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Research Update

Abstracts of research publications of Thapar University

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Editorial Note

Dear Readers

The second issue of "Research Update" is before you. The first issue had been a great success. Its objective is to share with the outside world, the research conducted by the Thapar University faculty, and, it is published twice a year in hard as well as electronic form.

It includes 'extended abstracts' of the research papers published in SCI journals.

Each issue of the 'Research Update' will cover the research facilities and the research conducted in one of the Thapar University research labs as well. This issue includes the "Centre of Relevance and Excellence (CORE)."

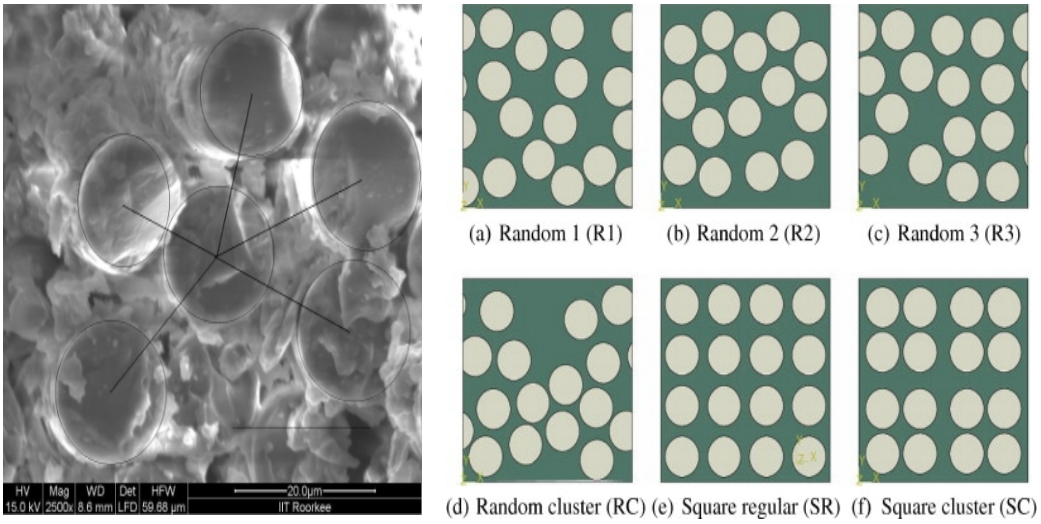
Your feedback and suggestions are solicited, please send them to update@thapar.edu.

I am thankful to the members of the editorial board for their support to bring this issue. I am also thankful to Mr GS Lotey for the technical support, Mr Abhishta for designing this issue and Ms Parveen for secretarial support.

N.K. Verma

Micromechanics of diffusion-induced damage evolution in reinforced polymers

In this work we numerically investigate the nucleation and evolution of micromechanical damage in reinforced glassy polymers under transient hygro-mechanical loading. In particular, we demonstrate the role that fiber distribution plays in the evolution of overall damage due to fiber–matrix interfacial debonding under moisture ingress. The heterogeneity of fiber distribution (clustering) is characterized by the coefficient of variation Cv of the center-to-center distances between interacting fibers, determined by identifying a cut-off radius around a typical fiber. The initial moisture diffusion-induced damage provides synergistic conditions for the rapid evolution of debonding under subsequent mechanical loading. The results indicate that microstructural heterogeneity strongly affects the moisture diffusion characteristics that in turn hurt the overall load carrying capacity of a composite due to aggravated damage. The strong dependence of the moisture-induced damage evolution on the fiber arrangement suggests that one should not resort to using simplistic unit cell models that assume regular fiber arrangements in such cases.



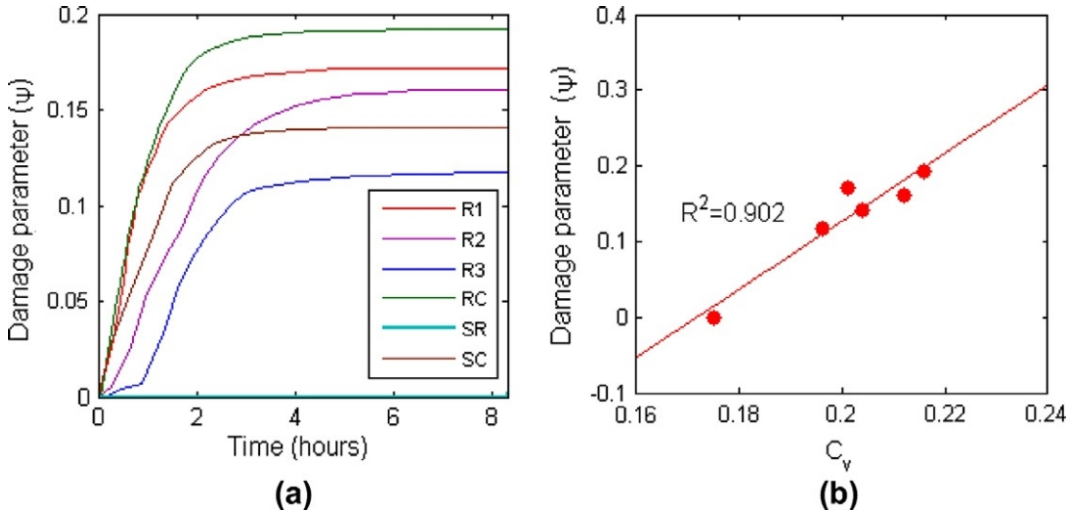


Figure (a) Evolution of the overall interface damage ψ, and (b) ψ - $C_υ$ correlation between damage for f = 0.50 and d = 10 lm with (a) r_c = 4r, (b) r_c = 4.5r, and (c) r_c = 5r. Moisture-resistant interfaces.

Reference

A.S. Abhilash, Shailendra P. Joshi , Abhijit Mukherjee , Leon Mishnaevsky Jr, Micromechanics of diffusion-induced damage evolution in reinforced polymers, Composites Science and Technology 71, 333–342, (2011)

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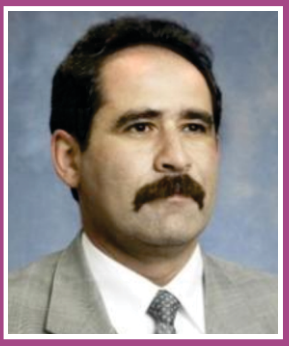

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Active protection of fiber-reinforced polymer-wrapped reinforced concrete structures against corrosion

Large number of reinforced concrete (RC) structures that have been damaged from corrosion of steel reinforcements are rehabilitated with fiber-reinforced polymer (FRP) composites. This paper investigates active protection of the steel embedded in concrete that is treated with surface-bonded carbon FRP. The electrically conductive carbon fiber is used as an anode while the reinforcing bar is used as a cathode. Concrete cylinder specimens with embedded steel bars are immersed in salt water, and anodic current is passed through the reinforcement to initiate cracking in concrete as a result of accelerated corrosion of steel. Carbon FRP sheets have been bonded adhesively to the cylinders. The adhesive has been modified to impart electrical conductivity. Specimens were exposed to a highly corrosive environment for a specified time. Pullout strength, mass loss, potentiodynamic scans, and the half-cell potential of steel are reported as metrics of performance of the samples. The proposed technique has been very effective in retarding the corrosion of steel.

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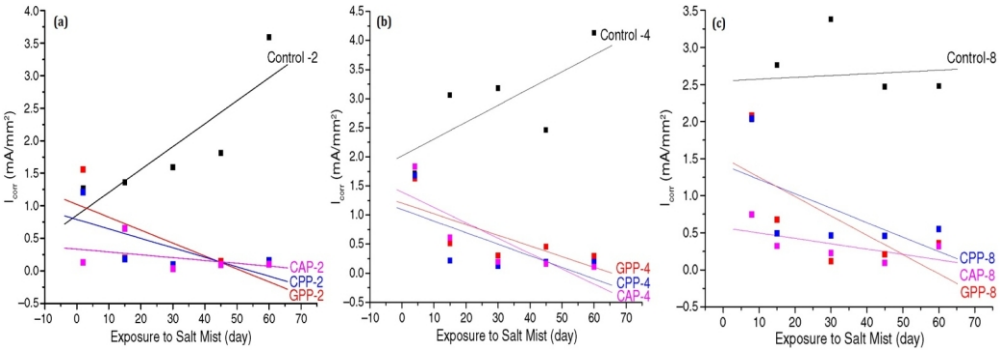

Figure. Variation of I_{corr} with time of exposure to salt mist: (a) 2-day, (b) 4-day, and (c) 8-day samples

Reference

S. Gadve, A. Mukherjee, S.N. Malhotra, Active protection of fiber-reinforced polymer-wrapped reinforced concrete structures against corrosion, CORROSION 67 (2), 025002-11, (2011) .

Investigations on Functional materials for advanced technologies

Electro-optical liquid crystal displays serve perhaps as the most significant interface in this age of information. Demand for displays continues to grow and diversify as more and more application areas become identified. The roots of display technology go back to such disciplines as electronics, chemistry, physics, electro-optics, communications, psychology, vision, and many more. The requirements like lower power, more saturated colors, higher reflectivity, greater luminance, faster response, wider viewing angle are centre of attraction for our research group.

