoxidized natural rubber: melt morphology and interfacial reaction

**Assoc. Prof. Jamil Ismail**

Recent findings from our study on blends comprising PHB and ENR have revealed evidence of chemical reactions during annealing at temperatures above the melting point of PHB ranging from 184 –199 °C [1-2]. It comes as a great excitement as we continue to search for ways and means to improve PHB crystallization and mechanical properties while maintaining its biodegradability. The great impact is that it opens up a spectrum of new materials from a combination of PHB and ENR, both being our natural resources, ranging from *PHB filled elastomers* to *ENR reinforced thermoplastics*.

The reaction is confined to a highly viscous environment at the interface of the immiscible PHB/ENR phases. Typical melt morphologies taken a few seconds after the melting of PHB are shown for PHB/ENR 40/60 and 60/40 in Figure 1. They are highly unstable and apparently disappear within one to two minutes. Further study is needed.



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A series of reactions arising from ring opening of the epoxide group of ENR by the chain end carboxyl group of PHB has been proposed as shown in the scheme below [2].

The reactions yield PHB grafted ENR and probably some cross-linking of ENR. FTIR spectrum confirms ring-opening reaction. A significant outcome of this interfacial reaction is the enhancement of compatibility between PHB and ENR as evidenced from the results of blends glass transition temperatures. Looking at the interface, one may visualize new chemical bonding and extended inter-diffusion of chain ends of the two components. This imparts dramatic hindrance to the crystallization of PHB.

Although the experimental results appear to be complementary, the system is actually quite complex. This is due to the dynamic nature of melt morphologies and interfaces. Further study on the reaction and kinetics at equilibrium morphologies are important and investigation is being carried out to have a better understanding of the process and its dependence on composition and temperature. These are future challenges.

We anticipate more interesting changes in the structures and morphologies of PHB/ENR blends as the results of the melt reaction at the interface. Improved mechanical property arising from enhanced adhesion at the interface is expected to occur.

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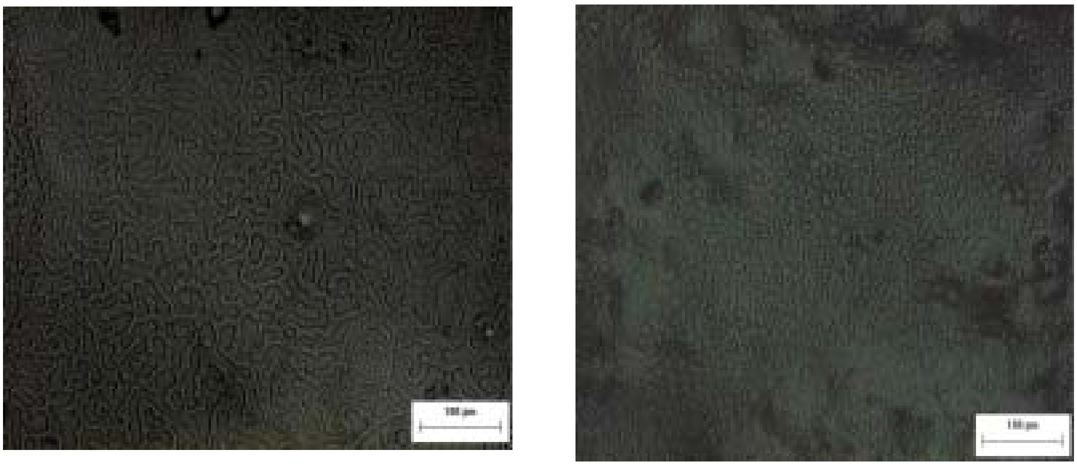

a. 40/60 PHB/ENR-50 blend

b. 60/40 PHB/ENR-50 blend

**Figure 1.** Melt morphologies of PHB/ENR-50 blends prepared by solvent casting.

# Properties and Manufacturing of Plastic and Polymeric Foams

**Dr. Coswald Stephen Sipaut**
**@ Mohd Nasri**

Polymeric foams or cellular polymers, are also referred to as expanded or sponge polymers. The importance of these polymer foams has significantly increased due to the extreme versatility of the foam materials which can be produced in the density range of 1.6 kg $m^{-3}$ to over 960 kg $m^{-3}$. Since the mechanical strength properties of plastic materials are related to the foam density, the applications usually determine which range of foam density is applicable. Thus, low-density flexible foams are usually used in cushioning as mattresses, pillows, automotive seats, packaging and vibration absorbers. Semi-rigid foam finds uses as marine fenders, flotation devices, thermal insulation, electrical insulation and cushion packaging. Rigid foams are used extensively in aerospace applications, sandwich panels, flotation devices, electronic encapsulation, insulation and in many furniture applications where wood was formerly used[1].

Three most important generic foam types are polyurethanes, polystyrene and polyolefin foams. The main areas of application of polymer foams depend upon density reduction. As the density decreases, improvements are seen in energy absorption, thermal conductivity and strength to weight ratio. Another factor is that closed-cell foams exhibit buoyancy, which may be used in combination with other factors above to enable them to penetrate many markets[1].

A major generic foam type which has gained wide acceptance and has been extensively studied is crosslinked polyolefin foams. Crosslinking gives a considerably higher heat resistance and the material behaves as a thermoset compared with the base polymer (such as polyethylene, ethylene-vinyl acetate and polypropylene) which is thermoplastic in nature. They can be processed and shaped under the influence of heat and pressure, retaining the shape upon cooling below the softening point of the polymer.

The most widely used cross-linked polyolefin foam is based on cross-linked polyethylene and it is believed that its market will substantially increase due to further development and environmental concerns of physical blowing agents (PBAs) used in non-crosslinked polyethylene foam manufacture. Historically, chlorofluorocarbons (CFCs) were widely used as PBAs in non-crosslinked polyethylene foam manufacture. The usage of CFCs has been dramatically reduced and they have been phased-out in the developed world following international legislation designed to reduce the rate of destruction of the earth's ozone layer[2].

Polyolefins can be crosslinked by chemical or irradiation methods, involving free radical generation, which can result in intermolecular covalent bonding and three-dimensional network formation[3,4]. This molecular crosslinking is the most important structural modification when used in the manufacture of polyolefin foams, which stabilises the cellular structure during expansion above the melting point of the polymer. However, different base

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polymers used in crosslinked polyolefin foam manufacturing give different physical and mechanical properties and thus affect their processability[5].

