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THE DUAL EFFECT OF LOW DOSE RADIATION, DAMAGE VERSUS BENEFIT

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Biological organisms present hierarchical levels of organization capable of maintaining homeostasis at low-level perturbations through intricate signalling between cells. Ionizing radiation may damage DNA and other molecular components. This primary risk rises linearly with dose over a certain dose range. A second risk describes the probability of the initial DNA and other damage to propagate in the body to cause disease, such as cancer. The homeostatic control of the second risk does not function in a linear fashion. Moreover, low-dose irradiation may adaptively up-regulate protective responses at different organizational levels genetically controlled. Such adaptive protections (AP's) usually defend also against the inevitable abundant non-radiogenic perturbations mainly from exogenous and endogenous toxins, such as reactive oxygen species. Below ≅ 0.1 Gy, AP's are potentially beneficial in outweighing the consequences of the relatively rare radiogenic damage at low doses. The balance between health risk and benefit of low-level irradiation of an individual may become predictable by gene-expression profiles also for eventually treating disease.

FORAY'S IN RADIATION RESEARCH

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RE-CREATING THE BIG BANG

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A few microseconds after the Big Bang, our Universe may have been dominated by the quark-gluon plasma (QGP), an hitherto undiscovered phase predicted by the current theory of strong interactions. Heavy ion collision experiments at very high energies at Brookhaven National Laboratory, New York and the upcoming Large Hadron Collider in CERN, Geneva have the potential for producing the right conditions for such a phase transition to occur. My introductory review of the subject will endeavur to explain what quark-gluon plasma is, why it is important and how it can be created and studied in laboratory.

INDIA'S ADVANCE IN RADIO ASTRONOMY

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With the establishment of a radio astronomy group at the Tata Institute of Fundamental Research (TIFR)) at Mumbai in 1963, India joined a select group of countries that were active in this young branch of science which began in earnest only during the 1950s. Radio astronomy has since made rapid strides and claimed many path breaking discoveries and several Physics Nobel prizes. In India the TIFR group has set up generations of internationally competitive radio telescopes of novel design, mainly using indigenous design and technology. The first of these radio telescopes were built in Kalyan (1964-65) and Ooty (1966-70) while the latest one has been set up near Pune, called the Giant Metrewave Radio Telescope (GMRT). This world's largest telescope operating at metre wavelengths, is being extensively used since 2001 by astronomers many of which come from the western world. This paper summarizes India's role in radio astronomy from an international perspective.

EXTENDING PERIODIC TABLE: PRODUCTION OF SUPER HEAVY ELEMENTS (SHE)

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To extend and find the limits of the periodic table has been the cherished aim of nuclear experimentalists. The suggestion that island of stability may exist at Z=114 and N=184 has prompted vigorous searches for this island. Till todate the elements up to Z=118 have been produced and studied. It may be that this is the limit of modern technology for the discovery of super heavy elements (SHE). To proceed further newer technologies will have to be developed. In fact new experiments are currently envisaged at the Flerov Laboratory (Dubna, Russia), GSI (darmstadt, Germany), RIKEN (Japan) and elsewhere in the world.

We present here the results of our systematic study of the decay half lives of the nuclei appearing in the observed α decay chains of the Superheavy elements (Z = 108 - 118). In such studies the pairing and the deformation play an important role. The calculation proceeds in three steps. First, the Relativistic Mean Field equations are solved in the axially symmetric deformed oscillator basis to obtain the ground state properties like the binding energies, radii, deformations, densities, etc. The results are in good agreement with the available experimental systematics. Next, the calculated densities are used in the Double Folding prescription, to determine the interaction potentials for the α - daughter systems. Finally, these potentials, along with the calculated as well as the experimental *Q* values are used in the WKB approximation to estimate the decay half lives. The calculated half lives, which sensitively depend upon *Q* values, qualitatively reproduce the experiment.

The answer to two fundamental questions: How many elements can nature create and how can they exist, hopefully may emerge in future.

RADIATION INDUCED SYNTHESIS OF NANOPARTICLES

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Radiation chemical methods form an excellent tool for the synthesis and understanding of reaction mechanism of nanoparticles because highly reducing species (e^-_{aq}) in known yields and in a controlled fashion can be produced. Both pulse and steady state radiolysis have been used for production of a variety of metal nano particles. The presentation will cover general aspects of pulse radiolysis and an account of the LINAC facility at the Pune University. A few examples of synthesis and mechanism of metal nanoparticles using our facility will be discussed.

A MECHANISM FOR GENERATION OF ULTRA LOW-FREQUENCY WAVES IN THE POLAR CUSP REGION

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Ultra Low-Frequency (ULF) electromagnetic waves, in the frequency range of ~1 mHz to 3 Hz, have been observed in the polar cusp and other regions of the Earth's magnetosphere by several spacecrafts, e.g., Geotail, Polar and CLUSTER. There are strong indications that these waves are generated locally by the energetic ion beams injected during magnetic reconnection taking place at the magnetopause. Ion beams observed in the polar cusp, plasma sheet boundary layer (PSBL), and on the auroral zone field lines are expected to have spatial gradients in their drift velocity. A generation mechanism for the ULF waves is proposed in terms of kinetic Alfvén wave instability driven by velocity shear of the ion beams. The noise due to velocity shear driven Alfvén modes is electromagnetic in nature, and also has a finite parallel electric field component.

OXIDATION OF ZR-BASED BULK AMORPHOUS AND NANOCRYSTALLINE ALLOYS

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Bulk amorphous alloys show a fairly wide temperature range between glass transition and the crystallization temperature and a remarkable resistance to crystallization. The bulk metallic glasses require cooling rates of about 1-100 K/s or less unlike conventional melt-spun metallic glasses which require very high cooling rates of about 10^6 K/s for processing [1]. Novel multicomponent Zr-based alloys like Zr-Ti-Cu-Ni-Be and Zr-Cu-Ni-Al form an important class of bulk metallic glasses with some interesting applications [2]. Nanocrystalline forms of these alloys have been obtained by thermal annealing. Interest in bulk amorphous alloys and their nanocrystalline forms has considerably grown in recent times due to their ability to offer scope for carrying out research investigations in amorphous, supercooled liquid and nanocrystalline states of a bulk glassy alloy.

Despite several studies done on the oxidation behaviour of conventional melt-spun amorphous alloys. Very few studies are available on oxidation of bulk metallic glasses [3]. The paper shall review the current status of oxidation research in bulk amorphous alloys and their nanocrystalline forms obtained after annealing. Some novel results from the author's recent work carried out on oxidation of the bulk amorphous alloy $Zr_{65}Cu_{17.5}Ni_{10}Al_{7.5}$ in air in its amorphous and the supercooled liquid states in the temperature range 573 K- 663 K using X-ray photoelectron spectroscopy (XPS) will also be presented.

[1] T. Zhang, A. Inoue and T. Masumoto, Mater. Trans. JIM 32 (1991) 1005.
[2] W. L. Johnson, Current Opinion in Solid State Mater. Sci. 1 (1996) 383.
[3] A. Dhawan, K. Raetzke, F. Faupel and S. K. Sharma, phys. stat. solidi (a) 199 (2003) 431.

NANOSCOPIC ASPECTS IN PHYSICAL, CHEMICAL AND BIOLOGICAL RADIATION SCIENCES

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Ionizing radiation is a primordial, ubiquitary factor in the presence of which all life on earth developed. Since Conrad Roentgen it plays also an important role in diagnostic and therapeutical medicine, and since Otto Hahn ionizing radiation helps to provide energy and could contribute a terrible aspect to war. Also in the technical arena tracks of ionizing particles have be promoted our knowledge in transmission and scanning microscopy, and provided new means of lithography, filters, etc. They helped also to date ancient artefacts and in radiation dosimetry.

Tracks left behind by the various qualities of ionizing radiation are characterized by their small sizes (typically nanometers) and short time scales of formation (typically sub-picoseconds). An understanding of their immediate formation, of the subsequent physical, chemical and biological re-actions to this fast disturbance has been attempted for almost a century, but still many important aspects have to be investigated. The existence and/or size of positive or negative effects of very low doses of ionizing radiation on human health is still unknown, and important decisions in the medical field and in power production would urgently benefit from such knowledge.

In this lecture an overview will be given on the present status of safe knowledge on the nanoscopic physical, chemical and biological aspects of charged particle tracks will be given as well as on new nanotechnological and computer based developments to overcome the still existent large gaps in this knowledge.

NUCLEAR MEDICINE IN 21ST MILLENNIUM: AN APPROACH VIA NANOTECHNOLOGY

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The radiation biology is concerned, on one hand, with a domain of science bordering the fields of physics, chemistry, and biology, and on the other hand with plethora of effects produced by radiation in living cells. The pragmatic aims of radiation biology are: How to arrive at realistic estimates for radiation-induced cancer? How to improve treatment strategies for the radiotherapy of human cancer? At present the general research interests lie in 3 domain:- *in vitro* neoplastic transformation, gene expression analysis, radiotherapy. Radiation therapy is now commonly accepted as one of the most effective forms of cancer treatment, and used for a variety of malignant tumors of different origins and stage. The success of radiation as a cancer treatment modality stems from the facts that radiation dose can be delivered locally and that cells within the radiation field can be killed effectively. Clinical schemes of radiation therapy result from many decades of experimentation and empirical development of most effective regimes both by laboratory researchers and clinicians. Since the 1920s it was recognized that damage to patient's normal tissue was less severe if the total dose was delivered in many fractions, with one or more days between fractions, rather than all at once. In contrast, fractionation of radiation dose does not have quite as a pronounced sparing effect on tumours. The sparing effects of fractionated irradiation are thought to be due to the repair of sublethal damage. Attempts to understand this process at molecular and biochemical levels are underway in many laboratories, including ours, as indicated by my colleagues.

In radiotherapy the role of nanotechnology is in offing. The role of dendrimer nanocomposites in radiotherapy and imaging of the tumor microvasculature has recently been realized. Balls of carbon atoms called buckyballs only a nanometer or billionth of a meter in diameter could serve as future antiradiation drugs to help protect against the side effects of cancer therapies or against dirty bombs. One way that radiation therapy and chemotherapy frequently injures cells and tissues are by producing damaging "reactive oxygen species," such as free radicals, oxygen ions and peroxides. The researchers and their collaborators at Houston-based nanotechnology firm C Sixty speculated the electron clouds that surround buckyballs might "soak up these free radicals. Looking at several such recent developments the emerging role of nanotechnology conjointly radiation biology is quite promising.

NANOTECHNOLOGY AND CANCER TREATMENT

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The cancer treatment is normally carried out by radiation therapy, chemotherapy and surgery. However, the success rates in the treatments have been very poor. One of the reasons for this has been the failure in detection and diagnosis of the cancer in its initial stage.