Pankaj Kumar et al.[1] investigated dichroic polymer dispersed liquid crystals based on nematic liquid crystal materials with azo dyefor the application of display devices. Polarizing optical microscopy, differential scanning calorimeter and electro-optic experiments all have shown that the DPDLC containing low concentration of dyes modifies the basic properties of these materials like optical transmission, threshold voltage, contrast ratio and absorbance factor. A minimum amount of dye needs to be added to the liquid crystal with the polymer matrix for its effective phase separation and to minimize the transmittance in the OFF state and therefore gives rise to an overall improvement in contrast ratio of the devices.

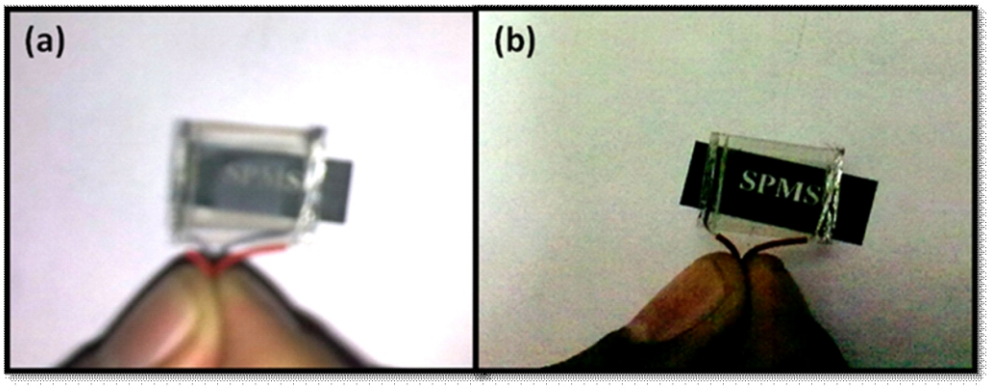

Fig. Polymer dispersed liquid crystal switchable display: (a). "OFF State", (b). "ON State" [**K.K.Raina and Rishi Kumar**].

Neeraj et al.[2] investigated dynamic responses of high polarization ferroelectric liquid crystal—multi walled carbonnanotubes (CNT) composite material in the wide frequency range(up to 1 MHZ). Permittivity increased by ~20% to 40%(50 Hz–1 kHz range) but athigh frequency >2 kHz, it was independent of carbon nanotube concentration. Theincrease in permittivity is attributed to strong anisotropic interactions which enhancesthe orientational order.The studies on FLC-CNT composites show that transition temperature increases and is afunction of CNT concentration. An increase in the dielectric permittivity and dielectric losshas been observed in CNT dispersed FLC composites. The conductivity anisotropy and thedipolar interactions contribute to this variation.

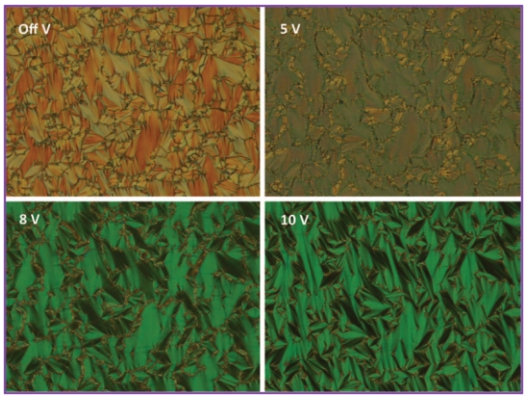

Fig. Switching responses of 0.02% CNT-FLC composite in presence of an electric field.

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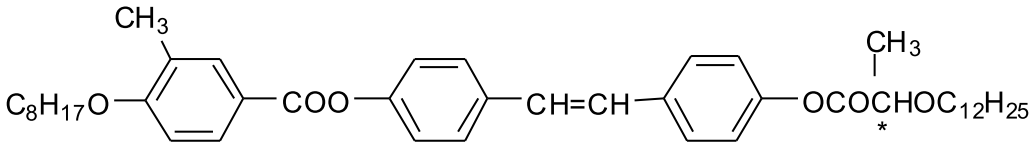
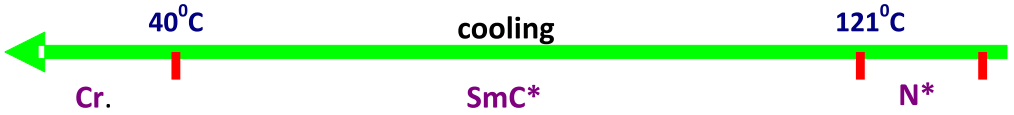
Ravi K. Shukla et al.[3] studied effect of multi-wall CNT dispersed in FLC material. Due to the molecular self assembly of rod-shaped molecules, LC materials also exhibit the orientantional order that brings up possibility for synthesis of new materials with enhanced electrical and dielectric anisotropy via dispersing with nano size impurities restraining the electrical and dielectric anisotropy. Among nano- materials, carbon nano-tubes (CNT) possess extraordinary properties such as large mechanical and electrical anisotropy triggered possibilities to design new composite systems. CNTs dispersed FLC [KrS 8/12 containing 3-methyl-4-alkoxybenzoate group and a double bond in the 4,4'-dihydroxystilbene unit of the mesogenic part of the molecule]composite systems were investigated to understand the structural and dielectric behaviour.





It was found that CNT does not affect the ordering of molecules in the mesophases but affects the phase transition temperatures: an increase for about 5 ^{0}C has been detected. In ideal case, in pure FLC near isotropic temperature the elastic interactions of FLC molecules are almost zero, perturbing the orientantional order of the system. In these composite systems, due to the coupling of CNTs, LC molecules experienced small induced local orientantional order up to some extent, enhance the temperature of the isotropisation. Dielectric studies demonstrate the gradual increase in permittivity for theCNTs- FLC composite system (10% and 11.5% for **x**= 0.03 and 0.10, respectively) in lower frequency (50Hz) regionnear SmC*- N* transition.

In the recent years, there is a renewed scientific interest in the study of the ferroelectric-ferrite composites because these composite shows the property of both constituent phases and also shows unique property called magneto-electric effect. These composites can be exploited in sensors, isolators, phase shifters, wave guide, transducers and memory applications etc. However to improve the working of these devices, it is necessary to modify the properties of these composites. The modification can be done by two ways. i.e. either by modification of individual ferroelectric or ferrite phases or by changing the ratio of two individual phases in composites.

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Study on multifunctional futuristic nanomaterials for nanodevices

Multifunctional materials are the demand of future technology. In the development towards device miniaturization and high-density data storage system, it becomes highly desirable to integrate multifunctions in a single material. The advanced materials such as Dilute Magnetic Semiconductors (DMSs), Magnetoelectric, Multiferroic materials, can be seen as multifunctional-futuristic materials, and have emerged as new building blocks for magnetoelectric device applications in future ***Spintronic***s. Our group is working on the study of size dependent properties of DMSs.

Sunil Kumar et al.[1] reports Room temperature ferro-magnetism in NidopedCdSe nanoparticles (NPs) synthesized by a wetchemical precipitation method is reported. Transmissionelectron microscopy shows that the average particle size ofNi-doped CdSe NPs is about 8 nm. X-ray diffraction showsthe zinc blende (cubic) structure of $Cd_{1-x}Ni_xSe$ NPs.Superconducting quantum interference device was utilizedto study the magnetic behavior of NPs. Magnetic studiesrevealed that pure CdSe NPs exhibit diamagnetic behaviorat 300 K, whereas 5% Ni doped CdSe NPs shows themixture of paramagnetic and ferromagnetic behavior.

Sunil Kumar et al.[2] We report here room temperature ferromagne-tism in CdSe and Ni-doped CdSenanorods. Pure and 3%Ni-doped CdSenanorods are synthesized by using lowtemperature solvothermal process by using ethylenedia-mine as solvent. X-ray diffractogram depicts the wurtzite(hexagonal) structure of the CdSenanorods. From Trans-mission Electron Microscopy analysis, it is found that theaverage diameter of the CdSenanorods is about 4–5 nmhaving length of about 50 nm. Magnetic studies are madeby the analysis of M–H curves, obtained by using Super-conducting Quantum Interference Device. The room tem-perature ferromagnetic behaviour has been shown by bothpure CdSe as well as Ni-doped CdSenanorods

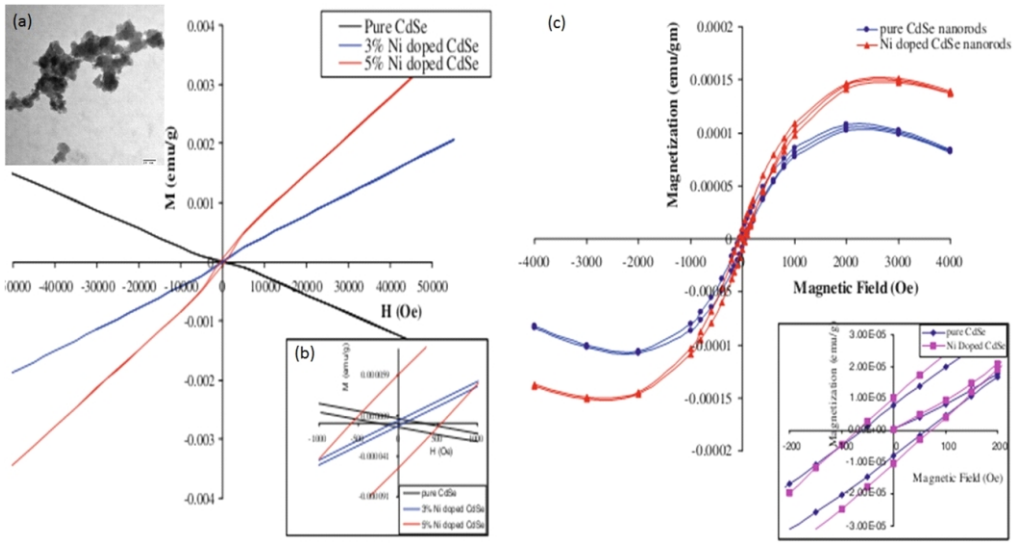

Fig. (a) M-H loop for pure and Ni doped CdSe NPs. Insets (a) TEM imges of nanoparticles and (b) aclose view of magnetic loops for pure and Ni doped CdSe NPs (c) M-H loop of pure and Ni-doped CdSe nanorods