The base polymer matrix provides the dispersion medium for the gaseous phase and gives structural integrity to the overall system. Foam systems produced using polymeric materials can be generally classified into two categories relating to the physical nature of the base polymer and manufacturing methods of thermoplastic (polystyrene, PVC, polyolefin) and thermosetting (polyurethane, polyolefin, epoxy, polyolefin, phenol formaldehyde) foams[1]. Globally, the majority of crosslinked foam sheet is produced by four processes based on either continuous or semi-continuous extrusion techniques at ambient pressure (i.e. chemical or irradiation crosslinking extrusion processes) and a two-stage bun batch process based on $N_2$ impregnation in an autoclave (involving autoclave process, injection moulding and compression moulding with single stage, heat transfer and heat and chill process)[1].

There is an increasing demand for plastic foams especially for use in food packaging of biodegradable materials and in interior or exterior energy absorption in automobiles and home appliances as insulation for hot water and air conditioner pipes. This requires higher heat resistance and good thermoformability. Most crosslinked polyolefins foam, though widely available, is unable to meet these requirements as they have lower melting point. Therefore there is a growing interest to use a base polymer with a higher melting point to meet these demands. The addition of additives as fillers for example, rice husk, oil palm and carbon black, may improve the strength, hardness, temperature stability and reduce cost in foam formation. However, processing method to develop such foam need to be examined. .

Recent work [4,5] showed that chemical, physical and mechanical properties such as functional group, crystallinity, crosslinking level, reaction rate, curing time, swelling, elongation at break, modulus and strength of the crosslinked base polymer (plastic material) can be correlated to the expansion behaviour and give significant effect to their final foam properties.

Ongoing project involves investigation of formulation parameters and manufacturing techniques to produce crosslinked foams based on polyvinyl chloride and polyurethane using rice husk as fillers and characterised by density, cell size and mechanical properties. An attempt has also been made to correlate results to the properties of the crosslinked base polymer (plastic material) and as a separate investigation utilising appropriate chemical characterisation techniques to define possible reaction mechanisms. The output of this research will not only provide novel foam material but will also reduce the usage of polystyrene foam in food packaging which is non-biodegradable, thus eliminating waste dumping problems in padi field industries.

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# From Black Liquor To Drilling Mud Thinner

**Dr. Mohamad Nasir Mohamad Ibrahim**

Records indicate that over two thousand years ago, as early as 256 B.C., the Chinese used the basic cable tool technique to drill wells seeking salt brine. The 19th century was the era of the cable tool rig. Primarily, wells were drilled for water. Occasionally, oil was encountered but there was no market for that mysterious fluid, except for medicinal purposes! In the 1850's, simple oil distillates were discovered to burn very cleanly in household lamps, prompting the drilling of the first commercial oil well near Titusville, Pennsylvania, under the leadership of Colonel Edwin L. Drake. Completed at a total depth of 69 feet on August 28, 1859, this well made history. The oil boom was "on" in the Northeast of United States.

Rotary drilling was first mentioned by an Austrian in 1858. In 1860 the first rig was built in France. In the following decades, rotary rigs were developed steadily and were used primarily for water wells. In 1901, at the Spindletop field in Southeast Texas, a rotary rig was contracted to seek oil. The resulting well was the first to be termed a "gusher", producing 100,000 barrels a day. From about 1915 to 1928, rotary equipment was developed considerably. From 1928 onward, with a greater emphasis on speed, rotary rigs rapidly replaced cable tool rigs.

In the early days, water was mentioned as being used occasionally with cable rings to "soften the rock" and to lift the cuttings. Water was standardly used with the early rotary rigs and in the 1880's; water-clay mixtures were first used to prevent loss of fluid to permeable formations. At Spindletop, nearby cows were herded into the shallow pits, which contained water to churn up clay and form a "mud". This fluid was then used to stabilize a section of unconsolidated sand that kept caving into the hole. The application of scientific principles to drilling mud began in the 1920's, flourished in the 1930's and has grown steadily since.

Wise drilling fluid practices can save an oil company millions of dollars directly and indirectly. Good engineering sense can lead directly to savings by knowing when simple mud can be used satisfactorily instead of using unnecessarily sophisticated mud. While direct mud costs may constitute about 7% of the total well cost, this figure does not include time lost circulating and conditioning the mud or other mud related problems such as stuck pipe, poor penetration rates, etc. Therefore, considerably more money can be saved indirectly when good mud practices are followed.

Although drilling mud has a humble name, mud engineering is by no means elementary. To explain mud properties, physical chemistry concepts must be employed. Topics such as colloidal suspensions, viscosity, gel formation, emulsion stability, flocculation, etc., are the

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subjects of advanced chemistry classes. Also, to understand chemical treatments and analytical tests, one will need to call upon his/ her basic chemistry background.

Today, lignin has been gaining popularity as one of the future valuable organic materials. This is principally because of their adhesion and dispersion properties. The major contribution of lignin towards the oil and gas industries is as a basic material in producing a drilling mud thinner which is lignin sulfonates or better known as lignosulfonates. Lignosulfonates are very versatile and utilized in mud to act as a deflocculants agent. The lignosulfonate molecules adsorb on the clay surfaces (bentonite) and prevent the platelets from linking. Besides, lignosulfonates are valuable for stabilizing oil-in-water emulsions which give the drilling mud improved properties in the control of water loss, reduction of torque on the drill stem, increase of bit life and general improvement of bore-hole conditions

In the School of Chemical Sciences, we are embarking on a project to formulate environmentally-friendly drilling mud thinners (lignin and lignosulfonates) from oil palm lignocellulosic waste namely the empty fruit bunch (EFB) in the form of black liquor which is in line with the trend of pulping and paper industries towards the EFB. The lignosulfonate molecules adsorb on the clay surfaces (bentonite) and prevent the platelets from linking. In other words, adding lignosulfonates into drilling fluid system can reduce the viscosity of the mud and therefore will reduce the amount of energy needed to rotate the drill stem and the drill bit. As an example of its effectiveness as a thinner, lignosulfonates with sodium hydroxide are the best treatment for salt contamination. In addition to these applications, lignosulfonate also has been used in a wide area of concrete admixtures, soil additives and dyestuff dispersants. Further improvement to these products including increasing their abilities to stand high temperature and high pressure (reservoir conditions) is extensively being developed.