The size of cells is typically of the order of 10 μm. The theme of nanotechnology is the control of material in the scale of 0.001 μm to 0.1 μm. Therefore, there is a feasibility that nano materials can enter into cancers cells and detect changes in the cells. Thus, it creates hope that nanotechnology can be used to create therapeutic agents that target specific cells and deliver toxin in a controlled manner. The aim is to create single agents that are able to detect cancer and deliver treatment.

In nanotechnology, the structures like cantilevers, nanopores, nanotubes, nanoshells and quantum dots have been developed. These structures can be utilized to decipher information about the cells and know whether the cancer molecules are present or not. A number of nanoparticles that will facilitate drug delivery are being developed and are in different stages of development.

On nanoscale, there is vastly increase in the ratio of surface area to volume. Due to this, the nanoparticles have higher chemical reactivity and biological activity. These can easily cross biological membranes and access cells, tissues and organs that larger particles cannot and thus can cause unwarranted damage. The toxicity of nanoparticles has to be appropriately controlled and regulated.

In the proposed presentation, an effort will be made to bring out the potential application of nano-structures like nanoshells, nanopores and quantum dots in detection, diagnosis and treatment of cancer. The progress made in developing these methodologies and the needed regulatory aspects will also be highlighted.

CHEMICAL SENSING OF IONS AND ITS CLINICAL APPLICATION

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Molecular fluorescent signaling is the natural interface between human and molecular domains via the intermediacy of the photon. Therefore, molecular fluorescence is one of the most visually powerful phenomena in photophysics/photochemistry. The phenomenon of molecular fluorescence processes have many features which make it particularly suitable for real-time and real-space monitoring of atomic and molecular species. Chemical sensing of ions using fluorescence technique is of considerable current interest as sensors in biomedical research. Imagine a day when blood concentrations of important analytes are determined not in a batch mode, but rather through the use of a fiber-optic bundle inserted into an artery. Development of different fluorescent sensing systems of ions along with some of the above aspects will be discussed.

DOMESTICATING ATOMS AND MEDICAL APPLICATION

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Nanoparticles (domesticating atoms i.e. by controlling their properties and behaviour) can do wonders to meet some of the world's biggest challenges. Since recent years there is a positive feeling towards this new technology of nanosciences which will bring both human and financial benefits. There is a strong need for regulation and public information at all stages of such research. The nanotechnology has many useful applications like in military, crime detection through disposable ultrasensors, firm root in chemistry labs, ability to measure features never measured before, helpful in perfect packaging and become miracle material of 21st century like carbon nanotubes for drug delivery, gene therapy and sensor probes.

Nanotechnology has also a bright and healthy future and may set a tremendous impact across the whole field of medicine. Some of the areas of development and challenges to overcome, so as to introduce nano science in a safe and effectively will be dealt here in brief. There has been a massive growth shown in the field of nanotechnology. It has given a great boon to vastly improved medical treatments like target drug delivery, improved diagnosis, better material for devices and implants.

It has many types of applications like first generation nanomedicines in medical field like nanotechnology based probes and sensors to monitor body physiology, to perform hundreds of diagnostic tests using nanoquantities of samples, to develop diagnostic imaging. Nanoparticles can be activated to specific sites –tumours, further miniaturization of devices and also to develop novel implantable devices. Surgical tools can also be better designed so as to give improved performance. Actuation based on nanomaterial – carbon nanotubes may be used in a variety of surgical and other applications. Nano-engineering of implant surfaces will provide better biocompatability.

However it is also important to understand the various types of risk involved in nanotchnology whenever a new product is introduced in market and during its acceptance by the doctors and public. An example can be cited i.e. nanoparticles could damage DNA and lead to cancer as they are small enough to penetrate cell membrane and defences yet they are large enough to cause problem by interfering with normal cell processes. As such to understand which type of nanoparticles are most dangerous as well as their exact mode of action will be an important element for future research.

Replicating nanotech robots (as mentioned in some science fiction) may be a genuine fear. Therefore there should be a check from nanoscientists about the ability to entry in body by nanoparticles and the possible toxicological or biological safety. Accordingly an effective communication coupled with a transparent applied risk analysis and management process about the possible risk and benefits of nanotechnology products shall be necessary to public, medical professionals and industry.

GENETIC ENGINEERING OF GRAPEVINE – CURRENT ISSUES AND FUTURE PROSPECTS

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Genetic engineering is one of the most powerful tools for plant improvement. Genes cloned from virtually any biological organism can be inserted singly or in combination into genome of any plant species. This allows for targetted improvement of elite cultivars, insertion of genes outside the usual gene pool of species, and study of gene function. Use of this modern tool for grapevine improvement has high potential because all grapevine cultivars are vegetatively propagated. Thus, modification to established cultivars by genetic transformation should, in theory, retain the essential characters and identity of the cultivar unaltered. This is especially important for the wine industry where the name of a cultivar is often used for product labeling and differentiation. New cultivars resulting from traditional breeding programs are always assigned new names, contributing to their slow acceptance in the market. Successful application of genetic engineering technology to grapevines requires a combination of the following: efficient transformation and regeneration systems; identification and isolation of useful genes; promoters for controlling gene expression and evaluation of introduced trait. While tremendous progress has been made in other crops especially maize and cotton, genetic engineering of grapevine however still remains at an early stage, since there is much to be discovered about transgene expression and the performance of transgenic plants in the field. It can be expected that in coming years the greatest impact of grapevine genetic engineering will be helping us understand biological processes and gene function. The objective of this presentation is to dwell on the current scenario and future out look of transgenic research on grapevine.

AGRICULTURAL INCOME AND PRICE POLICIES OF THE EUROPEAN COMMUNITY

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European Community presently consists of 25 countries. Although the level of economic development of individual member countries varies, the Community by and large is regarded as a developed region. Out of the population of 25 crores, only 1.1 crores (2.2%) depends on agriculture (which includes farming, livestock and forestry). Average area cultivated by a household in the Community is around 18 hectares. Yet, its share in world agricultural production is quite significant. Before the formation of the Community, the income and price policies of individual countries were quite different from each other as also aimed at protecting one's independence and food security. With the formation of the Community, naturally, there was a need to evolve a common agricultural policy to protect the incomes of the farmers, ensure food security of the member countries and respect the terms and conditions of the World Trade Organization. This formulation took many years and ultimately a Common Agricultural Policy (CAP) was announced in June 2003. The policy is extremely complicated and there are continuous efforts since then to simplify it. It is also unique in several respects and promotes entrepreneurial potential of farmers. The study of this policy is particularly useful for India, as it provides many lessons for drafting our agricultural policy as also enables us to become an effective partner in the world agricultural trade.

SOME ASPECTS OF FLUORINATED BIOACTIVE HETEROCYCLES OF MEDICINAL IMPORTANCE

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The small size of the fluorine atom (1.47 A°) is a unique characteristic and its van der Waals radius is similar to that of hydrogen (1.20 A°) therefore, a fluorine atom can mimic a hydrogen atom or hydroxyl group (1.40 A°) in a bioactive compounds with respect to steric requirements at receptor sites. In addition, the apparent size of CF_3 group is comparable to that of the isopropyl group coupled with its lipophilicity (strongest lipophilic group), impart the lipid solubility of the fluorinated heterocycles and thus, increases the rate of circulation and absorption of the drugs. The high electronegativity of fluorine (4.0, Pauling scale) can have pronounced effects on the electron distribution in a molecule, since the presence of the fluorine atom affects the acidity or basicity of neighbouring groups and can create a high dipole moment. Thus, this type of modification can also induce modified biological responses. Rational designs exploiting these special property of fluorine have been successful in the development of new effective biochemical tools as well as medicinal and therapeutic agents. In this communication different aspects of synthesis and medicinal uses of fluorinated indoles, quinazolenes, pyrazoles, uracil, phenothiazines, benzodiazepines and allied compounds would be presented.

CRAZE FOR ISO 9001 CERTIFICATION BY ALL KINDS OF ORGANIZATIONS AND ITS ADVANTAGE TO GENERAL PUBLIC

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In this paper a brief description of requirements for obtaining ISO 9001 certification and expectations from the organization by customers or consumers are narrated. The customer expects products which are fit for the purpose and expects them to perform well till the stipulated life time of the product. From the service Industry, prompt and proper service is expected for the very first time. How many Organizations, both Government and Private come up to the mark, in spite of being certified ? What are the limitations in the certification process? Status of Quality movement and Quality management system in India is presented and other related International Management Standards are also referred.

COMPUTATIONAL CHEMISTRY AS AN INTEGRATED TOOL FOR CHEMICAL STRUCTURE, REACTIVITY AND MODELING

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In this overview presentation, I would like to bring out the scope of computational chemistry as an integrated tool for chemical structure, reactivity and multi-scale modeling. With high performance computing environment and developments in quantum chemistry, accurate modeling and reactivity at small time and length scales are possible. Some of our work in this direction will be discussed. Modeling at large time and length scales presently requires use of empirical and classical methods, scopes of which will also be highlighted in this presentation.

ELECTRON TRANSPORT MEASUREMENTS IN GRAPHENE AND IN-AS NANOWIRES

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In this talk I will discuss our recent experiments probing the electronic porperties of individual In-As nanowire and few monolayer graphene sheets. We see a electric field induced modulation of the carrier density in InAs, the familiar FET behaviour. As a function of magnetic field we observe a reduction in the on-state current and gradual shift of the threshold. I will briefly describe how could be understood within a simple picture of geometrical confinement of circular orbits. For graph,l:me, I will summarize the measurements of tuning the electron density through the Dirac point.

APPLICATION OF NANOTECHNOLGY: PERSPECTIVE OF A CHEMIST

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The field of nanotechnolgy is not a new one. Mankind has been exploiting it without being aware of the same from time immemorial. Scientists have been studying and working with nanoparticles for centuries. The effectiveness of their work in the earlier times was hampered due to their inablity to see the structure and size of the nanoparticles with which they were working. The progress made lately in the area of engineering sciences has lead to the development of microscopes capable of displaying particles as small as atoms thereby giving impetus to this area of science. The later day research has established beyong doubt that physico-chemical properties of conventional materials undergo interesting modifications when synthesized using nanoparticles or converted into their nanoform. It has been realised that some of these modifications have potential for applications in fields as varied as defense, textiles, metallurgy, automobiles, chemicals, sensors, pharmaceuticals, environment etc. There are two basic approaches for synthesizing nanoparticles: the top down approach and the bottom up approach, the later being the methodology of interest as far as the chemists are concerned. The present talk will be providing details of the chemical synthesis of nanoparticles besides giving an overview of the applications of nanotechnolgy from the perspective of a chemist.

IONIC LIQUIDS: ENVIRONMENT-FRIENDLY SOLVENTS AND CATALYSTS FOR THE FUTURE

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Molecular solvents have been used traditionally to perform most of the chemical reactions. Recently, a new class of solvents has emerged-ionic liquids. The ionic liquids possess many fascinating properties, which make them interesting to all the researchers. Reactions performed in ionic liquids have dramatically different kinetic and thermodynamic profiles as compared to that in the molecular solvents.