Sunil Kumar et al.[3]reports the structural and magnetic properties of the Eu doped $Cd_{1-x}Zn_xS$ nanoparticles synthesizedby wet chemical method. The idea is to exploit the roomtemperature magnetic behavior of nanoparticles. The particles size as observed by Transmission electron microscopy(TEM) and X-ray diffraction (XRD) is about 5 nm. Themagnetic loop observed at room temperature using SQUIDindicates the ferromagnetic behaviour of doped particles.

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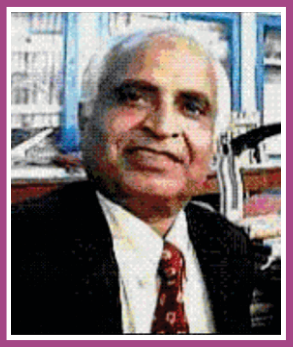

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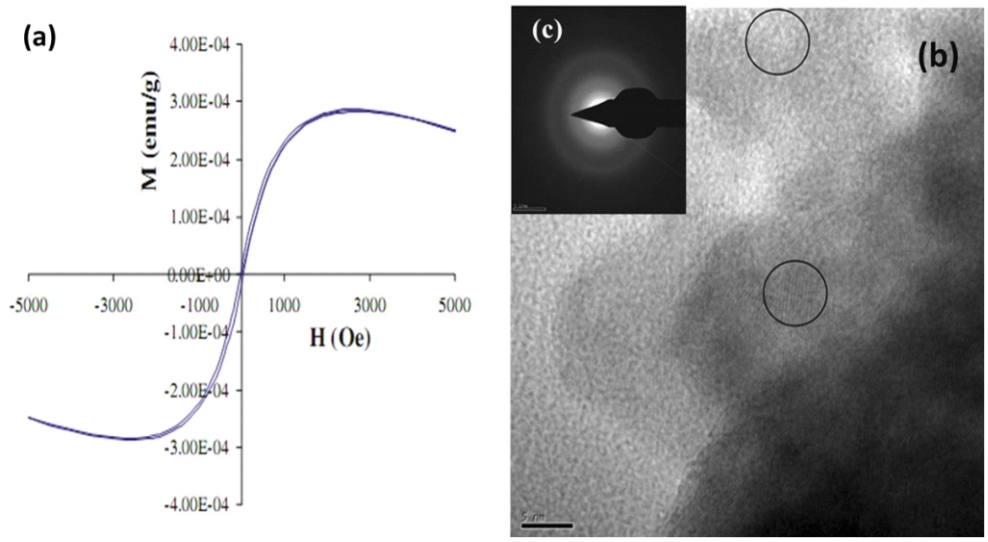

Fig.(a) M-H loop (b) HRTEM image and (c) SAEDof Eu doped $Cd_{1-x}Zn_xS$ nanoparticles

Poonam Shram et al. [4]The solution-combustion synthesis (SCS)method was used to prepare silver nanoparticles usingglycine and citric acid as fuels. The different combination of fuel to oxidant ratio was used to prepare Agnanoparticles and its effect on optical spectra, structure and the morphology explored. The purposedmethod is rapid, effective, cheap and convenient.Silver nanoparticles with different sizes and shapeswere synthesized depending upon the differentoxidant/fuel ratios. The nanoparticles were characterized using transmission electron microscopy, X-raydiffraction and ultraviolet–visible absorption spectroscopy. Histograms were drawn to compare themean particle size of synthesized nanoparticles. It wasfound that citric acid was better fuel as compared toglycine as it results in the more spherical symmetricalnanoparticles, which are supported by various characteristic studies.

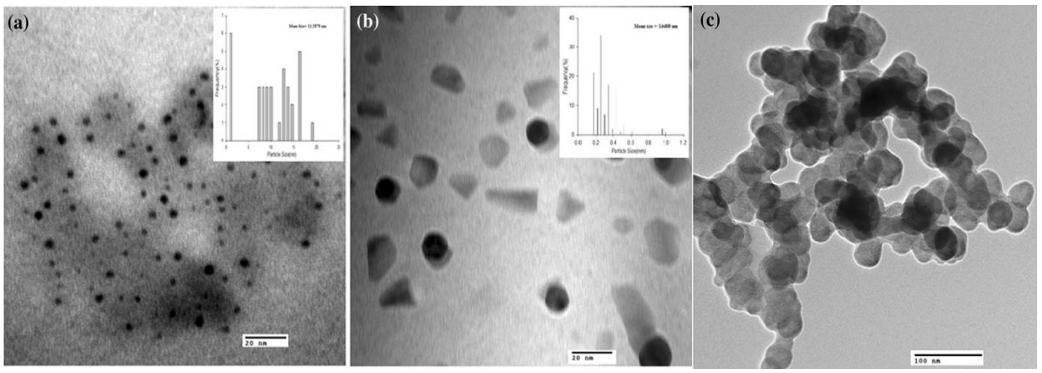

Fig. TEM images of Ag nanoparticles using citric acid as fuel
at (a) stoichiometric ratio (b) fuel-deficient ratio (c) fuel-excess ratio

G S Sekhon et al. [5]Synthesis of copper microstructures was doneusing the electrochemical template technique using theNTF (Nuclear Track Filter). The NTF was fabricated usingthe polycarbonate SSNTD (Solid State Nuclear TrackDetector) which was created by irradiation of Uraniumions. The synthesized copper microstructures were furtherused to fabricate a novel low voltage field electron emitter.As compared to traditional technique of lithography-basednano/micro fabrication, template synthesis is a simpletechnique, where pores of NTFs are used as templates andby using a suitable electrochemical cell design, any type ofnano/microstructures can be fabricated. The present paperenvisages the production of nuclear track filters and fabrication of copper microstructures through galvanic replication. The studies also reports first time, a

excellent lowvoltage field electron emitter fabricated by using coppermicrostructures in comparison to the earlier work. This lowvoltage field electron emitter being a novel cold cathodeemitter can be a potential candidate for an energy savingdevices.

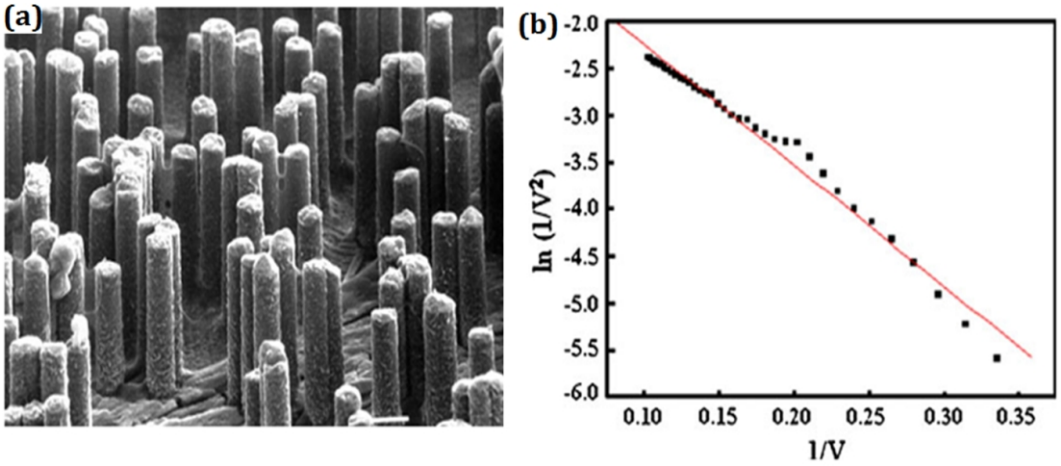

Fig (a) SEM of fabricated copper microstructures and (b) Fowler–Nordheim plot verifying the emission relation

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Sanjeev Kumar et al. [6] The highly reflective and durable coatings using synthesized zinc sulfide-capped thioglycerol nanoparticles has been developed. The coating material was prepared by dispersing ZnS/thioglycerol nanoparticles in an acrylic binder. The light reflectors were made applying this coating material to an aluminum substrate; their diffuse reflectance was measured and found to vary from 97% to 100% for 0.30-mm thick coating having 14% pigment-to-binder ratio. The aging effect of the reflectors with respect to temperature and illumination was also investigated to check their durability and they have been found to be optically stable up to 10,000 lux, and thermally up to 80 C.