Besides this project, my research interest also includes Rapid Prototyping, that i, producing three-dimensional ABS plastic object without molding and electroless nickel plating.

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# Electrogenerative Processes for the Recovery of Metals

**Assoc. Prof. Norita Mohamed**

In moving towards a cleaner processing procedure for metal recovery from industrial effluents or from mining activities, electrochemical methods offer the most promising systems for such industries. Electrolytic methods are mostly employed in these industries. However, these methods require the use of energy and, for low concentrations of metals in solutions, preconcentration is necessary. These prevent such methods from becoming economically viable. A more attractive electrochemical procedure would be the galvanic process. Methods based on this process can be left unattended and these energy efficient systems allow metal recovery from low concentration effluents or solutions to be done effectively.

These processes, which are based on a spontaneous electrochemical reaction as the driving mechanism to reduce the metal ions to metals, are still in its infancy of development. However, the latest development in carbon and membrane technology allows us to redesign the entire electrochemical system to suit the processing needs.

Our focus in this research is in electrode development by either modifying the carbon surface or by adding catalyst on the carbon surface to increase the efficacy of the electrochemical system and selectivity toward recovering the metals of interest. The development of membrane technology in the last twenty years also allows us to redesign the cell so as to increase its recovery efficiency and to allow a higher throughput. The choice of the electrolyte system and counter electrodes will enable better selectivity in the deposition of metals.

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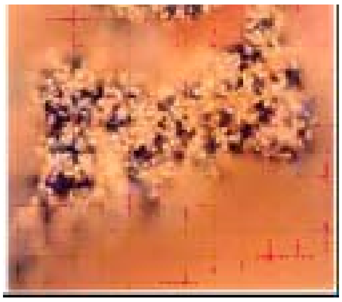
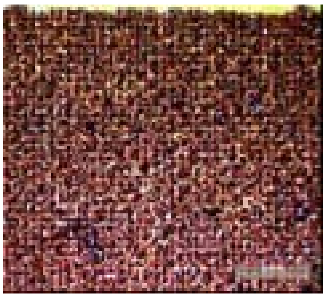
Batch recycle reactor experimental setup

Single electrochemical reactor



Gold deposited on electrode



Copper deposited on electrode

# Constructed Wetlands as An Alternative to Conventional Wastewater Treatment Systems

**Assoc. Prof. Ahmad Md. Noor**

A constructed wetland is an engineered system designed to simulate a natural wetland for wastewater treatment or some other purposes. It is essentially a biological system in which complex chemical and microbial interactions occur. Constructed wetlands are simple to construct, operate and maintain, but they need to be carefully designed and managed. There are two basic types of wetland, namely free-water-surface, where wastewater flows above the support medium, and subsurface-flow, where wastewater flows through the support medium either horizontally or vertically.

A constructed wetland can be used for the treatment of intermittent, episodic or continuous low- or high-volume flow of wastewater from domestic, agricultural or industrial sources, as well as for the treatment of grey water, storm overflow wastewater, landfill leachate, sludge and runoff from highways and urban areas. Constructed wetlands are potentially a cost-effective, low energy and robust way of achieving wastewater compliance and staying within discharge limits. Wherever wastewater contains biologically and chemically active substances, it is appropriate to consider treatment using constructed wetland either on its own or in combination with conventional systems. This wetland system has been used successfully to purify domestic sewage in the UK since 1903.

A constructed wetland comprises an intimate association of microorganisms, aquatic macrophyte vegetation, organic litter and detritus within the surrounding environment of a wetland ecosystem. The strength of these associations relates to wetland design, operation and management, as well as to the characteristics of the influent wastewater. Each of these components has an influence on the performance of the constructed wetland.

Wastewater enters the constructed wetland through an inlet and, as it passes through the system, undergoes biological and physicochemical transformation before being released at the outlet. These transformations may vary according to the nature of pretreatment and changing conditions, which affect the rate of treatment and the key components of the constructed wetland. Constructed wetlands are effective in reducing suspended solids, oxygen depleting substances, organic particulates, nutrients, and most other chemical and biological pollutants including hydrocarbons, de-icing agents, colour and bacteria.

The costs of building and operating constructed wetlands can be substantially lower than that of conventional treatment systems, particularly in rural areas with low population and availability of suitable large area of land. Constructed wetlands can be used on their own or as an add-on to an existing or ageing treatment works (including package plants and septic tanks), thereby extending the lifetime and performance of the facility. Constructed wetlands offer wide-ranging environmental benefits which include water quality upgrading, water conservation, water recycling and re-use, habitat creation and restoration, and protection of downstream ecosystems as well as commercial benefits such as aquaculture and energy production from harvested reeds.

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# Research Group on Palm Liquid Crystals

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**Assoc. Prof. Wan Ahmad Kamil Wan Mahmood,**
**Dr. Shafida Abdul Hamid and**
**Dr. Rohana Adnan**

The discovery on liquid crystalline materials and also the application of these materials in electro-optical devices have given an impetus towards generating a wide range of new liquid crystals over the last few decades. One of the areas in the recent development of liquid crystals focuses on the synthesis of ferroelectric and antiferrolectric liquid crystals.

In 1974, Meyer [1]adopted symmetry considerations to show that ferroelectric properties could be induced by the tilted, low symmetry and chiral smectic liquid crystal phases (e.g. Sc*). In addition, Clark and Lagerwall [2] found that the surface-stabilised ferroelectric liquid crystal display (LCD) devices offered many advantages over conventional nematic displays including a much shorter switching times, better viewing angle and a much greater level of multiplexability through bistability.

Study on the synthesis and characterization of liquid crystals in The School of Chemical Sciences has only started in a small capacity since 1997. The hitherto reported target compounds synthesized in the present laboratory encompass chiral ester derivatives and ester-imine compounds [3]. The progress of this work has been very encouraging and it helps to enhance the collaboration between researchers in USM and their counterparts overseas such as Japan. At present, an intensive work targeted at the obtainment of new or modified LC materials derived from palm oil waste components and related natural products is being carried out. In this respect, a research group consisting of a number of members from the School of Chemical Sciences was formed in February 2003 [4] wherein a project theme has been ascertained and the researchers identified. This research group would endeavour to use the palm oil waste components as the essential starting materials to synthesize the so-called palm liquid crystals (PLC) which exhibit desirable mesophases. At this stage, only the PLC materials of low molecular weight or monomer will be explored.