Ionic liquid consists of a cation such as alkylammonium and anion such as tetrafluoroborate or hydrogen sulfate. For example, methylimidazolium tetrafluoroborate [MeIm][BF_4] and triethylammonium sulfate [Et_3N][HSO_4]. Thus, many combinations of cation and anion are possible to design ionic liquids with the desired properties.

Ionic liquids have no measurable vapour pressure and therefore, there is no emission of volatile organic compounds. The conventional solvents are volatile and huge amount is lost to atmosphere due to evaporation which causes enormous damage to the environment. Therefore, ionic liquid, are termed as green solvents.

The solubility behaviour of ionic liquids is dramatically different from the molecular solvents which depend entirely on the structures of the cation and anion. Although, ionic liquids are polar in nature they can dissolve wide range of compounds including covalent gases such as hydrogen, oxygen, carbon dioxide and carbon monoxide, and highly polar compounds like metal complexes. It should be possible to design ionic liquid such that the reactants are soluble in it but the product is not. Thus, the product forms a separate phase which can be isolated by simple decantation. Another major area where ionic liquids find application is separation processes.

A very interesting property of ionic liquid is that functional group such as –SO_3H can be built in the ionic liquid which can act as a Brønsted acid catalyst. These ionic liquids serve as catalysts and media for Fischer esterification where high yields are obtained without removal of the water. The ester being insoluble in ionic liquid forms a separate phase and can simply be separated by decantation. This is a great advantage over the conventional procedure where the product is separated from catalyst by costly process of distillation. It is possible to tune the physical and chemical properties of the ionic liquids such as liquid temperature range, viscosities solubilities and electrochemical windows by varying nature of anion and cations. A variety of reactions have been carried out in ionic liquids as media. In addition to providing an eco-friendly solvent, the ionic liquids have shown dramatic increase in the selectivity in the reactions.

Ionic liquids have opened new avenues in chemistry. Much development is expected to take place in the area of organic reactions, catalysis and separation science. The chemical reactions are being looked at afresh in the light of ionic liquids. The environment-friendly behaviour of ionic liquids holds lots of promises as the future solvents for chemicals industries.

SYNTHESIS, CHARACTERIZATION AND APPLICATION OF YTTRIA-ZIRCONIA BASED STRONG LEWIS ACID CATALYST

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In recent years there has been tremendous upsurge of interest in various chemical transformations mediated by solid catalysts. While yttrium has got considerable prominence in superconductivity, very little is known about its application in organic chemistry. Since yttrium with its vacant d-orbital offers opportunity for developing strong Lewis acid sites in a heterogeneous catalyst, development of such catalyst becomes highly desirable for organic synthetic transformations.

We have synthesized a new yttria- zirconia catalyst by sol-gel coprecipitation method. The acidity of the catalyst has been demonstrated by FTIR of adsorbed pyridine, potentiometric titration with n-butylamine and temperature programmed desorption of ammonia, whereas its surface area was determined by N_2 adsorption (BET) method. XRD of the catalyst indicated the formation of cubic phase. The scanning electron micrograph showed the particle size of approx. 0.3 μm. Additionally, the utility of yttrium based Lewis acid catalyst was demonstrated by number of useful organic transformations. The details of catalyst synthesis, its characterization and application for various organic transformations will be presented.

SEMICONDUCTOR NANOSTRUCTURES: QUANTUM WELLS, WIRES, AND DOTS

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Semiconductor quantum structures are ultra-thin film, wire, or dot-like configurations of nanometer size, which so tightly confine electrons that their properties are modified by quantum mechanical effects in dramatic, and potentially useful, new ways. Due to continual advances in precision semiconductor growth techniques with atomic scale control such as molecular beam epitaxy and metal-organic vapour phase epitaxy, such structures can now be realized with great accuracy. In the last few decades, the study of confinement of electrons in quantum wells not only led to the discovery of novel phenomena such as the quantum Hall effect but also to the use of quantum wells in a variety of devices like high electron mobility transistors, resonant tunnelling diodes, and quantum well lasers. Many of these devices now enable everyday applications like cellular phones, CD/DVD players and laser printers.

The last few years have seen an intensive focus on the fabrication and characterization of quantum structures with reduced dimensionality, namely one- and zero-dimensional structures, quantum wires and quantum dots. Once again, the realization of such structures has resulted in the demonstration of new physical phenomena and novel device concepts such as single electron transistors. Quantum wires and quantum dots are now poised to provide the basic building blocks of the next generation of (opto) electronic devices.

In my talk, I would provide an introduction to the field of semiconductor nanostructures, illustrating it primarily with examples from ongoing work in the area of III-V semiconductor materials grown in our laboratory at TIFR. We have synthesized a variety of quantum dot systems such as InGaP QDs on GaP, and InAs QDs on InP, as well as compound semiconductor nanowires grown via the "Vapour-Liquid-Solid" (VLS) technique. Further, intersubband transitions in quantum wells and dots are a novel approach towards the fabrication of long-wavelength IR detectors, and I shall briefly report on some of our experiments in this area.

CONTROL OF MULTIWALL CARBON NANOTUBES DISPERSION AND ELECTRICAL CONDUCTIVITY OF NANOTUBE-POLYAMIDE6 COMPOSITES

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The homogeneous dispersion of carbon nanotubes (CNT) remains a hindrance in exploiting the exceptional properties associated with CNT in polymer/CNT composites. The key role of sodium salt of 6-aminohexanoic acid (Na-AHA) in assisting debundling the multiwall carbon nanotubes (MWNT) through specific interactions during melt-mixing leading to homogeneous dispersion within polyamide6 (PA6) matrix is observed for the first time. The composite fabricated via melt mixing route exhibits low electrical percolation threshold of 0.5 wt%, the lowest reported value in this system so far. Retention of 'network-like structure' in solid state with significant refinement is observed even at lower MWNT concentration in presence Na-AHA, which is assessed through AC electrical conductivity measurements. The phenomenon of reactive coupling between amine functionality of Na-AHA and acid end group of PA6 during melt mixing is also established. Reactive coupling is found to be a dominant factor besides 'cation-p' interaction in achieving low electrical percolation in PA6/MWNT composites. These nanocomposite materials can therefore be tailored depending on the end use as antistatic devices, capacitors and EMI shielding materials.

NANOTECHNOLOGY IN PAINT COATINGS

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Applications of nanotechnology are widespread. Hardly any field of science and technology would have left untouched from the benefits of nano-technology. Though there are several applications of nanotechnology in chemistry, the advantage of nano-technology in formulating advanced paint systems is phenomenal.

A paint coating is a mixture of an organic resin in a suitable solvent with addition of small quantities of pigments and some additives. Presence of pigments modify certain properties like corrosion resistance, weathering stability, hardness and strength. Normally, these pigments are of micro-dimension and are added in relatively higher concentration. However, the same pigments when added in nano-dimensions, provide phenomenal improvement in these properties at a much lower concentration. It is possible to achieve highly UV resistance and scratch free coatings with high hardness by addition of just less than 0.1% of nano-pigments such as ZnO, Alumina or Titania.

Another way to achieve these properties is by forming nano-structured coatings. These can be formed *in-situ* using sol-gel process based on organo-silane such as epoxy silane, amino-sliane and acrylic silane. These coatings can be waterborne or can be formed in some organic solvent. Transparent coatings of thickness ranging between 4-9 nm can be obtained which have excellent weathering resistance, corrosion resistance, high hardness and excellent flexibility. Another advantage is comparatively high thermal stability as well as repellency to water. The probable application area are : automotive, coil coatings, aerospace, glass and plastic coatings. Thus, the use of nanotechnology in the paint has to be regarded as a consistent further development of new paint formulations which are cheaper and readily acceptable to end user.

LOW TEMPERATURE SYNTHESIS OF NANO-MATERIALS USING SOL-GEL TECHNOLOGY

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The application of sol-gel technology for the production of high quality nano-materials from the chemically modified metal/hetero-metal alkoxides and related derivatives has given a new impetus to the material sciences. Applying the sol-gel process it is feasible to control the entire synthetic route from precursor to the final targeted material at the molecular level, a bottom-up approach, which is unachievable with the traditional, top-down approach. Results of some of the recent studies carried out in our laboratories would be highlighted.

CHARACTERISATION OF CARBONACEOUS MATERIALS USING RAMAN SPECTROSCOPY AND RAMAN SIGNATURE FOR DEGREE OF ALIGNMENT IN MULTI-WALLED NANOTUBE FILTERS

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A special variety of multi-walled carbon nanotubes (MWCNT filters) has been recently synthesized which has specific molecular filtering capabilities and mechanical strength. The Raman spectra of this material and four other materials: single-walled carbon nanotubes (SWCNT), commercially available MWCNTs, graphitised porous carbon (Carbotrap™) and graphite have been recorded using two excitation wavelengths, 532 and 785 nm. The spectra have been analysed for band positions and band shapes. The changes in peak position and intensity of D-band with different excitation wavelengths have been studied. A line shape analysis of the G-band of the SWCNT indicates the semiconducting nature of the SWCNT bundles. The line shapes have also been studied for different MWCNT varieties. A major difference between the different MWCNT varieties analysed is that, G-bands in the MWCNT filters exhibit almost no dispersion, whereas the other MWCNTs show a noticeable dispersive behaviour upon change of excitation wavelength. Optical and scanning electron microscopic studies have also been made on MWCNT filters, which revealed the formation of highly aligned arrays of bundles of carbon nanotubes having large lengths up to 500 μm.

The Raman spectra of different carbonaceous materials were recorded, and the most prominent band structures are analysed and compared. The D-band in the Raman spectra of different carbonaceous materials, which results due to disorder and symmetry lowering, exhibits a significant dispersive behaviour with change of excitation wavelength. The G-band of the carbonaceous materials except graphite consists of six modes. For each symmetrical mode in the nanotubes, the vibration of atoms is either along the axis of the nanotube or along the circumferential direction, which are designated as G + and G– bands, respectively. The G- and D2- bands of the other materials are also investigated for their dispersive behaviour with a closer look at the MWCNT and Carbotrap species. The stable Raman shift position of the triplet band system for the MWCNT filter species, nearly independent from the two excitation wavelengths, is a rather distinct and unique result of our investigation.

While studying the band intensities, it was found that the G-band in the spectral features of the MWCNTI filter species dominated over the D-band for both excitation wavelengths used in the present study. A relatively less aligned MWCNTII species showed a spectral similarity much closer to that of the microporous graphitised carbon black material, providing clues on the disordered structures. Based on the results of this

study, essentially the intensity of the two bands which is almost a Raman signature for disorder, Raman spectroscopy offers a quick method of quality control for the fabrication of aligned MWCNTs.