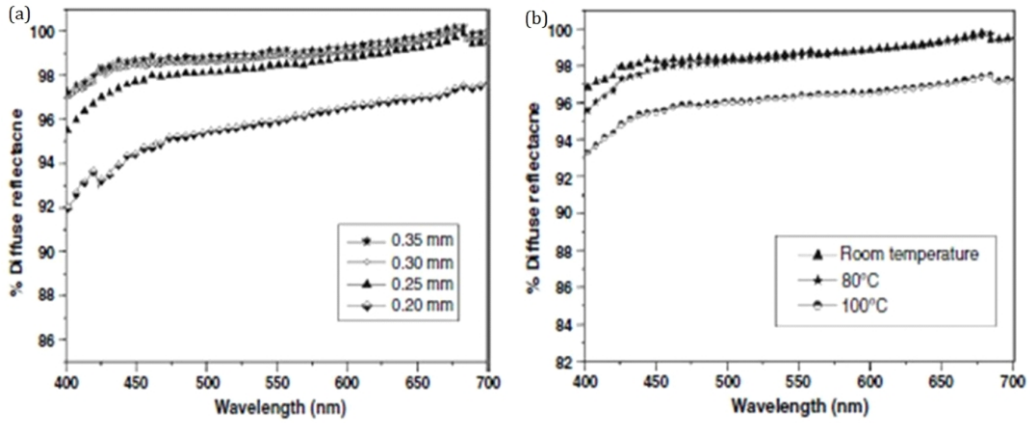

Figure: (a) Diffuse reflectance spectra of the developed reflectors having different coating thicknesses
(b) Diffuse reflectance spectra of the developed reflectors exposed to different temperature

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Effect of metakaolin on the near surface characheristics of concrete

Results on an investigation dealing with the effect of metakaolin (MK) on the near surface characteristics of concrete are presented in this paper. A control concrete having cement content 450 kg/m3 and w/c of 0.45 was designed. Cement was replaced with three percentages (5, 10, and 15%) of metakaolin weight. Tests were conducted for initial surface absorption, sorptivity, water absorption and compressive strength at the ages of 35, 56, and 84 days. Test results indicated that with the increase in MK content from 5 to 15%, there was a decrease in the initial surface absorption, decrease in the sorptivity till 10% metakaolin replacement. But at 15% MK replacement an increase in sorptivity was observed. All mixtures showed low water absorption characteristic i.e. less than 10%. Compressive strength shared an inverse relation with sorptivity. Higher MK replacements of 15% are not helpful in improving inner core durability, even though it helps in improving surface durability characteristics.

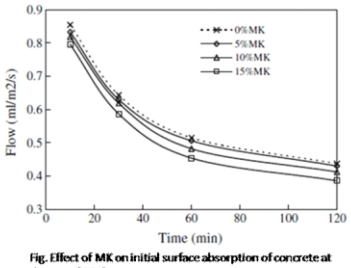

Fig. Effect of MK on initial surface absorption of concrete at the age of 35 days

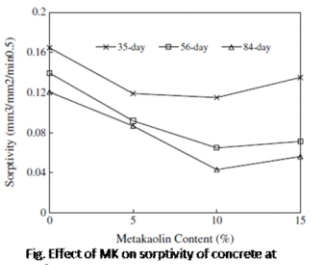

Fig. Effect of MK on sorptivity of concrete at various ages

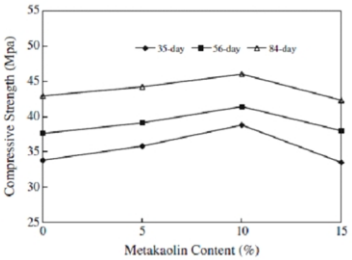

Fig. Compressive strength of concrete at various ages

Reference

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A novel method for the determination of individual lanthanides using an inexpensive conductometric technique

Komal et al. [1] A new conductometric titration method is established to determine quantitatively lanthanide ions (Lns) using ethylenediaminetetraacetic acid (EDTA) as a ligand and α-hydroxy isobutyric acid (α-HIBA) as a co-ligand. The detection limit of Ln(III) ions was found to be 1×10^{-5} M using a 5-ring conductivity sensor of cell constant 0.774 cm^{-1}. The proposed method is tested for selective determination of individual lanthanides in the presence of interfering ions like selected alkali, alkaline earth, and transition metal ions. The method does not suffer from interference from any of these species. A mechanism for selective detection by conductometry is given. Gd(III) determination is verified with the spectrophotometric method.

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Highly Selective Potentiometric Determination of Ag(I) Using 1,2,4,5-tetrakis (8-hydroxyquinolinoxymethyl) benzene Based Coated-Wire Ion-Selective Electrode

Kumar et al. [2] A coated-wire silver ion-selective electrode is constructed using 1,2,4,5-tetrakis (8hydroxyquinolinoxymethyl) benzene as neutral carrier in a poly(vinyl chloride) matrix plasticized with 2-nitrophenyl octyl ether. The sensor exhibited a linear Nernstian response with a slope of 60 ±1 mV per decade change and a detection limit of 1×10^{-6} M. The working pH range is 3.5-7.5. The response time of sensor is 15 s and it can be used for at least 2 months without any significant divergence in potential. The sensor shows good selectivity over a number of alkali, alkaline earth and several transition and heavy metal ions. The electrode is used as an indicator electrode for the determination of Ag^{+} in various synthetic samples and also used for the determination of SCN^{-}, CN^{-}, S^{-2} and I^{-} contents present in the sample solution.

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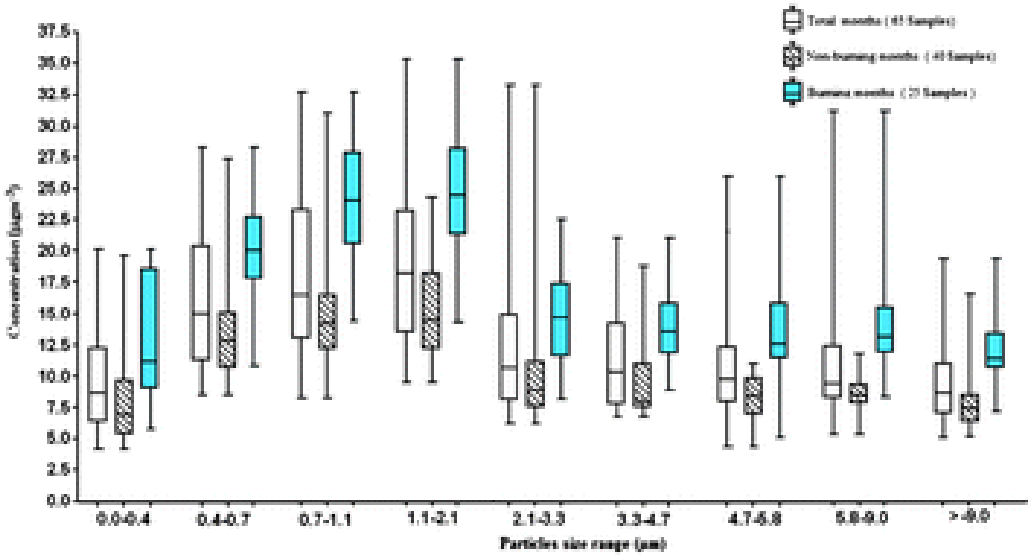
Study of size and mass distribution of particulate matter due to crop residue burning with seasonal variation in rural area of Punjab, India,

Amit Awasthi et al [3] Emission from field burning of agricultural crop residue has a significant potential health risk for the rural population due to respirable suspended particulate matter (RSPM). A study on eight stage size segregated mass distribution of RSPM was done for 2 wheat and 3 rice crop seasons. The study was



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undertaken at rural and agricultural sites of Patiala (India). Fine particulate matter ($PM_{2.5}$) contributed almost 55% to 64% of the RSPM, showing that, in general, the smaller particles dominated during the whole study period with more contribution during the rice crop as compared to that of wheat crop residue burning. Extensive statistical analysis of the data was done by using pair t-test. Overall results show that the concentration levels of different size particulate matter are greatly affected by agricultural crop residue burning but the total distribution of the particulate matter remains almost constant.