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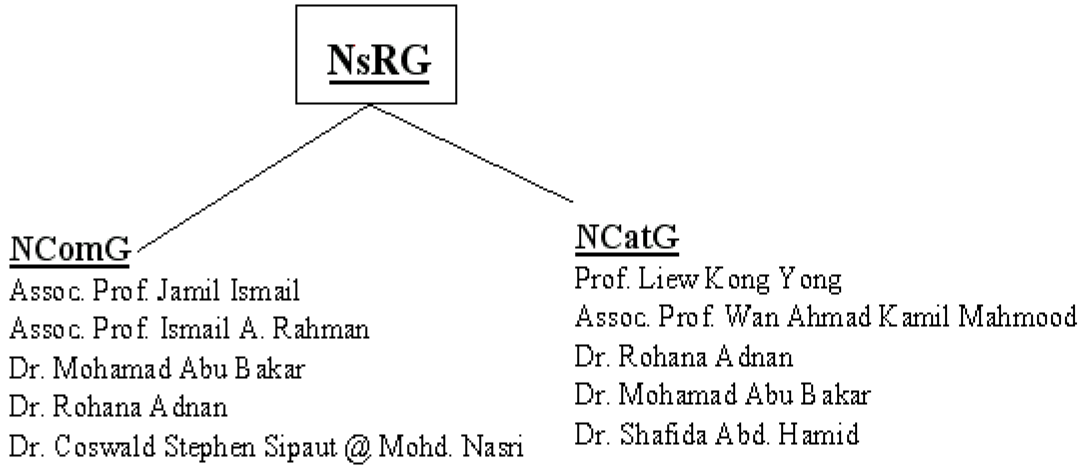
# Nanoscience Research Group (NsRG)

**Assoc. Prof. Jamil Ismail,**
**Dr. Mohamad Abu Bakar and**
**Dr. Rohana Adnan**

In line with the recently bestowed recognition upon Universiti Sains Malaysia as one of the research universities in the country and in support of the University mission towards innovative research and global competitiveness, the School of Chemical Science has established the Nanoscience Research Group (NsRG) that comprises two sub-groups, namely, the Nanocomposite Group (NComG) and the Nanocatalyst Group (NCatG).

The NsRG is nationally and internationally affiliated, with linkages including the newly formed National Nanoscience Satellite Laboratory and National Polymer Satellite Laboratory, University of Applied Science Osnabrueck, Germany (polymers), the University of Henri Poincare, France (catalyst), the University of Sydney, Australia (colloids), and the China Academy of Science, Beijing (nanocomposites).

The present output of NsRG is encouraging in terms of publications and the grants received. The members are a mix of active and dynamic senior and young academic staffs, twenty-three postgraduate students and a postdoctoral fellow. The academic staff involved in the NsRG are listed as follows:



**NsRG**

**NComG**
Assoc. Prof. Jamil Ismail
Assoc. Prof. Ismail A. Rahman
Dr. Mohamad Abu Bakar
Dr. Rohana Adnan
Dr. Coswald Stephen Sipaut @ Mohd. Nasri

**NCatG**
Prof. Liew Kong Yong
Assoc. Prof. Wan Ahmad Kamil Mahmood
Dr. Rohana Adnan
Dr. Mohamad Abu Bakar
Dr. Shafida Abd. Hamid

Current project

The NsRG activity concerns both the fundamental and applied aspects in advanced material research. For example, one major project currently being pursued by the NcomG concerns the development of polymeric resins based on silica nanoparticles for application as microelectronic materials in electronic devices and packaging. Divided into two phases, the first phase of this project, well underway, aims at the development of silica-organo composite nanoparticles. The method of preparation of silica nanoparticles has already been developed in our laboratory [1]. The silica-organo composite nanoparticles project has recently attracted the attention of INTEL where we have been invited to give a presentation at a project evaluation session [2]. The objectives are as follows:

- To establish the internal structure order of silica nanoparticles via molecular modeling.
- To activate and characterize the nanoparticle surface.
- To carry out reactions between activated surface and selected monomers.
- To characterize the silica-organo composite nanoparticles.
- To study the properties of the composite nanoparticles.
- To conduct preliminary assessment as filler.

The silica nanoparticles are almost spherical and monodisperse in size. Based on molecular modeling, three structures of different sizes have been predicted as shown in Figure 1. The structure, comprising 24 Si, 36 O, and 24 (OH), is the most spherical with a diameter of 77 nm. Owing to its unique structure, all the hydroxyl groups occur on the clusters' surface and pointing outward and the nanoparticles have pore measured at 70x40 nm, enough to allow small molecule inside. These two features can play a particularly significant role. The dependencies of structure as well as the physical and chemical properties of particles on their size will be an area of interest and high motivation to NComG.

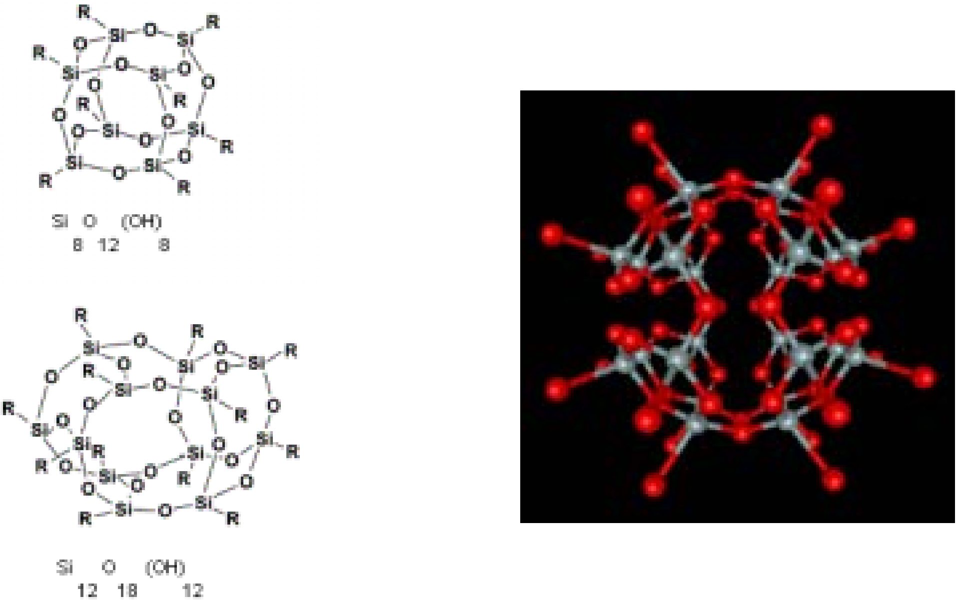


Figure 1. Proposed model of silica nanoparticles

Other than serving as the precusors for silica-based composite nanoparticles, silica nanoparticles possess the potential of being the host for small molecules and carrier for drugs. Realizing the potentials, NComG has identified the strategic topics and has prepared proposals to vie for the IRPA and FRGS grants.