SEQUENCE STRATIGRAPHIC FRAMEWORK OF LOWER – MIDDLE JURASSIC (BATHONIAN) SEDIMENTS OF THE JAISALMER BASIN, INDIA

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The Middle Jurassic sea transgressed the Rajasthan shelf simultaneously to the neighbouring Kachchh Basin on the western part of the Indian craton. Structurally, the part of the Rajasthan shelf, which records marine Jurassic sediments, has been termed as the Jaisalmer Basin. The sediments in the basin range from non-marine siliciclastics to brackish/marine mixed siliciclastic-carbonate muds. Lithostratigraphically, these sediments have been grouped into the Lathi, Jaisalmer, Baisakhi, and Bhadasar formations in ascending order. Of these the two older formations represent the first transgressive/regressive cycle ranging from Lower Jurassic to Upper Jurassic (Oxfordian). Well-cemented, fossiliferous carbonate units represent the peak transgressive events, whereas thick, cross-bedded non-fossiliferous sandstone units predominantly characterize regressive units. The sequence cycles predominantly consist of transgressive (TST) and highstand systems tracts (HST). Within the Lower-Middle Jurassic (Bathonian) time interval, a total of 91 parasequences of fourth order are recognized and have been grouped into 18 sequence cycles of third order. The sequence stratigraphic framework reveals that the time-interval between Lower and Middle Jurassic (i.e. up to Middle Bajocian) records weak trangressive events, which are represented by thin carbonate-rich units, whereas the late Bajocian time-interval, represented by thick rudstone unit, documents the first peak of transgression. Similarly, the upper part of Bathonian records another peak of transgression. There has been a gradual increase in the deepening of the basin and deposition of marine sediments from Late Bajocian to Late Bathonian. The character of the sediments deposited during HST and absence of any evidence of major change in tectonic setting in the basin suggest that climatic change has played a main role in the relative sea-level change and sediment supply.

- *Lower-Middle Jurassic, sequence stratigraphy, Jaisalmer Basin, Lathi and Jaisalmer formations*

SYMPHONY OF THE HIMALAYAN MOUNTAIN

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The Himalayan Mountain is understood to have evolved by collision of Indian Block against Asian Block about 50 million years ago when the intervening rocks were squeezed, deformed, metamorphosed and elevated to from this lofty mountain. The evolutionary history covers a protracted period of over 100 million year (Ma). About 220 Ma ago, India was located about 50 degree south of equator and was part of a giant congregation of continents, called the Gondwanaland. Convection currents in the deep Earth separated the Gondwana continents, including India. The separation of India not only developed the Indian Ocean but also set off the Indian Plate for its northward trip to collide with the Asian Plate (Plate connotes a continent with its encircling oceanic crust). The journey is documented by magnetic reversals on the Indian Ocean floor located to the south of India. There was also an ocean between the northward-moving Indian Plate and the Asian plate. This ocean was the Neo-Tethys of geologist and its subduction beneath Asian plate and consequent melting formed a chain of E-W trending granitic rocks, geologically making the Magmatic Arc or Island Arc, amongst them Ladakh and Kailash mountains (100-60 Ma old) are well known. These earliest formed mountains of the Himalaya are called the Trans-Himalayan Batholith. The afore-said Arc was accreted on the north by the Tibetan Block along Shyok suture and on the south by the Indian plate along Indus-Tsangpo suture (ITSZ). In the following event, some oceanic rocks during long journey from their birth place were hydrated and scrapped off at the subducting place due to "bulldozing effect" by the overlying Arc and, were "injected" (~55 Ma ago) into the Arc along its sutures on either sides. The two ophiolite mélange belts are the next suite of rocks of the Himalayan Mountain. With continued subduction, the oceanic crust was completely eliminated and India collided (~ 45 Ma) with the accreted Asian Block. In this event, 600 Ma and older rocks of northern Indian plate margin were stripped off and underwent deformation and metamorphism at great depths of 25 – 30 km at 30 - 32 Ma. To restore isostasy, the recrystallized crust, was thinned and excavated along a thrust, the Main Central Thrust (MCT), to shallower depths. These deformed and metamorphosed rocks constitute what is now called the Higher Himalayan Crystallines (HHC). When moved to shallower depths, the HHC juxtaposed against the Tethyan sediments (TH) in the north and were emplaced towards south over the old rocks of the Indian Plate, familiarly known as the Lesser Himalayan Sequence. It is proposed that the extrusion of these Great Himalayan rocks (HHC and TH) was by pushing up as a result of slab breakoff process, with similar effects to that occurring in the break off the rope in tug-of-war game. In this process, it is believed that the slab detachment can occur in pulses or in a single event and is also considered responsible for excavating ultra-high pressure rocks (UHP) rocks from deeper levels. This mechanism by the author finds support from the occurrences of the deep mantle anomalies recently discovered by seismic tomography at the base of lithosphere in West Pakistan, and also from the undeformed (Post-orogenic) basic rocks intruding the Himalayan metamorphics. The paradigm of slab breakoff is an efficient mechanism for

exhumation of the Himalayan rocks, and is independent of the parameters of the channel flow or any other model for exhumation of deep-seated rocks of the Himalaya.

SERENDIPITY

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An accidental discovery which was not intended is called Serendipity.

In science there have been a number of very interesting and exciting serendipitous discoveries than not only raised the living standard of the mankind, but also made it more enjoyable, healthy and comfortable. Woehler's synthesis of urea, Friedel-Craft's reaction, Perkin's Mauve, enantiomerism, teflon, nylon, polyethylene, rubber-natural as well as unnatural, quinine, vaccination, anaesthetics, insulin, penicillin, sulpha drugs, aspirin, psychoactive drugs, interferon are some of such serendipitous discoveries.

It is not exaggerated to claim that an accidental. breaking of a thermometer in a chemistry laboratory became the reason of Mahatma Gandhi launching his first non-violent disobedience movement in 1917 in the Champaran district of Bihar.

Sopme of such serendipitous discoveries will be narrated in an illustrated and interesting manner.

AGRICULTURAL INCOME AND PRICE POLICIES OF THE EUROPEAN COMMUNITY

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European Community presently consists of 25 countries. Although the level of economic development of individual member countries varies, the Community by and large is regarded as a developed region. Out of the population of 25 crores, only 1.1 crores (2.2%) depends on agriculture (which includes farming, livestock and forestry). Average area cultivated by a household in the community is around 18 hectares. Yet, its share in world agricultural production is quite significant. Before the formation of the Community, the income and price policies of individual countries-were quite different from each other as also aimed at protecting one's independence and food security. With the formation of the Community, naturally, there was a need to evolve a common agricultural policy to protect the incomes of the farmers, ensure food security of the member countries and respect the terms and conditions of the World Trade Organization. This formulation took many years and ultimately a Common Agricultural Policy (CAP) was announced in June 2003. The policy is extremely complicated and there are continuous efforts since then to simplify it. It is also unique in several respects and promotes entrepreneurial potential of farmers. The study of this policy is particularly useful for India, as it provides many lessons for drafting our agricultural policy as also enables us to become an effective partner in the world agricultural trade.

STRATEGIES FOR BIOFUEL PRODUCTION AND IMPROVEMENT IN DEVELOPING COUNTRIES: PROBLEMS AND PROSPECTS

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A large number of hydrocarbon yielding plants like *Calotropis procera* and Euphorbia spp. contain around 30 percent of triterpenoids. The investigations on biofuel plants were initiated in 1982 with suggestion from Noble laureate Professor Melvin Calvin who was pioneer in this field. The biocrude obtained from these laticiferous plants could be converted into petroleum like substances using hydrocracking. *Calotropis procera* is able to grow in vast expense of wasteland in Rajasthan (over 3 million ha) and it grows particularly well in the harsh climates of Western Rajasthan which lies North West of Rajasthan which has a rainfall from 5 to 300 mm per annum. In Rajasthan, *Calotropis procera* grows wild while *Euphorbia antisyphilitica* has been introduced from Mexico. Attempts have been made to increase their growth and hydrocarbon yield potential during several years of investigation at Energy Plantation Demonstration Project Centre at University of Rajasthan campus. The biocrude yield of Euphorbia antisyphilitics could be increased to 18 percent by using combination of growth regulators and nutrients and employing improved ago technology. Detailed studies have been conducted on the growth and cultivation and improvement of hydrocarbon contents of *Calotropis procera* and *Euphorbia antisyphilitica*. 12 accessions of *Calotropis procera* were analysed and their growth parameters studied at the Energy Plantation Demonstration Centre, University of Rajasthan, Jaipur under Department of Biotechnology project. Details of the investigation shall be presented.

INVESTIGATIONS OF THE AMPHIBIOUS HETEROSPOROUS FERN FAMILY MARSILEACEAE; SYSTEMATICS, PHYTOGEOGRAPHY, SPECIATION AND EVOLUTIONARY BIOLOGY

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Marsileaceae, the heterosporous aquatic/amphibious fern family forms a central, pivotal position in botanical compendium and thought in terms of botanical conundrums and riddles like the Land—Water Form conversions, heterospory and the emergence of Seed Habit, Reproductive Biology features like micro- and mega-spore differentiation, sporal aberrations in shape, size and number/sporangium, parthenogenetic/apogamous expressions, heterophylly juvenile adult leaf sequencing, leaf margin serrations-crenations, phototropic-photonastic leaf movements including nyctinasty, heliotropism and sleep-seista movements, Biological Clocks and Chronobiological regulation, phytogeographic parameters like geographic Continental speciation and distribution of Marsileaceae (Cosmopolitan *Marsilea*, Restricted *Pilularia*, Endemic *Regnellidium*), plant nutrition to include biological regulation of Land-Form — Water-Form Conversions in response to carbohydrate nutrion/CO_2 concentration/Infra-red treatment , Gametophytic regulation of sexual fertilization and genetic expression Vs Sporophytic governance. All these aspects have received considerable attention from specialized laboratories in England (Allsopp, Manchester), Sossountzov (Paris, France}, Martens & Feller (Belgium). Wallace (North Carolina, USA).

Systematics and monographic treatment was initiated and comprehensively carried out in Germany with the first monograph being published by Braun at the Botanischer Garten u, Museum, Berlin followed by Baker in England and Launert in Nartural History Museum, London in last quarter of twentieth century (Braun's monograph was published in 1871), while regional monographic surveys were published by Gupta for India & South Asia based on doctoral dissertation of Bhardwaja (1958), African Marsilea taxa by Kornas (late ninetees) , Australian Marsileaceae by Tindale (1981), New World species of Marsilea by Johnson (1985).