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Bioremediation of PAH contaminated soil[1,2]

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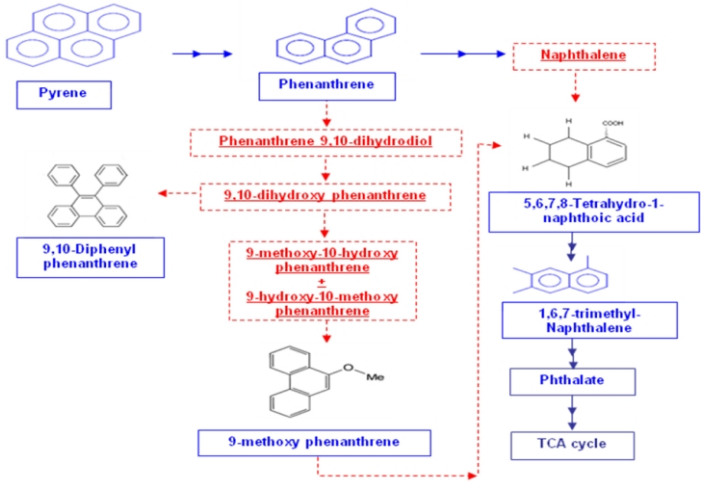
Bioremediation has evolved as the most promising technology for clean-up operations because of its economical, safety and environmental features since organic contaminants become actually transformed (thus achieving a reduction in their concentration) into harmless compounds, and some of them are fully mineralized (1). An important sector of the bioremediation market is petroleum-contaminated soils which are sinks for various non-ionic organic contaminants like polychlorinated biphenyls (PCBs) and polycyclic aromatic hydrocarbons (PAHs) (2). Polycyclic aromatic hydrocarbons (PAHs) are important environmental contaminants because of their hydrophobic and recalcitrant nature (1). *Bacillus pumilus* from crude oil contaminated soil identified by 16S rDNA gene sequence analysis, was capable of growing in the presence of 50µg/ml of pyrene. During growth on pyrene *B. pumilus* was able to cometabolize 64% of 50µg/ml pyrene in basal medium containing 0.5% glucose in 35 days while in pulse-chase studies, as assessed by HPLC analysis, log phase *B. pumilus* cells (2mg protein) were able to uptake approximately 11% of 100µg pyrene as pure substrate in 7 hours at 30°C. This report implicates *B. pumilus* (PK-12) as a potential pyrene biodegrader suitable for practical field applications for effective *in situ* PAH bioremediation.

In another attempt aerobic, mesophilic bacteria from coal-tar contaminated soil were analyzed for pyrene utilization capacity and identified by 16S ribosomal DNA sequencing as members of three genera Bacillus sp., Pseudomonas sp. and Rhodococcus sp. The soil contained nine different hazardous polyaromatic hydrocarbons

(PAHs) Benzo[g,h,i]perylene, Dibenzo[a,h]anthracene, Indeno[1,2,3-c,d]pyrene, Pyrene, Acenaphthylene, Fluorene, Phenanthrene, Benzo[k]fluoranthene and Benzo[b]fluoranthene. Bacillus sp. (PK-6) MTCC 1005 showed 56.4 % utilization of pyrene ($C_{16}H_{10}$) (50 µg ml^{-1}) in four days with growth associated biosurfactant activity and resulted



in the formation of five new intermediates, phenanthrene ($C_{14}H_{10}$), 9,10-Diphenylphenanthrene ($C_{26}H_{18}$), 9-Methoxyphenanthrene ($C_{15}H_{12}O$), 5,6,7,8-Tetrahydro-1-naphthoic acid ($C_{11}H_{12}O_2$) and 1,6,7-trimethyl-Naphthalene ($C_{13}H_{14}$). The results suggested that Bacillus sp. could be found suitable for practical field application for effective in situ PAH bioremediation.

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Extraction of tylophorine from in vitro raised plants of Tylophora indica[3]

Tylophora indica (Burm. f.) Merill. (Asclepiadaceae) commonly known as “Antmool” is an important medicinal plant traditionally used as a folk remedy in treatment of bronchial asthma, bronchitis, rheumatism, allergies and inflammation. The roots and leaves of this plant contain therapeutically active alkaloids like tylophorine, tylophorinine and tylophrinidine. Major alkaloid tylophorine has various pharmacological activities like immunosuppressive, anti-inflammatory, anti-tumor, anti leukemia, anti allergic and anti-amoebic properties. Due to lack of adequate propagation efforts, commercial cultivation of this important medicinal plant is uncommon and indiscriminate use and over exploitation of wild populations have rendered the species highly vulnerable to extinction.

The present investigation embodies an efficient method for the mass propagation of *T. indica* under *in vitro* conditions followed by extraction, separation and purification of major alkaloid tylophorine from *in vitro* regenerated plants. Leaf explants excised from 3 years old healthy mature plants of *T. indica* were cultured on Murashige and Skoog's (MS) medium supplemented with various growth regulators in different concentrations and combinations. *De novo* adventitious shoot formation occurred directly from the leaf segments on MS medium supplemented with 8.8 µM 6-benzyladenine (BA) where nodular mersitemoids differentiated from the cut ends of leaf lamina which eventually developed into green leafy shoots (70-80/flask) in about 85% cultures. Leaf explants cultured on 9.0 µM α-napthalene acetic acid (NAA) and 4.6 µM kinetin (K) resulted in callus formation after 7-8 days of culturing and the whole segment turned into mass of callus after 4 weeks. The callus cultures differentiated numerous green leafy shoots (35-40) when transferred to 9.84 µM 6-benzyladenine.The regenerated shoots, thus,

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formed were rooted on half strength basal MS medium which resulted in the formation of long healthy roots leading to the formation of complete plantlets. Plantlets were hardened through various weaning stages and successfully transferred and established in the field conditions.

For the extraction of tylophorine, leaves of regenerated plants were excised, air-dried and grounded to fine powder. The leaf powder was extracted using organic solvents like hexane, chloroform and dichloromethane and further purification of tylophorine was done on high performance thin layer chromatography (HPTLC). The developing solvent system consisted of toluene: chloroform: ethanol: ammonia (4:3.5:1.5) and the optimum wavelength of scan was 258 nm. The amount of tylophorine was found to be much higher in the *vitro* regenerated plants when compared to the tylophorine content present in the *in vivo* plants.

Fig.1 A) Development of green leafy shoots on 9.84 µM 6-benzyladenine shoot inducing medium B) Rooting of Regenerated shoots on half strength basal MS medium C) Acclimatization of plantlet in soil: vermicompost potting mixture.

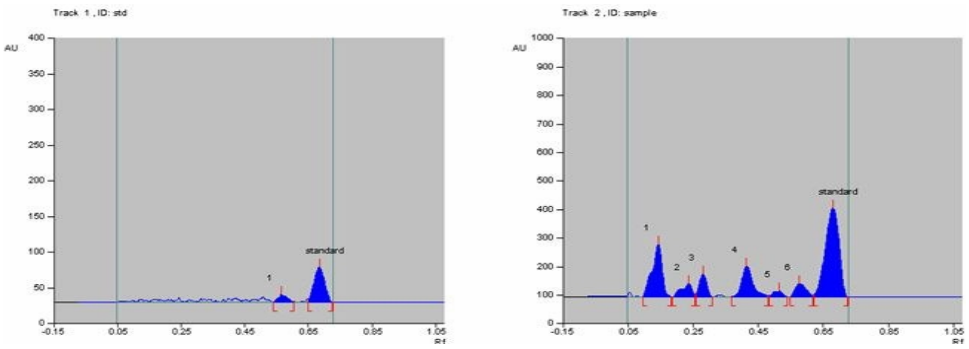

Fig.2 HPTLC profile of micropropagated plants

A) Chromatogram of standard tylophorine track showing the presence of tylophorine at Rf 0.68

B) Chromatogram of *in vitro* raised plants showing seventh tylophorine peak with Rf 0.68 and 38.84% peak area.

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Remediation of bauxite residue (red mud) and ash ponds using microorganisms[1-3]

Bauxite residue is the major solid waste produced in the process of alumina extraction from bauxite ore with concentrated sodium hydroxide at elevated temperature in the Bayer process. The use of NaOH in the Bayer process results the bauxite residue being extremely alkaline having a pH range from 9 to13. The disposal of bauxite residue is a major problem in alumina plants throughout the world. Establishing a sustainable vegetation cover on residue storage areas represents a significant challenge to alumina producers globally because of the high alkalinity, salinity, sodicity, high Al content and poor soil permeability. A nursery experiment was conducted to evaluate the potential role of arbuscular mycorrhizal (AM) fungi in encouraging the vegetation cover on bauxite residue sites. An alkali tolerant bermudagrass adapted to local conditions were grown in red mud with different amendments with and without AM fungi to assess mycorrhizal effects on plant growth, mineral nutrition, metal uptake and neutralization of bauxite residue. Inoculation of AM fungi significantly increased the plant growth, nutrient uptake and reduced Fe, Al accumulation in plant tissue and also improved the soil physicochemical and biochemical properties. Gypsum and sludge amended treatments inoculated with AM fungi had maximum biomass, nutrient uptake and reduced accumulation of metals. The neutralization of red mud was significant in presence of AM fungi than control. Gypsum and sludge amended treatments inoculated with *Aspergillus tubingensis* also showed higher above ground biomass, nutrient uptake and reduced accumulation of metals. The native AMF colonization also increased because of *A. tubingensis* inoculation. These experiments provided evidence for the potential use of bermudagrass in combination with AM fungi for ecological restoration of bauxite residue sites.

Fly ash is one of the residues produced during combustion of coal and its disposal is a major environmental concern throughout coal based power generated counties. Deficiencies of essential nutrients, low soil microbial activity, high soluble salt concentrations of trace elements are some of the concerns for reclamation of fly ash ponds. The effect of fly ash adapted arbuscular mycorrhizal (AM) fungi and phosphate solubilizing fungus *Aspergillus tubingensis* was studied on the growth, nutrient and metal uptake of bamboo plants grown in fly ash. Co-inoculation of these fungi significantly increased the P, K, Ca and Mg in shoot tissues compared control plants. The Al and Fe content were significantly reduced due to the presence of AM fungi and *A. tubingensis*. The results showed that combination of AM fungi and *A. tubingensis* elicited a synergetic effect by increasing plant growth and uptake of nutrients with reducing metal translocation.