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# Treatment and Speciation of Trace Heavy Metals In Wastewater Stabilization Pond System

**Assoc. Prof. Seng Chye Eng**

Waste stabilization ponds have been recognized as a very efficient and low cost method for the treatment of domestic sewage particularly in the tropical and sub-tropical climates. This treatment system depends entirely on natural processes. Their long hydraulic retention time requires, however, a large land area and this is their principal disadvantage. In Malaysia, the ponding system is popularly used to treat palm oil mill effluent, rubber factory waste and domestic waste prior to their discharge into watercourses. Evaluation of the performance of this type of treatment system generally shows that it is effective in reducing, among others, the BOD and suspended solids in the effluents [1,2]. However, very few information regarding the efficiency of the removal of heavy metals in this system had been reported.

Sewage treatment ponds may receive effluents from both domestic and industrial sources, as well as intermittent influxes of storm water runoff from nearby areas. All these sources produce effluents contaminated with heavy metals and some portions of these metals will pass through the treatment process to be discharged to surface waters [3]. If there is a trend towards the greater use of sewage treatment ponds to treat industrial effluents, a better understanding of the role of treatment processes in metals abatement is warranted [4].

The waste stabilization pond system in Taman Kota Permai, Seberang Perai Tengah, Penang consisting of two facultative ponds in parallel and a maturation pond connected to each of them in series is being used to treat domestic wastewater. The mean percentages of the removal of the dissolved heavy metal concentrations throughout the treatment path from the raw sewage to the final effluent were: Zn (79%), Cu (63%), Pb (73%) and Cd (66%). Most of the removal were found to occur in the facultative ponds with the mean percentages of the removal as follows: Zn (65%), Cu (50%), Pb (64%) and Cd (49%).

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Dissolved trace metals species are differentiated utilizing anodic stripping voltammetry (ASV) and their labilities towards ammonium form chelex resin in successive column and batch procedures [5]. Species are classified as being ASV-labile, moderately labile, slowly labile and inert. It was observed that there was some reduction in the percentages of ASV-labile and moderately labile species along the treatment path. However, there was an increase in the percentage of the other two species. This phenomenon could be due to the formation of metal complexes with organic matters.

The mean percentages of removal of trace particulate heavy metals along the treatment path were 69, 68, 58, 88 and 23% for Zn, Cu, Pb, Cd and Fe, respectively. The speciation of particulate heavy metals was carried out according to the procedure [6] which partitions particulate trace metals into five fractions: (a) exchangeable, (b) bound to carbonates, (c) bound to hydrous Fe-Mn oxides, (d) bound to organic matter and (e) residual. The results showed that Cd, Pb and Zn appeared mainly in the hydrous Fe-Mn fraction with the percentages of distribution of 58, 69 and 74%, respectively. In contrast, 64% of Cu was found in the organic matter fraction. Among the toxic metals studied, Zn and Pb are the most easily remobilized when there are changes in the environmental conditions, followed by Cd. Cu is the element that is least affected by environmental changes.

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# Assessment on Releases of Dioxins/Furans

**Assoc. Prof. Dr. Md. Sani Ibrahim**

Polychlorinated dibenzodioxin (PCDD) and polychlorinated dibenzofuran (PCDF) are a group of chemicals considered as persistent organic pollutants. Dioxins and furans are collective term for 75 congeners of polychlorinated dibenzo-p-dioxins and 135 congeners of polychlorinated dibenzofurans. Amongst these 210 compounds, 17 congeners which have chlorine atoms in the 2, 3, 7, and 8 positions are found to be highly ecotoxic. In fact, 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) is considered the most toxic man-made compound.

2,3,7,8-TCDD is carcinogenic to human while other toxic congeners showed similar biological and toxic effects such as dermal toxicity, immunotoxicity, teratogenicity, and endocrine disruption. Toxicity Equivalent Factors (TEF) for risk assessment of complex mixtures of PCDD/PCDF was then developed based on acute toxicity values from *in vivo* and *in vitro* studies (Kuts et al. 1990). The TEF values were first established by a NATO/CCMS Working Group known as International Toxicity Equivalent Factors (I-TEF) (NATO/CCMS, 1988) but were later re-evaluated by a WHO/IPCS working group to establish a new scheme in 1997 (WHO 1998).

Presently, very few countries in the world have national inventories or record on sources and levels of dioxins. In order to assist countries to identify sources and estimate releases of PCDD/PCDF, UNEP Chemicals has developed a "Standardized Toolkit for Identification and Quantification of Dioxin and Furan Releases." (UNEP, 2001). The "Toolkit" takes into account the emission of PCDD/PCDF from chemical production processes, thermal and combustion processess, and biogenic processess and releases to air, water, land, waste, residue and products. The source strength of PCDD/PCDF is a product of emission factor and the activity rate for the process. The toolkit has identified 10 main source categories such as waste incineration, metallurgical, and other industrial processess.

Currently, Malaysia does not have a complete inventory of dioxin. There is no report on the sources and environmental levels of dioxins in Malaysia. There were a few studies on the levels of dioxins in products but have not been reported or made available to the public. However, recently, we undertook a project to estimate the release of PCDD/PCDF in Malaysia using the UNEP Dioxin Toolkit (UNEP, 2001). This is an on-going effort to acquire more data from various sectors of the industries and compiled into a database of dioxin inventory.

The project had identified five main sources of PCDD/PCDF and five minor sources in Malaysia. The main sources include pulp and paper milling, motor vehicles, waste incineration, uncontrolled and accidental forest fires and electrical industry. There are minor sources including the timber industry from the used of polychlorinated phenols, agrochemicals from the use of 2,4,5-T, other industrial process, exhaust emission from diesel engines, and combustion of fuel in power plant.