I have been concerned with investigations of Marsileaceae since 1955 when I started studies of the Indian species of the genus for my doctoral dissertation and have thus been researching on this fascinating group for almost half a century specially with the systematics and speciation aspects as also the evolutional specifics in the genus Marsilea specially and the allied genera Pilularia & Regnellidium in general. It has been possible to access the world material of Marsileaceae in Botanischer Garten & Museum, Berlin. Heidelberg, Munich & Bochum in Germany: Uppsala Botanic Garden, Sweden, British Museum, Natural History, London & Royal Botanic Gardens, Kew, Surrey England, Botanic Gardens, Sydney, Australia; and New York Botanical Gardens, Bronx, USA; Western Carolina University, North Carolina, USA. These studies were carried out on live cultivation of almost forty species of Marsilea from across the world and representing taxa from all the continents. It is intended to develop a Botanical Garden containing Marsileaceae taxa from all over the world for a trans-world monograph of this interesting but complex group of plants. The required inputs have been collected painstakingly and the Universities in Rajasthan are being approached for the projected Marsileaceae Garden encompassing amphibious taxa to include all groups of the plant

kingdom. It is expected to initiate this ambitious project in near future and colleagues are requested to provide suggestions and help for this ambitious project, which will be an academic asset for this region.

INTERATOMIC COULOMBIC DECAY USING MANY BODY METHODS

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Inter-atomic coulombic decay (ICD) is a radiationless decay mechanism occurring via electron emission in an inner valence ionized weakly bound clusters. Decay width of the state of the neon in Ne clusters are calculated using *ab initio* Greens' function method. Complex absorbing potential with many body methods is used for the accurate prediction of decay widths.

FRACTURE OF SMART STRUCTURES

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The development of technology and ever increasing demand of the mankind has leaded the search for different materials because of their utility. One such branch emerged is that of smart material. The existing material has the property of altering their behavior significantly in a controlled fashion by external stimuli, such as stress, temperature, moisture, pH, electric or magnetic fields. Few of the smart mateial are: Piezoelectric ceramics and polymers, Thermoresponsive materials, Magnetic shape memory alloys, Halochromic materials, Chromogenic systems etc. The proven utility of these material gave impetus to the study of varius aspects of the smart material themselves. One such aspect is the fracture of these materials. We investigate the mechanics of the fracture of piezoelectric materials which are widely used in all electronic medical equipments, as sensors and actuators in hi-tech structures *etc.*. Under combined mechanical and electric loads the cracked piezoelectric materials tend to collaps. The need of arresting the propagation of these cracks gives a way to calculate valuable time, load bearing capacity of structures before collaps thus averting the catestropies not only in terms of monetory cost but also the invaluable human lives. The development of such investigation makes the subject matter of the presentation.

MICROFACIES AND DEPOSITIONAL ENVIRONMENT OF THE BATHONIAN JHURIO FORMATION AT THE JUMARA DOME, KACHCHH, WESTERN-INDIA

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The Kachchh Basin is a pericratonic rift basin situated at the western margin of the Indian plate. The Jumara Dome is one of the important exposures of Bathonian sediments among the Kachchh Mainland exposures. A rigorous facies analysis using the microfacies approach for the reconstruction of the depositional environment and setting of carbonate sedimentation with correlation of basin components had been lacking. Thus an important Kachchh Mainland outcrop of the Bathonian sediments (Jhurio Fm.) viz. the Jumara Dome was taken up for the present study. In accordance with the above-mentioned objectives detailed stratigraphical sections of the Jhurio Formation have been measured. Macrofacies were recorded for corroborating the microfacies data. Microfacies analysis has been carried out by studying thin- sections of rock samples under the microscope with the aim to interpret the depositional environment and setting. The study helped in the reconstruction of the depositional environment and setting at the Bathonian times represented by the Jhurio Fm.

The Jhurio Fm. at the Jumara dome is characterized by well-bedded limestone-marl/marlstone alternations and massive limestones (packstones and grainstones). The sections have several units, where the limestone show nodular feature. Various microfacies types are present in the Jhurio Fm. at the Jumara dome. The MF types are associated into two MF associations at the dome.

A carbonate ramp setting seems to have been prevalent at the time of sedimentation of the carbonates during the Bathonian. In general, the depositional environment seems to have been a marine, open sea mid to outer (deep) ramp environment. Depositional environment was largely low energy just below storm wave base which had seen phases of slight influence of storm-events. Reworked sediments of the transgressive phase witnessed relatively higher energy depositional environment.

WHAT IS NEW IN THE CONFINED ELECTRONIC SYSTEMS

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Taking the text-book examples of the Hydrogen atom and the Harmonic Oscillator quantum mechanical systems under (a) Free, and (b) Spherically confined under impenetrable boundary walls the characteristic features of the eigen-spectral changes will be highlighted. Consequences of such effects in designing the nano-systems will be discussed.

NANOTECHNOLOGY : A DOUBLE-EDGED SWORD

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Nanoscience and Nanotechnology comprise one of the fastest-growing research and development areas in the world. Nanotechnology**,** which refers to a technology in which materials are designed and manipulated on a molecular scale, represents a technological leap on a scale analogous to the first industrial revolution. Nanotechnology has the potential to benefit environmental quality and sustainability through pollution prevention, treatment, and remediation. However, the development and use of nanomaterials also involves a great many environmental unknowns. There is a saying that "All good fruits will turn bad", with nanotechnology destructive objects such as atomic bomb grenades, nuclear weapons, robotic killers designed to kill humans etc., can be made which can dump humanity in danger.

THE EAST-WEST ENCOUNTER

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In the global village of today the mere mention of east as east and west as west sounds like an anachronism of the past. However, although a lot of momentum has been gained in terms of technological homogeneity across different nations of the world, a lot sti1l remains to take place in areas of cultural exchange and a true understanding of each others' religions, social and natural environments. This could sound cliched in the context of a fast-growing internet awareness and especially in the American melting pot situation where one nation seamlessly merges into another. It is my intention to put forward relevant observations in order to describe the cultural intensities of Germany and India - the points of divergence and convergence where both combine to enrich and enhance a comprehensive view of human life. These new understandings and awarenesses definitely lead us to those areas where higher truths start to form and emerge.

We have indeed been a privileged community to whom the Humboldt Foundation has provided a generous platform from which to start a long and exciting journey. At this point it will make sense to mention that this journey has been an extraordinarily rewarding one in the fact that it has been shared by the members of our personal families, our spouses and children. In fact, it would not be incorrect to say that many of the most significant cultural exchanges have taken place through individual and social bonding developed by them at the time of our stay in Germany. The different areas of cultural exchange are found to reside in various institutions such as the Church and schools-in the inbuilt social system of transport and tourism and the social values built around them. In fact, the first most striking thing about the country is the fusion of the past and the present; tradition and high-tech seem to move along hand-in-hand. This gets reflected not only in the beautiful architecture that simply surrounds and overpowers the first-time visitor but also in the quality of day-to-day life that the German citizen leads. My observations are based on first-hand encounters that have developed over the years to give both me and my family the insight and understanding of ourselves and others in the universal context of mankind.

LOW TEMPERATURE SYNTHESIS OF MESOPOROUS ORGANOSILICA

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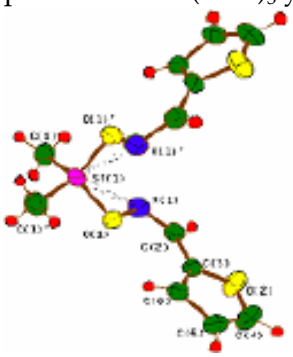
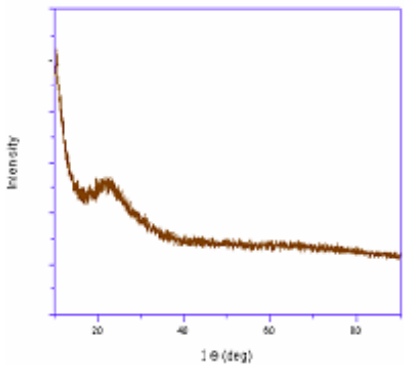
Periodic mesoporous organosilicas are receiving special attention due to their multi-fold practical applications. The synthesis of these materials require suitable tailor-made precursors.

A considerable number of organosilicon(IV) complexes with internally functionalized oximes have been synthesized and characterized in our laboratory. The solid state structure of $[Me_2Si\{ON=C(H)C_4H_3O\text{-}2\}_2]$ (Fig.1) is quit interesting. The silicon atom is in (4+2) coordination state.

Hydrolysis of Me_2SiL_2 and $MeSiL_3$ [HL = internally functionalized oxime] by Sol-Gel technique yields dimethylsiloxane and organosilica ($MeSiO_{3/2}$), respectively. Characterization of $MeSiO_{3/2}$ was carried out by elemental analysis, TGA, XRD and SEM images (Fig. 2 and 3). Under similar conditions, hydrolysis of $Me_2SiL_2/MeSiL_3$ in presence of $Al(OPr^i)_3$ yields interesting mesoporous material.





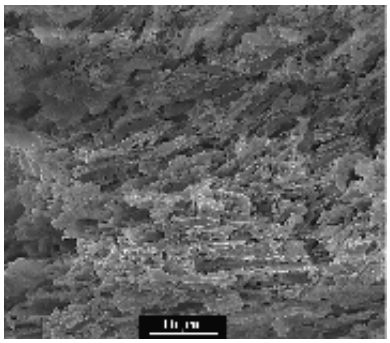


Fig. 1 : Crystal structure of $[Me_2Si\{ON=C(H)C_4H_3O\text{-}2\}_2]$

Fig. 2 : XRD pattern of $MeSiO_{3/2}$

Fig. 3 : SEM image of $MeSiO_{3/2}$

SYNTHETIC STUDIES AND STRUCTURAL ASPECTS OF SOME OXOVANADIUM(V) COMPLEXES WITH FUNCTIONALLIZED OXIMES

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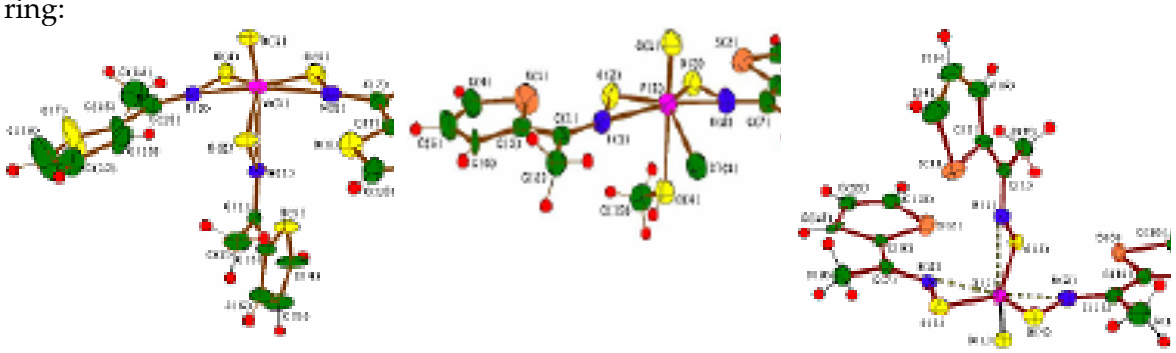
A new class of heteroleptic oxovanadium(V) complexes, i.e., $[VO\{X\}_{3-n}\{ON=C(CH_3)(Ar)\}_n]$ (where X = OPr^i or Cl; Ar = C_4H_3O-2, C_4H_3S-2 & C_5H_4N-2 and n = 1-3) have been synthesized in quantitative yield by the reaction of either $VO(OPr^i)_3$ or $VOCl_3$ with internally functionallized oximes in different molar ratio in refluxing anhydrous benzene. The complexes are characterized by elemental analyses, spectroscopic techniques (FT-IR, ^1H, ^{13}C & ^{51}V-NMR) and FAB-mass spectral studies. Single crystal X-ray diffraction studies of the three products $[VO\{ON=C(CH_3)(C_4H_3O\text{-}2)\}_3]$, $[VO\{ON=C(CH_3)(C_4H_3S\text{-}2)\}_3].0.5C_6H_6$ and $[VOCl\{ON=C(CH_3)(C_4H_3S\text{-}2)\}_2]$. CH_3OH show that the vanadium(V) atom exist in hepta-coordinaton state with distorted pentagonalbipyramidal geometry. The oximato ligands are bonded to the central vanadium atom in a dihapto- (η^2-N,O) manner with the formation of three membered ring:



(a) (b) (c)

Fig. : Crystal and molecular structures of (a) $[VO\{ON=C(CH_3)(C_4H_3O\text{-}2)\}_3]$; (b) $[VO\{ON=C(CH_3)(C_4H_3S\text{-}2)\}_3]$ $0.5C_6H_6$ and (c) $[VOCl\{ON=C(CH_3)(C_4H_3S\text{-}2)\}_2].CH_3OH$

SUBSTITUENT EFFECTS ON ACTIVITY OF >C=P- FUNCTIONALITY IN DIELS-ALDER REACTION OF 2-PHOSPHAINDOLIZINES : A DFT INVESTIGATION

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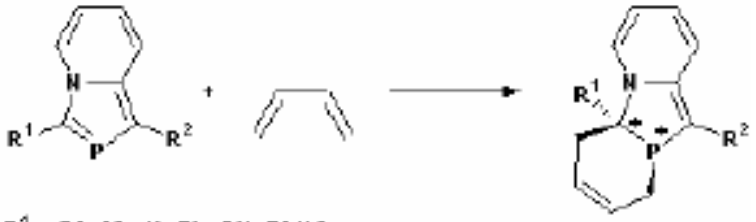
During the last few years the potential of the >C=P- functionality present in several classes of organophosphorous compounds, namely phosphaalkenes, heterophospholes including anellated azaphospholes and phosphinines, to undergo Diels-Alder (DA) reactions has been recognized.

3-Ethoxycarbonyl[1,3]azaphospholo[1,5-*a*]pyridine failed to react with 2,3-dimethylbutadiene. However, when both C-1 and C-3 carbon atoms are substituted by electron-withdrawing substituents, the reaction becomes feasible. A systematic theoretical investigation of DA reactions of unsubstituted as well as substituted 2-phosphaindolizines has been carried out at the DFT level (B3LYP/6-311++G**//B3LYP/6-31G*). The results reveal that substitution at C-1 by the CO_2Me group lowers energy of activation (E_a) more efficiently than at the C-3. In case of 1,3-bis(alkoxycarbonyl)-2-phosphoindolizines, E_a comes in the range of 22.43 kcal/mol thereby making the DA reaction possible.



R^1 = CO_2Me, H, Ph, CN, $PhNO_2$
R^2 = CO_2Me, H, Me, COPh

SOME RECENT SYNTHETIC AND THEORETICAL RESULTS OF DIELS-ALDER REACTIONS OF AZAPHOSPHOLES

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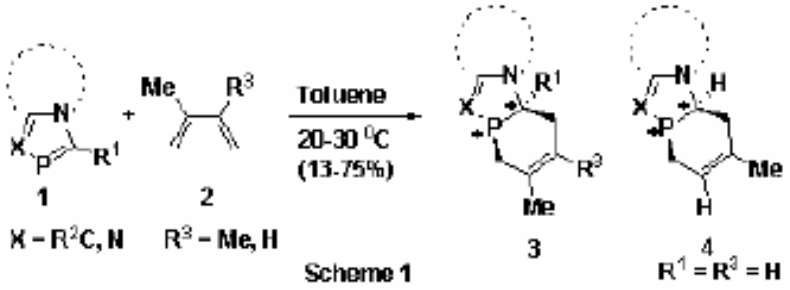
The Diels-Alder reaction of azaphospholes is of particular significance, as both the phosphorus as well as the carbon atoms of the >C=P– moiety serve as prochiral centres and its occurrence on the >C=P– functionality leads to the generation of two stereogenic centres in one step (Scheme 1). Moreover the stereo- and regioselective nature of this cycloaddition makes it more interesting to investigate experimentally as well as theoretically.



Scheme 1

During the last few years a large variety of the anellated azaphospholes **1** have become accessible in our laboratories.[2] Now we have shifted our attention to the reactivity of these compounds, mainly to their Diels-Alder reactions. In this regard, Diels-Alder reactions of azaphospholes (**1**, X = R^2C) and diazaphospholes (**1**, X = N), namely 1,3-azaphospholo[5,1-*a*]isoquinolines, -[1,5-*a*]pyridine, -[5,1-*b*]benzothiazole and thiazolo[3,2-*d*][1,4,2]diazaphospholes as well as their 5,6-dihydro and benzo derivatives with 2,3-dimethylbutadiene and with isoprene have been carried out successfully. All these reactions proceed with complete stereoselectivity. Furthermore, reactions with isoprene occur generally with complete regioselectivity affording the regioisomer **3** only. However, the regioselectivity decreases in the case of Diels-Alder reaction of 1,4,2-diazaphospholo[5,4-*b*]benzothiazole (**1**, X = N, R^1 = H) and both the regioisomers **3** and **4** are obtained in 2:1 ratio. The significance of these reactions is a possibility to provide an alternative pathway to the classical synthesis of chiral phosphines. Furthermore, the stereo- and regioselectivities observed in the reactions of azaphospholes and diazaphosphole with 1,3-butadiene and with isoprene have been rationalized by carrying out computational calculations at the DFT level (B3LYP/6-311++G**//B3LYP/6-311G**).

PROCESSING AND PROPERTIES OF WOOD BASED SiC

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The conversion of bioorganic structures like wood or ligninocellulosic fibers into porous microcellular SiC-ceramics is a novel manufacturing technology. The wood based SiC ceramics with isotropic properties are more attractive and more desirable for heat exchanger application. To produce such ceramics, wood powder of two different size fractions were homogeneously mixed with pitch or phenolic or pitch-phenolic blend.

Further it was made into plates (100mmx100mmx9mm) by compression molding process at 150°C. By varying parameters such as wood type, particle size, amount of binding agent as well as pressure and temperature during the pressing process a wide range of structure modification in wood based composite is possible. These materials were carbonized at temperatures up to 11000 C to obtain porous carbon preform and it would then be converted into SiC ceramic by reaction infiltration with liquid silicon. The micro-structures, phase composition, mechanical properties of these ceramics were investigated.

HYDROGEN ADSORPTION BY CARBON NANOMATERIALS FROM NATURAL SOURCE

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Carbon nanomaterials are getting importance in various applications such as hydrogen storage, fuel cell, electron field emitter etc. In order to make the cost of the gadgets utilizing carbon nanomaterials economical, efforts are being made to synthesize them at lowest possible cost. In addition, most of the processes which are being developed use precursors which are derived from petroleum products, which is destined to get depleted one day. Hence synthesis of carbon nanomaterials based on such precursors will also get depleted and the technology based on carbon nanomaterials will come to a halt.

Considering these two factors, Sharon and his research group are making efforts to search for precursors which are plant derived and could give the desired type of products at an economical rate. Another advantage of using precursors derived from plant based materials like oil seeds, plant fibers (coconut fiber or bagasse etc) is that these materials possesses different types of morphology e.g. channel type hollow cylindrical fibers, or various types of structures having various orientation of pores etc. These varied morphologies may have some useful properties like storing of hydrogen gas, intercalating of lithium etc. Moreover, such type of structure would be extremely difficult to synthesize in laboratory.

In this paper we report the utilization of some plant based fibers and some oil seeds to make carbon nanomaterial by pyrolysing them at very high temperature in an inert atmosphere, and characterize them by SEM for their morphology. It was observed that carbon nanomaterials obtained from fibers based precursors like coconut fiber; baggas etc have fibrous structure whereas carbon nanomaterials formed from seeds of different plants show very complicated porous carbon structures. These carbon materials are being utilized for the application of Hydrogen Storage. In order to compare the utilities of plant derived carbon nanomaterials, acetylene and alcohol have also been used to prepare carbon nanomaterials by the pyrolysis. However, unlike plant based precursors, these precursors needed suitable catalysts, which adds to the cost

The fibrous carbon from Bagasse (Saccharum officinarum) gave hydrogen adsorption of 0.656 wt% at 11kg/m2 pressure of hydrogen which is nearly the same as observed with carbon nano materials obtained from acetylene (0.51 wt%), suggesting that plant derived precursors can be used for such purpose. Efforts are made and presented in this paper to discuss the role of surface area and pore sizes in facilitating hydrogen adsorption.

ULTRASOUND PROMOTED SYNTHESIS OF SOME 1-(4-HALOARYL-THIAZOL-2-YL)-3-SUBSTITUTED- 4-HALOARYL-2-AZETIDINONES *VIA* PTC AND THEIR INSECTICIDAL ACTIVITY

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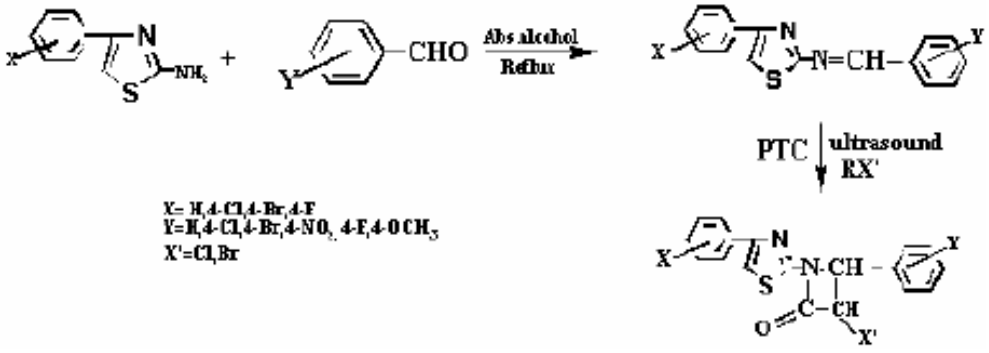
Thiazoles are one of the most intensively investigated classes of heterocyclic compounds having one nitrogen atom and one sulphur atom oriented in 1,3-positions and known to posses various biological properties including antifungal, antifilarial, anxiolytic, anticonvulsant, anticancer, antitubercular, β-adrenergic receptor agonist, TPRV-antagonists activities. Coupling ultrasound irradiation with PTC enables chemical reaction to proceed due to the fact that sonochemistry and recent upsurge of intrest in sustainable chemistry share similar aims, such as the use of less hazardous chemicals and environmentally benign solvents. Keeping all these observations in view, we have undertaken a comprehensive study to synthesize 1-(4-haloaryl-thiazol-2-yl)-3-substituted-4-haloaryl-2-azetidinones and their insecticidal activity. The title compounds were synthesized from the [2+2] cycloaddition reaction of thiazolyl azomethine's double bond and ketene using PTC under ultrasound irradiation. The main advantages of the present procedure are milder reaction conditions, shorter reaction time and higher yields as compared to conventional methods. All the synthesized compounds were characterized on the basis of elemental analyses and spectral data (*viz*; IR, [1]HNMR and Mass).The compounds were screened for their insecticidal activity.