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Utilization of rock phosphate as fertilizer source to enhance the yield of crop using Phosphate solubilizing microorganisms in alkaline soils[4]

Phosphorus (P) is an essential element for plant growth and development. Plants utilize little amounts of applied P fertilizers and the rest is rapidly converted into insoluble complexes in the soil. This leads to the need of frequent application of P fertilizers, but its use on a regular basis is expensive and environmentally undesirable. Natural phosphate rocks have been recognized as a valuable alternative for P fertilizers. In India, it is estimated that there are almost 260 million tons of phosphate rock deposits and this material may provide a cheaper source of phosphate fertilizer for crop production. Unfortunately, rock phosphate is not plant available where the pH of the soil is greater than 5.5 - 6.0 and even when conditions are optimal, plant yields are lower

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than those obtained with soluble phosphate. For a sustainable agriculture system, microbial solubilization of rock phosphate and its use in agriculture is receiving greater attention. Phosphate (P) solubilizing fungi, *Penicillium oxalicum* and *Aspergillus* spp., were isolated from the rhizosphere soil of rock phosphate mine landfills and tested for its efficacy to solubilize rock phosphate (RP) as well as promotion of the growth of wheat and maize plants grown in soil amended with RP. The results showed that these fungi effectively solubilized RP in Pikovskaya's medium and released higher amount of phosphorus. Field experiments showed that inoculation of these fungi significantly increased the growth and yield of two consecutive crops i.e. wheat and maize compared to the control soil. The P content was significantly increased in the plants. The available P and organic carbon levels increased in RP amended soil inoculated with these fungi compared to the control soil. These results suggest that P solubilizing fungi along with RP can substitute the chemical fertilizer in alkaline soil and help in improving the crop production.

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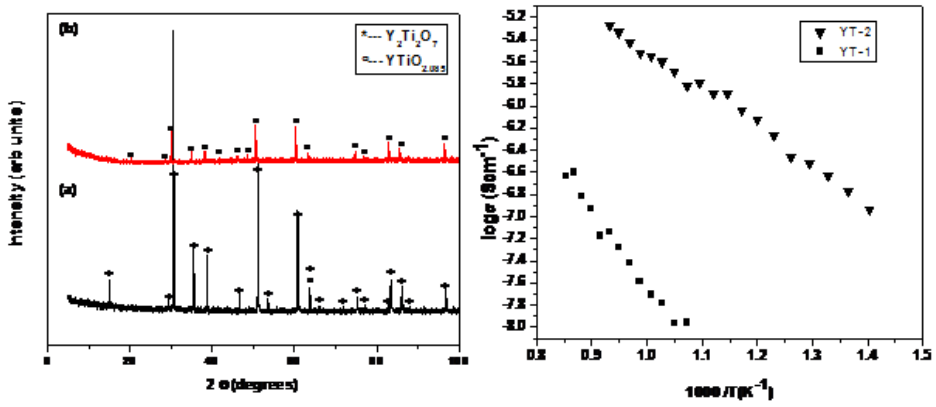
Conference

A gathering of important people who singly can do nothing, but together decide that nothing can be done.

-Fred Allen

Role of sintering temperature on thermal, electrical and structural properties of $Y_2Ti_2O_7$ pyrochlores[1]

Pyrochlores exhibit variety of properties which can be tailored by changing the processing conditions. In the present study, the sintering characteristics, thermal expansion coefficient, crystal structure and conductivity behavior of pyrochlores have been studied for different applications. It was observed that sintering at 1550 ºC for 12h exhibits more oxygen deficient $YTiO_{2.085}$ phase which shows two order of magnitudes higher conductivity than $Y_2Ti_2O_7$ phase. The conductivity enhancement in $YTiO_{2.085}$ sample is attributed to higher oxygen deficiency which may be created due to transformation of Ti^{4+} to Ti^{3+} at low oxygen pressure. The EPR spectra of both the samples exhibit resonance signals of different intensities indicating that Ti^{3+}/Ti^{4+} ratio differs in both the samples.



Influence of Y_2O_3 on structural and optical properties of SiO_2–BaO – ZnO – xB_2O_3 - (10-x) Y_2O_3 glasses and glass ceramics[2]

SiO_2–BaO – ZnO – xB_2O_3 - (**10**-x) Y_2O_3, ($0 \leqslant x \leqslant 10$) glasses are synthesized. The effect of Y_2O_3 on structural and optical properties of glasses has been investigated using different characterization techniques. The results are discussed in light of non-bridging oxygens (NBO), optical basicity and heat-treatment of glasses. The band gap has been calculated for as cast and heat-treated glasses. The band gap energy is found to decrease with the increasing content of Y_2O_3 in the glasses and heat treatment. The presence of crystalline phase in glass matrix showed remarkable effect on band gap which decreases to semiconducting range.

SiO_2 –BaO – ZnO – xB_2O_3 - (**10**-x) Y_2O_3, ($0 \leqslant x \leqslant 10$) glasses are synthesized. The effect of Y_2O_3 on structural and optical properties of glasses has been investigated. The band gap energy is found to decrease with the increasing content of Y_2O_3 in the glasses and heat treatment. The presence of crystalline phase in glass matrix showed remarkable effect on band gap which decreases to semiconducting range due to heat treatment

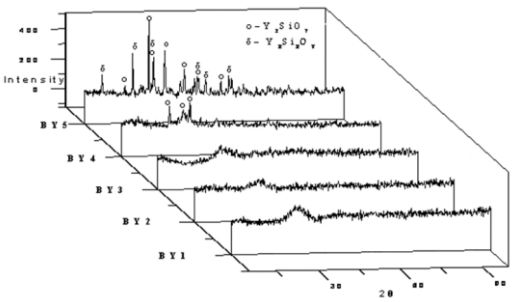


Fig. The XRD diffractogram for heat-treated glass samples..

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Role of important parameters in ring opening polymerization of polylactide

Parmjit Kaur et al. [1] Different parameters, namely polymerization temperature, polymerization time, monomer/initiator ratio, nature of the initiator, amount of water or other impurities etc. are very significant for polymerization reactions either in bulk or solution. Monomer to initiator ratio has a very significant role in polymerization reactions and a value ranging from 50 to 5000 that has been reported by different researchers. Recrystallization of the monomer removes the meso compounds from the monomer, which absorbs the moisture and effects polymerization reaction. So, it is necessary to recrystallize the monomer with any anhydrous solvent like dry toluene, ethyl acetate etc. Prolonged reaction time cannot increase the polymer yield; it generally causes the decrease of molecular weight and broadening of molecular weight distribution of formed polymers. This is probably due to the transesterification side reaction in polymerization, intensifying at prolonged time periods. Several groups like hydroxyl and carboxylic acid affect the polymerization rate. In most of the cases, the effect of polymerization temperature and time goes up to a certain value and after that polymer yield and molecular weight decreases. It also causes the broadening of molecular weight distribution. This is probably due to the transesterification side chain reaction. The average molecular weight decreases at very high monomer-to-initiator ratios. This may be due to the fact that with a fewer number of growing polymer chains, the presence of even a trace amount of chain terminating agent can limit the molecular weight. The presence of moisture also decreases the polymer yield, so it is very important to recrystallize the monomer before the start of polymerization, otherwise, low molecular weight product is obtained.

Synthesis of Polylactide: Effect of Dispersion of the Initiator

Parmjit Kaur et al. [2] The ring opening polymerization of L- lactide was studied in bulk using stannous octoate as initiator. In some experiments, triphenylphosphine, a Lewis base was also used as co-initiator. The polymerization was carried out at 130 °C up to 29 hr. The monomer was used after recrystallizing thrice with dry toluene. Experiments were carried out using a wide range of monomer to initiator ratio. The averages and distributions of molar masses of resulting PLA have been determined by means of size exclusion chromatography, SEC. It is shown that the (mode, process) procedure of dispersion of the catalyst in polymerization system affects the molar mass distribution of the product as is evidenced by the bimodality or even trimodality observed in the SEC chromatograms.

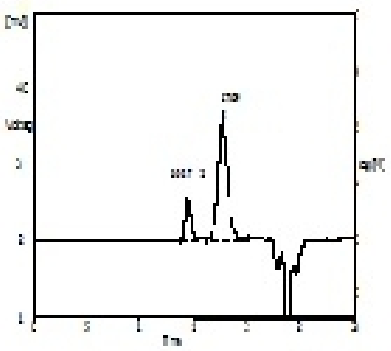

Fig. SEC of PLA (with stannous octoate and triphenylphosphine)

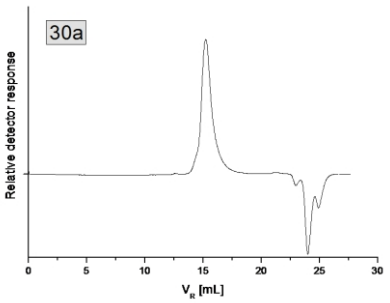

Fig. SEC of PLA (with pure stannous octoate)

The bimodal or multimodal PLA was formed as result of the incomplete, imperfect mixing of initiator with monomer. It was observed that the pronounced bimodality or trimodality of PLA observed on the SEC chromatograms has been in principle removed with a proper dispersion of initiator in the monomer. The present work has shown the importance of complete dispersion of the initiator in the polymerization system of lactide. A basically unimodal molar mass distribution is observed in the product obtained with application of additional steps that include dispersing the initiator in the appropriate solvent, mixing the resulting solution with monomer and removing the solvent by distillation. However, a polymeric product with controlled bimodal/trimodal molar mass distribution may have some interesting applications similar to polyacrylonitrile where low molar mass part allows polymer processing and fibre production, while high molar mass fraction gives necessary physical properties to fibres.