The preliminary result of the study may be summarised as follows;

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*Release through waste incineration*

An estimated 8.03 x $10^6$ ton of total waste was produced in 2001 in Malaysia. There are a total of 177 landfills in Malaysia in 2001 (KPKT, 2002). There are four small domestic waste incinerators located in four islands i.e. Langkawi, Labuan, Pangkor, and Tioman with a capacity of about 20 ton per day. There is one hazardous waste incinerator operated by Kualiti Alam Sdn. Bhd. situated in Southern part of Peninsula Malaysia. There are also five fixed medical waste incinerator and seven "mobile" medical waste incinerators scattered throughout Malaysia with capacities ranging from 20 – 500 kg/hour. Based on the estimated activities of these incineration plants, municipal waste incineration released 0.72 g TEQ/year to air and 0.51 g TEQ/year in bottom ash while hazardous waste incineration released 0.30 g TEQ/year to air and 13.61 g TEQ/year to residue. The estimated total amount of PCDD/PCDF released by waste incineration processes in Malaysia in 2001 was 15.14 g TEQ.

*Release through production of mineral products.*

For the moment, we have available data for cement production. There are seven cement companies in Malaysia with varied production activities. Based on one response from the questionnaires sent out, it may be estimated that total production of cement in 2001 was 13.8 million tons. Therefore, PCDD/PCDF released to air may be calculated to be 2.07 g TEQ and to residue a much smaller amount of 0.04 g TEQ. Therefore the total release of PCDD/PCDF by the cement production activities in 2001 was 2.11 g TEQ/year.

*Release through motor vehicles*

From the statistic obtained for 2001, (JPJ , 2002) there were 5.61 million motorcycles and 4.56 millions motorcars in Malaysia using gasolein fuel. There is an estimated 85% of motorcars on the road using unleaded gasolein since being introduced in the early 80's. Smaller number of vehicles are using diesel fuel such as taxi, buses, lorries and tractors. THe major source of PCDD/PCDF from transportation were from motor vehicles using diesel engine contributing about 11 g TEQ/year and a total controbution from this sector was estimated to be 19.2 g TEQ/year.

The total release of PCDD/PCDF in Malaysia would be at least 36.45 g TEQ/year. It should be emphasized that the value is a very conservative estimate and quite incomplete. There are a number of sources particularly the industrial sector which have not been comprehensively considered in this estimate. This PCDD/PCDF release value will be improved when more data is available. However, this value are comparable to results from similar exercise by other developing countries in the world (UNEP, 1999). Japan and USA, on the other hand, have high release of PCDD/PCDF as revealed in a 1995 assessment study with values as high as 3,981 g TEQ (Japan) and 2,744 g TEQ (USA). A more recent report by the Ministry of Environment, Japan indicated a drastic decrease from 7.3 Kg in 1997 to 2.2 Kg TEQ in 2000 with about 90% contribution from waste incinerators.

Currently, Malaysia incinerate only 0.3% of the municipal waste. Most of the waste are dumped into landfill sites which finally will be developed as land reclamation projects for industrial and residential estates. The four small incinerators situated on remote islands releases about 0.72 g TEQ/year but the hazardous and medical waste incinerators were estimated to release significant proportion (13.91 g TEQ/year) of total PCDD/PCDF (36.45 g TEQ/year) released in Malaysia.

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# Fundamental and Applied Aspects of Tin Chemistry

**Prof. Teoh Siang Guan**

My research interest is in the field of organotin chemistry, reflecting both basic and applied aspects. The basic portion of my research involves the synthesis of various organotin compounds and the determination of their structures using infrared, nmr and X-ray crystallography. The applied aspects of this work deal with the development of organotin compounds as possible biocides such as antifungal and anticancer agents.

Some of the basic work involves the Schiff base adducts with inorganic and organotin compounds as well as outer sphere complexes comprising the tin moiety as the cation and the protonated ligand as the counter anion. One of the interesting discoveries made was that the long held notion that the infrared azomethine shift of benzilideneaniline ascribed to the coordination of the azomethine nitrogen atom to the tin atom was proven incorrect and the correct structure by X-ray crystallographic determination reveals the protonation of the azomethine nitrogen as being responsible for the observed shift. Others include the first established example of a complex formed by an organotin compound with an (N-meta-substituted phenyl)salicylidineimine, the first trimethyltin derivative of (N-para-substituted phenyl)-2-hydroxy-1-naphthalideneimine, and novel coordinative interaction of a diorganotin dihalide with (N-ortho-substituted phenyl)-2-hydroxy-1-naphthalideneimine.

Recent work on the structural studies of organotin carboxylates resulted in the novel hydroxo bidentate carboxylate bridged diorganotin(IV) carboxylate complex, m-hydroxo-m-trichloroacetato-*O,O'*-bis(trichloroacetato-*O*)-bis[dibutyltin(IV)].

The applied aspects include a project involving synthesizing thiosemicarbazone organotin compounds and testing them *in vitro* against the fungi *Curvularia sp., Drechslera sp., Rhizoctonia sp.*and *Alternaria sp.* Our research has concluded that organotin compounds containing the diphenyltin moiety are excellent inhibitors of the fungi. This is in contrast to the widely held notion that only triphenyl tin compounds possess biological activity.

Studies on the catalytic properties of tin compounds include the di-n-butyltin dichloride induced concomitant C-N and C-S bond cleavages and C-S bond formation at exocyclic carbon of 2-(2'-hydroxynaphthyl)-benzothiazoline and the novel tin(IV) chloride induced formation of salicyldehyde azine and related azines from methylhydrazones.

The present work is focused on structural studies of tin peptide complexes with potential pharmaceutical applications.

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# The Beginning of Oil & Gas Era in the School of Chemical Sciences

The School of Chemical Sciences, Universiti Sains Malaysia would like to congratulate Ms. Cheng Phooi Yann, a final year Industrial Chemistry student who won the first runner up prize in the Shell-SPE-UTM Inter-Varsity Student Paper Presentation Contest (S-SPEC 2003) held in Universiti Teknologi Malaysia (UTM) on 15-16 February 2003. Ms. Cheng successfully brought back a certificate, a trophy and a cheque worth of RM 1,000.00 to USM.

This second annual competition was opened to undergraduate and graduate students from local universities throughout Malaysia and was mainly sponsored by Shell Malaysia. The judging process comprised two parts, namely full paper evaluation and oral presentation. Only short-listed finalists were invited to give the oral presentation before the judges and fellow audiences in Skudai, Johor.