A 'ONE POT' SYNTHESIS OF 2-ARYL-4*H*-1-BENZOPYRAN-4-ONES UNDER COUPLED MICROWAVE PTC OR ULTRASONIC IRRADIATION PTC

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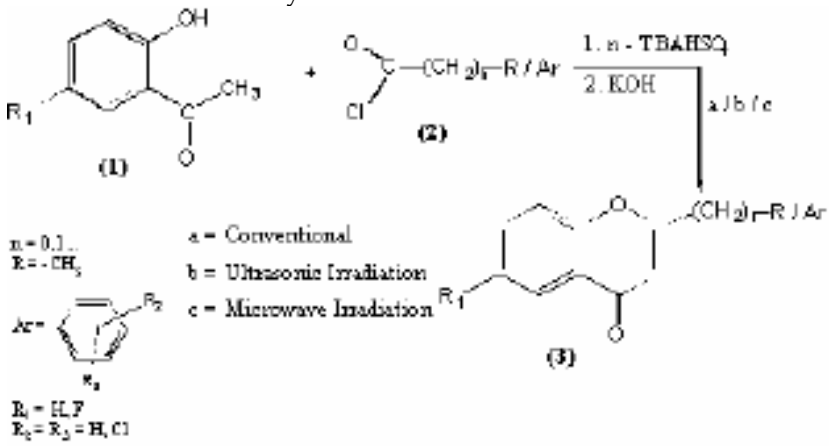
A 'one pot' synthesis of 2-aryl-4*H*-1-benzopyran-4-ones is being reported. A mixture of *o*-hydroxyacetophenone, aroyl chloride, powdered *n*-$TBAHSO_4$ and KOH were either irradiated by microwaves or sonicated in an ultrasonic cleaning bath to afford directly the title compounds. On the contrary, conventional liquid-liquid PTC using benzene as organic phase and aqueous KOH as the second phase afforded first β-diketones in accordance with Baker-Venkatraman synthesis which upon cyclization by *p*-TSA gave desired flavones in the next step. PTC coupled with microwaves or ultrasound show enhanced yields, clean reaction conditions, require lesser time and have easier workup protocol. All synthesized compounds were characterized by their PMR, IR, Mass and elemental analyses.



EFFECTS OF A CHEMICAL REACTION ON AN ISOTHERMAL VERTICAL SURFACE IN SLIP FLOW REGIME

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Combined effects of the free convection heat and mass transfer on VISCOUS incompressible fluid flow past a vertical surface in slip flow regime has been discussed, taking into account the homogeneous chemical reaction of first order. The velocity, temperature and concentration profiles are studied for different parameters like Schmidt number, Prandtl number, thermal Grashoff number, mass Grashoff number and chemical reaction parameter and are shown and discussed with the help of graphs.

SYNTHESIS OF NEW NAPHTHAQUINOXALINE AND NAPHTHAZAQUINOXALINE DERIVATIVES FROM NATURALLY OCCURRING QUINONES

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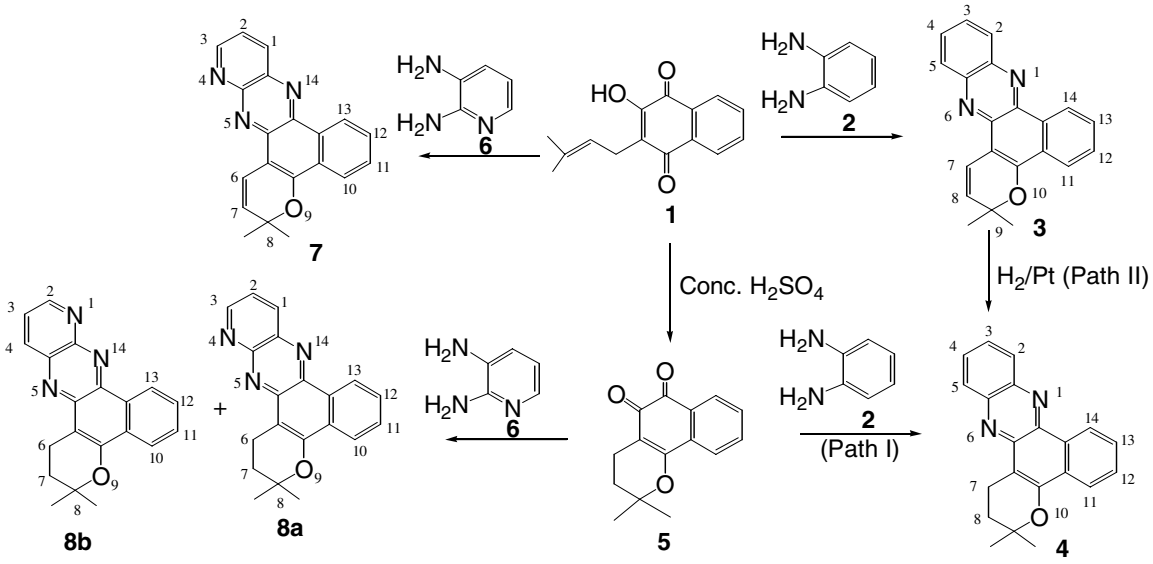
Lapachol and its congener β-lapachone occur naturally in certain plant families and their molecular structures endow them with redox properties, being involved in different biological oxidative processes. Lapachol, an isoprenylated hydroxy-1,4-naphthoquinone has been widely exploited for its antiviral, antimicrobial, analgesic, anti-inflammatory, antimalarial, cercaricidal and schistosomicidal activities along with potential activity against *Trypnosoma cruzi*, the casual agent of chagas disease. β-Lapachone, an 1,2-naphthoquinone also exhibited a wide variety of activities including anticancer activity. It has been noticed that structural modifications and the introduction of other heterocyclic moieties modified the pharmacological properties of the parent skeleton.

Inspired by above fact, facile synthesis of naphthaquinoxaline and naphthazaquinoxaline derivatives have been carried out by the reaction of lapachol (1) and β-lapachone (5) with *o*-phenylene diamine (2) and 2,3-diaminopyridine (6). Regioselectivity in the reaction of β-lapachone with 2,3-diaminopyridine was confirmed by single crystal X-ray diffraction of a representative compound 6,7-dihydro-8,8-dimethyl-8H-pyrano[3′,2′:4]-naphtha[2,1-e]pyrido[2,3-b]pyrazine (8b), whereas analogous reaction of lapachol (1) with 2,3-diaminopyridine (6) occurred with regiospecificity. (**Scheme-I**). Reactions of lapachol (1) with 1,2-diamine representing a new entry into the synthesis of heterocyclic compounds from hydroxylated naphthoquinones.



Scheme I

QUINONOIDS CONSTITUENTS FROM THE HEARTWOOD OF *TECTONA GRANDIS* LINN.

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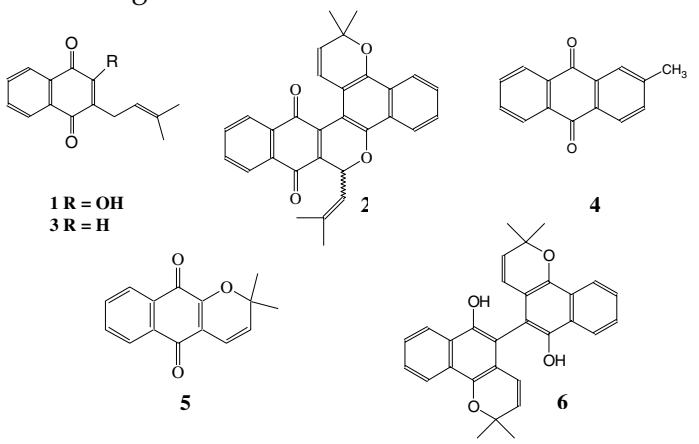
Tectona grandis commonly known as Teak or Sagwan belongs to the family Verbenaceae, occurs mainly in the Asian continent. Earlier work on this plant led to the isolation of a number of naphthaquinone and anthraquinone derivatives, together with sterols, oils, alcohols, diterpenic compounds. Various plant extracts from different parts of *Tectona* have shown vast medicinal importance *viz.* 1, 4-Naphthaquinone found to be antifungal and cytotoxic, deoxylapachol induces fungal cell wall stress. 5-Hydroxy 1,4-naphthalenedione obtained from the MeOH extract of the bark is inhibitory to *Listeria monocytogenes* and methicillin resistant *Staphylococcus aureus.* In the present study the heartwood of *T. grandis* has been investigated and the compounds isolated are: lapachol (**1**), tecomaquinone-I (**2**), deoxylapachol (**3**), tectoquinone **(4**), stigmasterol, dehydro-á-lapachone (**5**), tectol (**6**). An interesting quinone, dehydro-á-isodunnione is also being reported from this plant. Their detailed extraction and spectroscopic analysis will be discussed in the forthcoming conference.



MELT-MIXED POLYAMIDE 6/ MULTIWALL CARBON NANOTUBES COMPOSITES

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Melt mixed composites of polyamide 6 (PA6) and multiwall carbon nanotubes (MWNT) were prepared in order to obtain conductive composites at low MWNT content. It is understood that uniform dispersion of MWNT in PA6 matrix is largely affected due to vander Waals force of attraction between the nanotubes. In order to achieve uniform dispersion of MWNT two different types of MWNT were utilized in addition to purified MWNT (p-MWNT) utilizing specific interactions which would overcome the intertube van der Waals interaction. The strategy was based on exploiting a specific interaction of 'cation-ð' type between the ð-electron clouds of MWNT and cation containing organic modifier (sodium salt of 6-aminohexanoic acid, Na-AHA). Functionalized MWNT (f-MWNT) were also utilized with PA6 matrix in which reactive coupling between acid end group of PA6 and the amine functional group of f-MWNT was envisaged during melt-mixing and would lead to better dispersion of MWNT. Specific interactions were established through FTIR and Raman spectroscopy. The state of dispersion of MWNT was assessed through AC electrical conductivity measurements and transmission electron microscopy. 'Network-like structure' formation was explained via melt rheological analysis. Mechanical and dynamic mechanical properties were evaluated in order to understand the role of MWNT and their state of dispersion in PA6 matrix.