Modeling impact of solar radiation on site selection for solar PV power plants in India

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Amil Jain et al. [3] Solar power is gaining importance in the light of discussion about climate change and renewable energy sources. In most parts of India, clear sunny weather is experienced 250 to 300 days in a year. The annual global radiation varies from 1600 to 2200 kWh/m^2, which is comparable with radiation received in the tropical and sub-tropical regions. This paper runs simulation scenarios for various sites in India for technical and financial viability of solar power generation with photo voltaic (PV) technology. Solar radiation data is accessed from National Aeronautics and Space Administration (NASA) website and other meteorological parameters are collected from Indian Meteorological Department (IMD). The data is fed into RETScreen model to run various simulation scenarios. Feasibility of sites in India to build a 5 MW PV-grid connected power plant from techno-economical and environmental points of view are discussed. A model is run for 31 major sites in India to measure the viability of Solar PV plants at these sites. Financial incentives announced in national solar mission of India have been used as an input to the model. Viability indicators like internal rate of return (IRR), net present value (NPV), cost of electricity (CoE), benefit cost (B-C) ratio are identified on the basis of the model. A comparison of results is done and the best sites in India are reported.

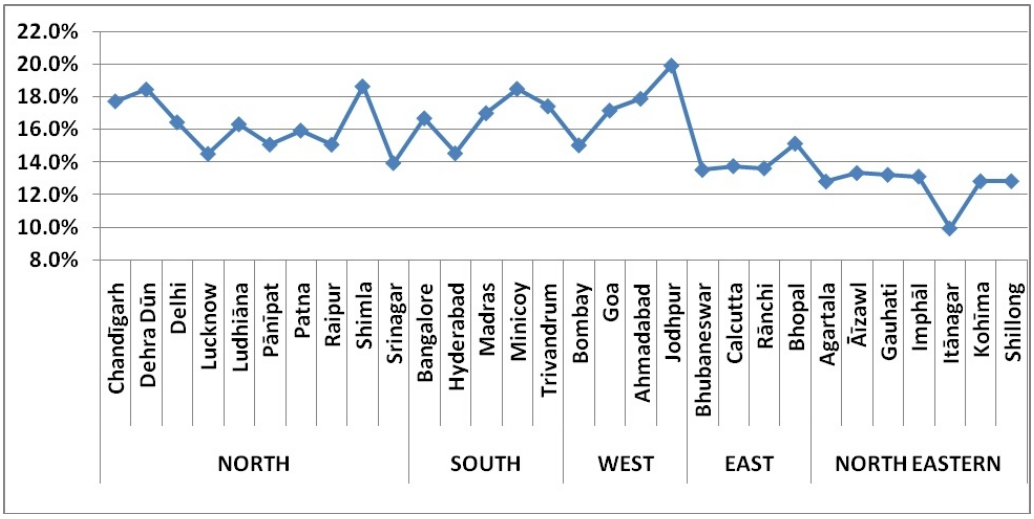

Figure: Pre-tax IRR-Equity for different cities of India

Simultaneous removal of copper, nickel and zinc metal ions using bulk liquid membrane system

Ranpreet Singh et al. [4] One of the novel techniques of mixture components separation is an application of liquid membranes. This paper reveals the ability of liquid membrane in simultaneous transport of mixture components in which a liquid membrane (LM) constitutes a separate phase which separates mixture from an internal receiving phase. In the present work, the experiments were performed for determining the distribution coefficient and Cu, Ni and Zn metal ion removal measurements. Metal distribution coefficients were obtained by simply equilibrating an aqueous solution of the metal ions with an organic liquid membrane containing a complexing agent (D2EHPA), in a separating funnel at 25^0C. Initially, to assure mass balance, samples of both the phases were analyzed by an atomic absorption spectrophotometer. Routinely, only the aqueous phase was analysed. Distribution coefficients were measured over a broad range of metal ion concentration. The separation of metal ions was analyzed for bulk liquid membrane-cylinder in cylinder setup, by varying the source metal ion concentration. Maximum extraction of 98.8% of zinc, 95.8% of copper and 95.0% of nickel metal ion was achieved at the optimum conditions and maximum removal of the metal ions was in the order Zn>Cu>Ni.

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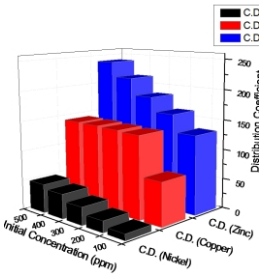

Figure 1: Membrane/aqueous Distribution Coefficients (C.D.) vs Initial concentration

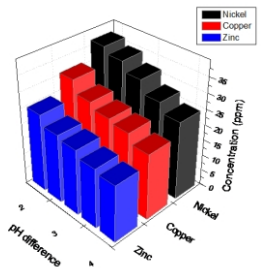

Figure 2: Final feed phase concentration vs pH difference between feed and internal phase

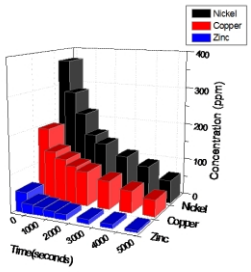

Figure 3: Feed phase concentration (ppm) vs time (seconds)

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Fusion excitation functions of ^{64}Ni + $^{112-132}$Sn reactions studied on the dynamical cluster-decay model

Manoj Kumar et al. [1] The dynamical cluster-decay model (DCM) of Gupta and Collaborators has been used to study the decay of various Pt-isotopes ^{176,182,188,196}Pt* formed in ^{64}Ni + ^{112,118,124}Sn and ^{132}Sn + ^{64}Ni reactions. The evaporation residue (ER) and fission cross-sections (σ_{ER} and σ_{fiss}) are calculated in reference to available experimental data at near- and sub-barrier energies. The calculated σ_{ER} show excellent agreement with experimental data at all incident center-of-mass (c.m.) energies, with the characteristics of emitted light particles (LPs) showing a change with the increase of the iso-spin N/Z ratio of compound nucleus (CN). The only parameter of DCM, the neck-length parameter, for ^{196}Pt* becomes much smaller, compared to other ^{176,182,188}Pt* isotopes, and more so at higher c.m. energies, possibly due to additional eight neutrons of the radioactive ^{132}Sn nucleus. Another interesting result of the DCM calculation is that, similar to other well-known Ni-induced (^{58,64}Ni + ^{58,64}Ni and ^{64}Ni + ^{100}Mo) reactions, an inbuilt 'barrier lowering' effect is also shown operating for σ_{ER} as well as σ_{fiss} at sub-barrier energies in these reactions. Furthermore, the calculated σ_{fiss} shows a significant contribution of quasi-fission (σ_{qf}) at the highest one or two energies, and, due to the deformation and orientation effects of fission fragments, shows a change of the mass distributions from a predominantly symmetric to a predominantly asymmetric one with the increase in the N/Z ratio of CN. This change in fission mass distributions provides the possibility of fine-/sub-structure in fission products of Pt* isotopes.

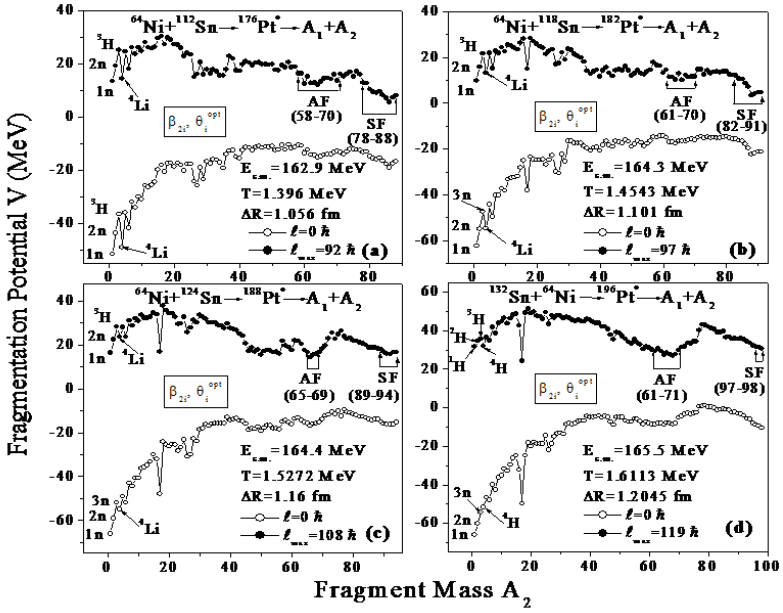

Figure: Fragmentation potentials V (A_2) for the decay of ^{176,182,188,196}Pt* nuclei, plotted for the extreme ℓ-values, with effects of quadrupole (β_{2i}) deformations and 'optimum' hot orientations θ_i^{opt} included.