Ms. Cheng who was supervised by Dr. Mohamad Nasir Mohamad Ibrahim, presented her paper entitled “Tin-Tannin-Lignosulfonate: An Improved Chrome-Free Drilling Mud Thinner”. She was the only participant outside UTM who has successfully made it into the Final for undergraduate category. Due to its significant contribution towards hydrocarbon drilling technology; the judges, who had various industrial background, finally chose this paper as the second best paper out of eight finalists in the competition.

Besides being able to place the School of Chemical Sciences, USM at the same level with the Faculty of Chemical and Natural Resources Engineering, UTM in terms of contribution towards oil and gas industries, this success helps to promote a new research area, namely Chemistry in Petroleum Industry, in USM.

# Simposium Kimia Analisis Malaysia Ke-15 (SKAM-15) Ekspo Peralatan Sains 2002 (EXPERTS 2002)

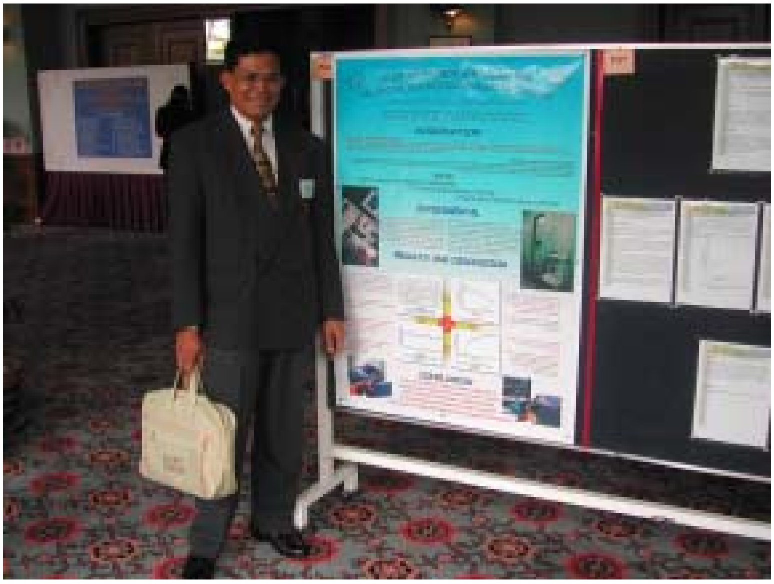
*Opening ceremony officiated by T.Y.T. Tun Dato' Seri Haji Abdul Rahman Bin Haji Abbas, Yang DiPertua Negeri Pulau Pinang.*

*Pre-conference dinner with Planery and Keynotes Speakers.*

*Keynote Speech by Prof. Mhd. Radzi Abbas, President of Malaysian Analytical Chemistry Society.*

# 15th. Malaysian Analytical Chemistry Symposium. (SKAM-15) and Scientific Instrumentation Exposition 2002 (EXPERTS 2002)

*A participants with one of more than a hundred poster presentation.*



*One of the two conference dinner hosted by USM and Pulau Pinang State Government.*

*Group photograph of some of the participants attending the three days symposium*

# School of Chemical Sciences, USM
# Highlights of Activities In the Second Half of 2002

## Industrial Linkage

This programme aims to invite people from the industrial sector to share with the university researchers their experience and knowledge in research. Specifically, the Intel-USM Academic Engagement has been supported by the Dean (Assoc. Prof. Jamil Ismail) and the Deputy Deans (Assoc. Prof. Boey Peng Lim and Assoc. Prof. Mohd Asri Mohd Nawi). Some technical and invited lectures presented by Intel Corp. on specific topics are as follows:

| No. | Date | Topic | Speaker |
|---|---|---|---|
| 1 | 28/6/2002 | Materials Challenges in Electronic Packages | Dr. Kim Gupta , USA |
| 2 | 3/7/2002 | Metals : Description, Properties, Functions, Trends, Issues & Analysis | Mr. Sim Kian Sin , Malaysia |
| 3 | 26/7/2002 | Polymer Materials for the Semiconductor Packaging I | Dr. Chee Choong Kooi , Malaysia |
| 4 | 23/8/2002 | Polymer Materials for the Semiconductor Packaging II | Dr. Chee Choong Kooi , Malaysia |
| 5. | 8/11/2002 | Technology Evolution and the Need for New Materials | Michael Garner(Director, Intel Corp.) , USA |

## School of Chemical Sciences Alumni

A pro-tem committee led by Assoc. Prof. Yeap Guan Yeow has carried out some activities aiming at setting up a platform for the chemistry graduates to communicate and share their working experiences with the chemistry undergraduate students. The seminar given by alumni members during 2002 are listed as follows:

| No. | Date | Name(Year graduated with BSc/BSc.Appl.) | Position &Address | Topic |
|---|---|---|---|---|
| 1 | 7/6/2002 | Dr. Beth Yam Wei Yin(1997) | Senior Materials EngineerIntel (M) Sdn Bhd, Penang | Application of Chemistry Knowledge in Electronics Industry – Part I |
| 2 | 14/6/2002 | Ms Shereen Ong Joo Suan(1997) | Materials EngineerIntel (M) Sdn Bhd, Penang | Application of Chemistry Knowledge in Electronics Industry – Part II |
| 3 | 12/7/2002 | Dr. Chong Kim Foong(1997) | Materials EngineerIntel (M) Sdn Bhd, Penang | Application of Chemistry Knowledge in Electronics Industry – Part III |

The information with regards to this committee, the activities and the record of chemistry graduates are also available through the Alumni website (http://www.chs.usm.my/chem/alumni.htm).

### Simposium Kimia Analisis Malaysia Ke 15 (SKAM 15) and Ekspo Peralatan Sains Serantau 2002 (EXPERTS 2002)

A National Analytical Chemistry Symposium and Regional Instrumentation Expo was held in Bayview Beach Resort, Penang from 10-12 September 2002. More than 300 scientists in Malaysia, Singapore, Australia, Japan and United Kingdom attended this symposium. A total of 34 companies took part in the Instrumental Expo.

### Academic Visitors and Speakers

V.Murugesan, Professor and Head of Department of Chemistry, Anna University, Chennai, gave two seminars, respectively, entitled "Photocatalytic Degradation of Textile Dyes in Water" on 16 September 2002 and "Synthesis, Characterisation and Catalytic Activities of Zeotype Molecular Sieves" on 17 September 2002.