Electrical percolation threshold was observed between 0-0.3 wt.% of p-MWNT in presence of Na-AHA, whereas in presence of p-MWNT and f-MWNT the observed electrical percolation was between 2-3 wt.%. Structure property relationship studies were established in PA6/MWNT composites.

INFLUENCE OF SPECIFIC INTERACTIONS AND REACTIVE COUPLING IN ASSESSING THE STATE OF DISPERSION OF MULTIWALL CARBON NANOTUBES IN CO-CONTINUOUS POLYMER BLENDS

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An efficient strategy to achieve electrical conductivity in melt-mixed co-continuous blends is to restrict the conducting filler in a particular phase in the blends next to forming a percolative 'network-like' structure in that particular phase. However, strong inter-tube van der Walls' forces often hinders the formation of percolative 'network-like' structure and in addition, the migration of the conducting filler during melt-mixing and the blending sequence significantly affects the bulk conductivity of the blends. To understand these complexities we studied the electrical conductivity of melt-mixed blends of polyamide6/Ionomer with multiwall carbon nanotubes (MWNT). We observed from the SEM micrographs that due to the existence of specific interactions ('cation-π') between the extended 'π-clouds' of MWNT and the ionic domains (Na^+) in the ionomer, the MWNT were localized in the vicinity of the ionic domains. However, we observed that the blends with even 3 wt% MWNT showed insulating behaviour irrespective of the blending sequence adopted. We report here the key role of a reactive modifier (sodium salt of 6-amino hexanoic acid, Na-AHA) in facilitating uniform dispersion and subsequent 'network-like' formation by establishing specific interactions with MWNT. In addition, it was found that due to melt-interfacial reaction between the ~NH_2 functionality of Na-AHA and the ~COOH end groups of PA6 the MWNT is selectively localized in the PA6 phase in the blends manifesting in higher electrical conductivity (~10^{-5} S/cm at 3 wt% MWNT) related to a specific blending sequence. FTIR and Raman spectroscopic analysis also supported the existence of the specific interactions. The concept of specific interactions together with the reactive coupling also manifested in lower electrical percolation threshold (0.5 wt% MWNT) in melt-mixed co-continuous blends of PA6/ABS. Next to confinement of MWNT in the PA6 phase in presence of Na-AHA in PA6/ABS system, which was supported by solution experiments this strategy also manifested in the refinement of the co-continuous structure as observed from the SEM micrographs.

GROWTH AND CHARACTERIZATION OF INN QUANTUM WELLS BY METALORGANIC VAPOUR PHASE EPITAXY

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Compound semiconductors based on Nitrogen are the basis for novel, compact light sources for the 21st century. Gallium nitride and related materials have revolutionized the field of optoelectronics, particularly with the widespread use of ultra-high-brightness LEDs and the development of blue semiconductor lasers. Among the Group III-nitrides, Indium Nitride has been an enigma, with excellent material properties predicted theoretically, which have been difficult to realize experimentally, primarily limited by poor material quality. After a lot of controversy, the fundamental bandgap of InN seems to be accepted to be around 0.7eV. Thus, low band gap InN could potentially significantly impact optoelectronics by extending the spectral range covered by the group-III nitrides, from the ultra violet to the near infrared, enabling even lightwave communication wavelengths to be reached.

I will discuss our results on the synthesis of InN via metalorganic vapour phase epitaxy (MOVPE) in a showerhead reactor system. Apart from a detailed investigation of the growth of InN onto GaN buffer layers on sapphire, we have also grown InN directly on *c*-plane sapphire substrates using a low-temperature nucleation layer. We have also attempted to grow single and multiple quantum well structures of InN/GaN, and have obtained luminescence from these structures.

HALL EFFECTS ON THE UNSTEADY HYDROMAGNETIC COUETTE FLOW WITH HEAT TRANSFER

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An exact solution of hydromagnetic oscillatory Ekman boundary layer flow of an electrically conducting fluid between two parallel flat plates, one of which is at rest and the other oscillating in its own plane, is obtained when the entire system rotates about an axis normal to the plates. The influence of hall currents and transversely applied magnetic field on the flow is studied. The exact solution of the steady and unsteady velocity and temperature fields are constructed. For M=O (Magnetic field parameter) and D=O (Hall parameter), the problem reduced to the one discussed by GANAP A THY [8] and for D=O the problem reduced to that discussed by SINGH [9]. During the Mathematical analysis it is found that even the claim of GANAP A THY [8] that the solution of Mazumder [7] explains the importance phenomenon of resonance in rotating systems is incorrect.

JATROPHA CURCAS: A POTENTIAL PLANT FOR BIOFUEL

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In Rajasthan, Jatropha grows wild in South-East Rajasthan, which lies on South east side of Aravalli hill range, which roughly divides the state in semi-arid and arid regions. A detailed survey was carried out in these areas. Nursery techniques for large scale plantation of elite strains have been developed. An area of 35 ha has been planted with *Jatropha curcas* with the high yielding strains identified during the course of investigation. These strains have been characterized to contain over 35 percent of the oil using heptane extraction method. The morphological parameters have been employed to characterize initial growth of the plants in the nursery stage. The plants showing improved growth at the nursery stage in terms of stem girth and plant height had positive correlation on its further growth. Some of the plants in their third year of growth, have shown flowering and fruiting during moth of September to January. Application of fertilizers and proper irrigation schedule has improved the growth and productivity of plants. Jatropha oil can easily be converted in the methyl esters and glycerol is obtained as by product. This Jatropha oil could be used as 5 to 20 percent additive to fossil fuel to improve its fuel value. Biofuels have very low net CO_2 emission, NO_x, SO_2 and very much reduced suspended particle matter. Thus, they are environmental friendly and there is need to optimize their production strategies to check the global warming. Rajasthan with its over 3 million ha of wasteland is ideally suited for production of bio-energy plants.

MODULATION OF RADIATION INDUCED DAMAGE IN BRAIN OF SWISS ALBINO MICE BY SESAME OIL

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Radiation has various harmful effects on biological systems. Increasing use of nuclear radiation for human welfare necessitates developing potential drug of plant origin for the modification of radiation toxicity. Common nutritional plant sesame *(Sesamum indicum*) is rich of lignan and may prove efficient antioxidants; this plant may be recommended in the nutritional dietary course easily. The proposed invention will discuss the effects of sesame against radiation induced oxidative stress on mice brain. The mice have been administered with sesame oil for fifteen days, before an acute dose of radiation (5 Gy at a dose rate of 1.07 Gy/min). The herb sesame oil found to check the level of lipid peroxidation and protein degradation induced by radiation in mice brain. As well as radiation induced depleted levels of GSH and DNA were also raised by sesame oil treatment. The survivability in terms of life span showed much better picture in sesame oil pretreated irradiated mice in comparison to only irradiated mice. Statistically analyzed survival data produced a dose reduction factor (DRF) =1.45 for sesame oil. The results indicate that sesame oil provides protection against irradiation. Since, sesame oil has demonstrated excellent antioxidative effect against radiation, it would further pave way to the formulation of medicine against radiation and several radiomimetic drug induced toxicity.

NOVEL WATERBORNE NANOSTRUCTURED COATINGS

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Paints and coatings industries are among the first to take advantage of nanotechnology by incorporation of nanoparticle in coatings or in-situ creation of nanostructured coatings. Nanostructured coatings have nano-level of interaction among the various coating components which leads to the smooth, strong and more durable coating. These coatings are used generally used where excellent end user properties such as improved corrosion resistance, UV stability and high hardness with better flexibility are required. Sol-gel process is generally used to produce these nanostructured coatings with practically all type of chemical composition at low temperature on metals, glass and plastic of various shapes through the use of liquid solution (aqueous and non-aqueous). The most common precursors for these coatings are silanes which are hybrid molecules containing functional organic groups, such as methoxy or ethoxy groups and chlorine, amine, sulphur or epoxy on inorganic silicon atoms. These ethoxy or methoxy groups on hydrolysis forms silanol groups Si-OH which can react with metal hydroxide groups on the substrate surface, thus forming a Si-O-M covalent bonded metal/film interface. This is the beauty of these nanostructured silane coatings which donot requires metal oxidation or species reduction processes, unlike chemical conversion treatments such as chromating, zirconium or titanium conversion, in the film deposition mechanism. Furthermore, silanes are environmentally friendly.

In the present study, waterborne silane based coatings for lightweight alloys (aluminum and magnesium alloy) have been developed. Lightweight alloys have the competitive advantage of modern aerospace and automotive structures because they enable achievement of high structural efficiency, improved fuel efficiency without scarifying mechanical strength. However, these alloys undergo sever corrosion when exposed to continued aggressive environment. Coatings restrict the access aggressive environmental stresses to the metal as well as interfere with metal dissolution reaction. This is the key to corrosion control by protective coating.

The first step of coating formulation was the preparation of primary sol which involves the hydrolysis and condensation of methyltrimethoxysilane (MTMS) and 3-glycidoxypropyltriethoxysilane (GPTMS) in aqueous medium. It was followed by the further modification of primary sol by with conventional organic polymer such as waterborne alkyd and waterborne polyester to improve the technical as well as economical limitation of sol-gel coatings. Two amino functional organosilanes namely 3-aminopropyltriethoxysilane (1N), N-(2-aminoethyl)-3-aminopropyltrimethoxysilane (2N) and hexamethoxymethylmelamine (HMMM) were used as hardeners. Coating materials were characterized using SEM, AFM, TEM, TGA/DSC. Corrosion resistance and hydrophobicity of coated substrate were evaluated by EIS, potentiodynamic polarization and contact angle measurements. Furthermore, UV stability of coatings was studied using UV-visible spectroscopy and UV-weatherometer to see performance of

coating in outdoor application. Hardness, abhesion and flexibility of coating on substrate were also determined.

Results show that the coatings are uniform, transparent and crack free. It is found that the corrosion current of coated substrate reduced by one to three orders of magnitude than bare substrates. UV-visible spectroscopy and UV-weathering suggest that these coatings are suitable for outdoor application. Excellent UV-resistance is observed for HMMM cure coatings and alkyd incorporated coatings. It was observed coating have no glass transition coating in the temperature range of 30-700°C. Alkyd incorporated sol-gel coating shows excellent thermal stability upto 300°C. All the coatings have shown chemical interaction with substrate which leads to their excellent adhesion.

Thus, the use of nanostructure sol-gel coating and their further modification with organic polymer have to be regarded as a consistence further development of the new innovative sol-gel technology which is characterized by the combination of novel and conventional method of the formulation of coatings. These coatings are environmentally-friendly coatings of a new era of high technology for protection of material from environmental stresses and to get preferred properties.