### Siri Syarahan Umum : Perlantikan Profesor (Public Lecture Series: Professorship Appointments)

The School of Chemical Sciences organized two public lectures on 28 September 2002. The first lecture on "Simen Portland Sebagai Bahan Pengikat: Kepentingan dan Cabarannya dalam Industri Komposit" was given by Professor Zakaria Mohd Amin. The second lecture entitled "Bahan Kimia Stanum: Dahulu hingga Sekarang" was delivered by Professor Teoh Siang Guan.

### Award

In an Expo on Science & Technology held in Kuala Lumpur on 2-4 November 2002, Assoc. Prof. Mohd Asri Nawi and his research group won a gold medal for the development of "Cleancat 1".

The university has also conferred the award of "Sanggar Sanjung" for the year 2002 to the following from the School:

1) Assoc. Prof. Mas Rosemal Hakim Mas Haris and his research group in recognition of their significant contribution in research and development.

2) Assoc. Prof. Mohd. Asri Mohd. Nawi and his research group in recognition of their significant contribution in research and development.

3) Assoc. Prof. Wan Saime Wan Ngah in recognition of his achievement as an excellent educator.

### Short Course on FT-NMR

A FT-NMR workshop coordinated by Assoc. Prof. Yeap Guan Yeow and Dr. Shafida Abdul Hamid was held on 12-14 September 2002. The main facilitator for this workshop was Mr. Peter Sprenger from Bruker. This workshop was also supported by a renown FT-NMR (Jeol) specialist Prof. Yoshiyuki Nakamura from the FT-NMR laboratory in the Tokyo Institute of Technology, Japan. More than 40 local and foreign graduate students and also lecturers participated in this workshop.

*Assoc. Prof. Yeap (front row, 8th from the left) and Dr. Shafida (front row, 4th from the right) together with Prof. Yoshiyuki Nakamura (front row, 9th from the left) and all participants during the workshop.*

*At Closing, our Dean, Assoc. Prof. Jamil Ismail (back row, 4th from the right) joined Mr. Peter Sprenger (back row, 5th from the right) and participants who attended both the theoretical and practical* sessions

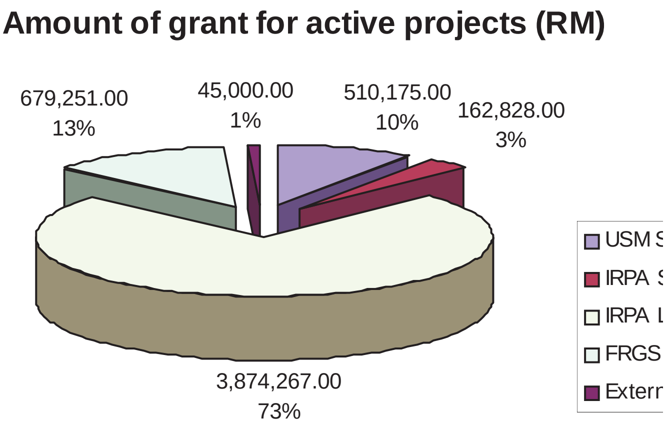
The coordinators would like to thank the facilitator (Mr. Peter Sprenger) and speaker Prof. Yoshiyuki Nakamura, the operators Mr. Khoo Kay Hock, Mr. Zahari Othman and Mr. Mohd Kassim for the assistances given throughout the workshop. The supports from our Dean (Assoc. Prof. Jamil Ismail), Deputy Deans (Assoc. Prof. Boey Peng Lim and Assoc. Prof. Mohd Asri Mohd Nawi) and Director of MUPA (Assoc. Prof. Bahruddin Saad) have made this workshop a success.

# Research Grants Secured by the School of Chemical Sciences in Year 2002

| Types of grant | Grants awarded for new projects (RM) | Grants awarded for existing projects extended(RM) |
|---|---|---|
| USM Short-Term | 153,664.00 | 5,000.00 |
| IRPA Long-Term | 606,200.00 | 380,820.00 |
| Total | 759,864.00 | 385,820.00 |

# Total Amount of Grants for Active Projects Conducted in the School of Chemical Sciences in Year 2002

| Types of grant | Amount of grant for active projects(RM) |
|---|---|
| USM Short-Term | 510,175.00 |
| IRPA Short-Term | 162,828.00 |
| IRPA Long-Term | 3,874,267.00 |
| FRGS | 679,251.00 |
| External Sources | 45,000.00 |
| Total | 5,271,521.00 |


Amount of grant for active projects (RM)

# Analytical Services : Gas Chromatography, Mass Spectrometry and Inductively Coupled Plasma-Mass Spectrometry.

School of Chemical Sciences, Universiti Sains Malaysia has a large repertoire of analytical instruments used by the staff in research and teaching. Instruments such as 400 MHz multinuclei nuclear magnetic resonance spectrometer (NMR), inductively coupled plasma-mass spectrometer (ICP-MS) and gas chromatograph-mass spectrometer (GC/MS) were recently acquired to facilitate expanding research activities in the school. However, the facilities are also extended to the USM campus community as well as other academic and research institutions throughout the country with minimal maintenance fees. These facilities are also offered to the industries as analytical services and consultations.

Gas chromatography is an important tool to analyse composition of organic mixtures, to determine purity as well as to identify chemical structures using GC/MS. We have a number of gas chromatographs with several types of detectors such as GC-FID, GC-ECD, and GC-TCD which enable detection of a wide range of chemicals. For trace volatile organic compounds, there are available head space and purge&trap samplers. Beside the newly acquired GC with quadrapole mass spectrometer detector, we have the “MS-Engine” GC/MS which is also capable of direct introduction of sample which cannot go through any GC column. Those mixtures of organic compounds which cannot go through the GC column may be analysed by high performance liquid chromatograph (HPLC) with several detectors such as UV detectors, refractive index as well as fluorescence detectors.

ICP-MS is capable of analyzing very low concentration of several metals cations simultaneously unlike the conventional atomic absorption spectroscopic technique. The ELAN 6000 ICP-MS in the MUPA laboratory (our own analytical services laboratory) is able to detect 25 elements simultaneously at the sub-ppb and ppt levels.

The analytical charges are minimal ranging from RM 50.00 for a simple GC analysis to about RM 1000.00 for the ICP MS with substantial volume discount. Interested parties may contact the Dean Office or the MUPA Director at:

Phone : 604-6573262 or Fax : 604-6574854.

# KIMIA.USM

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