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Role of higher-multipole deformations in exotic ^{14}C cluster radioactivity

Gudveen Sawhney et al. [2] We have studied nine cases of spontaneous emission of ^{14}C clusters in the ground-state decays of the samenumber of parent nuclei from the trans-lead region, specifically from ^{221}Fr to ^{226}Th, using the preformed cluster model (PCM) of Gupta and collaborators, with choices of spherical, quadrupole deformation (β_2) alone, and higher-multipole deformations (β_2, β_3, β_4) with cold "compact" orientations θ^c of decay products. The calculated ^{14}C cluster decay half-life times are found to be in nice agreement with experimental data only for the case of higher-multipole deformations (β_2-β_4) and θ^c orientations of cold elongated configurations. In other words, compared to our earlier study of clusters heavier than ^{14}C,

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where the inclusion of β_2 alone, with "optimum" orientations, was found to be enough to give the best comparison with data, here for ^{14}C cluster decay the inclusion of higher-multipole deformations (up to hexadecapole), together with θ^c orientations, is found to be essential on the basis of the PCM. Interestingly, whereas both the penetration probability and assault frequency work simply as scaling factors, the preformation probability is strongly influenced by the order of multipole deformations and orientations of nuclei. The possible role of Q value and angular-momentum effects is also considered in reference to ^{14}C cluster radioactivity.

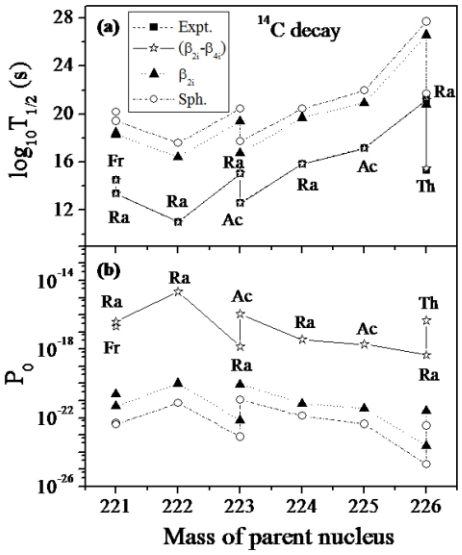

Figure: (a) PCM calculated decay half-life times for the ^{14}C cluster emitted from various parent nuclei, compared with experimental data. Calculations are for spherical nuclei, and with deformation and orientation effects included. (b) Preformation probability P_0 corresponding to the calculations in (a).

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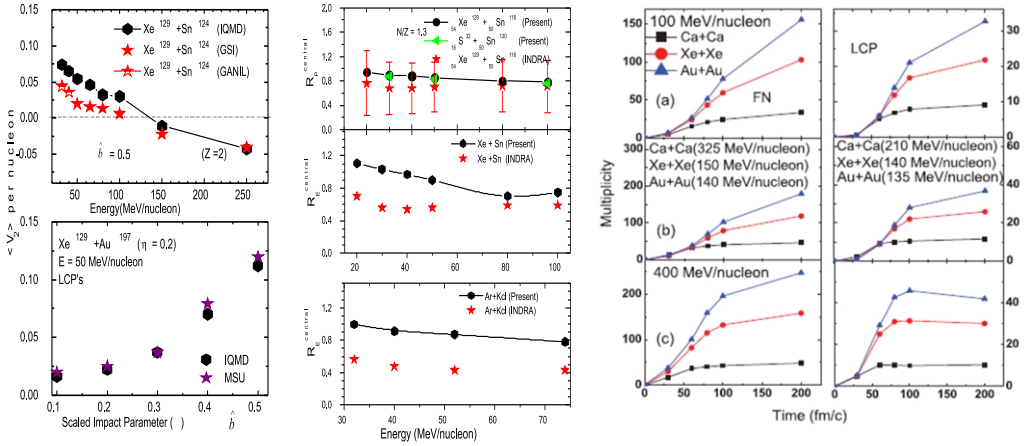
How to present a paper orally

Talk low, talk slow,
and don't say too much.
-John Wayne

On the elliptical flow and mass asymmetry of colliding nuclei[1-3]

A study of elliptical flow and nuclear stopping is carried out for different mass asymmetries of colliding nuclei varying from 0.2 to 0.7. The present reactions are simulated at incident energies between 50 and 250 MeV/nucleon within the framework of isospin-dependent quantum molecular dynamics model. For this analysis, total mass of the colliding nuclei is kept fixed equal to 152 units. The elliptical flow shows a transition from in-plane to out of plane with incident energy in the mid-rapidity region. The transition energy is found to increases with the mass asymmetry for light charged particles. While in case of nuclear stopping, we find sizable effect of mass asymmetry on stopping and hence on the equilibrium of the nuclear matter. In both cases, a reasonable agreement is observed between the experimental data and our theoretical calculations.



Multifragmentation around the transition energy in intermediate-energy heavy-ion collisions[4]

Fragmentation of light charged particles is studied for various systems at different incident energies between 50 and 1000 AMeV. We analyze fragment production at the incident energies below, at, and above the transition energies using the isospin-dependent quantum molecular dynamics model. The trends observed for the fragment production and rapidity distributions depend upon the incident energy, size of the fragments, and composite mass of the reacting system, as well as on the impact parameter of the reaction. The free nucleons and ight charged particles show continuous homogeneous changes, irrespective of the transition energies, indicating that there is no relation between the transition energy and production of the free as well as light charged particles.

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On String Languages Generated By Spiking Neural P Systems With Anti-Spikes[1]

A Spiking Neural P system with anti-spikes uses two types of objects called spikes and anti-spikes which can encode binary digits in a natural way. The step when system emits a spike or an anti-spike is associated with symbol 1 and 0, respectively. Here we consider these computing devices as language generators. They allow non-determinism between the rules $a^c \rightarrow a$ and $a^c \rightarrow \bar{a}$, $c \in N$, thus help to generate languages which cannot be generated using simple SN P systems.

Spiking Neural P Systems with Anti-Spikes as Transducers[2]

In this paper, we consider spiking neural P systems with anti-spikes. Because of the use of two types of objects, the system can encode the binary digits in a natural way and hence represent the formal models more efficiently and naturally than the standard SN P systems. This work deals with the computing power of spiking neural P system with anti-spikes. It is demonstrated that, as transducers, spiking neural P systems with anti-spikes can simulate any Boolean circuit and also computing devices such as finite automata and finite transducers. We also investigate how the use of anti-spikes in spiking neural P systems affects the capability to solve the satisfiability problem.

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How to prepare a Poster

It takes intelligence, even brilliance, to condense and focus information into a clear, simple presentation that will be read and remembered. Ignorance and arrogance are shown in a crowded complicated, hard-to-read poster.

-Mary Helen Briscoe

Analysis of Dirichlet and Generalized "Hamming" window functions in the Fractional Fourier transform domains

The FrFT is ageneralization of the conventional Fourier transforms havingnumerous applications in many diverse areas such as signalprocessing, optics, pattern recognition etc. The FrFT belongs to the class of time-frequency representations (TFR) that have been extensively used by the signal processing community.In all the TFRs, one normally uses a plane with two orthogonal axes corresponding to time and frequency.The FrFT is a linear operator that corresponds to the rotation of the signal through an angle which is not a multiple of π/2, i.e. it is the representation of the signal along the axis u making an angle φ with the time taxis.

A new mathematical model for obtaining the FrFT of Dirichlet and Generalized "Hamming"window functions is presented. Based on the fractional Fourier transformation techniques, it canbeshownthattheFrFTofDirichletandGeneralized "Hamming" windowfunctionsaredirectlydependenton the fractionalFouriertransformangle φ.It is shown through simulations that the increasing value of the FrFT parameter a(φ = aπ/2) reduces the side lobe levels, which in turn broadens the main lobe width, thus reducing the resolution. It can further be concluded that for Dirichlet window function, as the parameter ais increased, MSLL (maximum side lobe level), HMLW (half main lobe width) and SLFOR (side-lobe fall-off rate) starts increasing. Similarly, for Hanning window function (for β = 0.50), MSLL, HMLW and SLFOR starts increasing with increasing value of the parameter a.

Thus, this reveals that there is a variation in the window function parameters with the variation in the FrFT parameter a and a best optimal solution can be obtained for the variety of practical applications such as, in image compressions. Efforts have also been made to choose the most convenient parameter adjustment to reduce the sidelobe effect and to increase the intensity of the mainlobe. Also, the results discussed in the above techniques can be beneficial to reduce the undesirable effects of the spectral leakage.

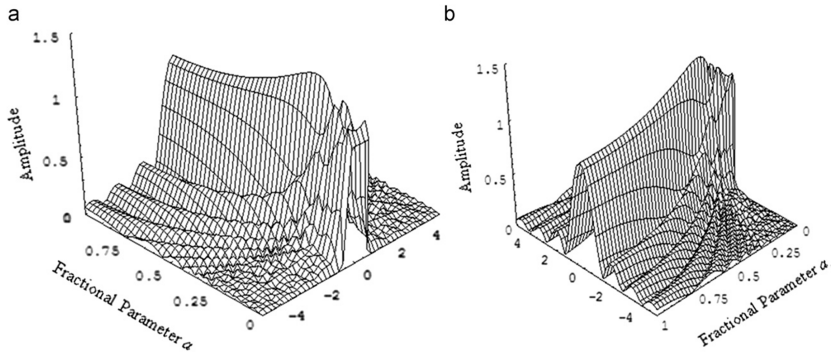

Fig. 1. The continuum of fractional Fourier transform of Dirichlet window function

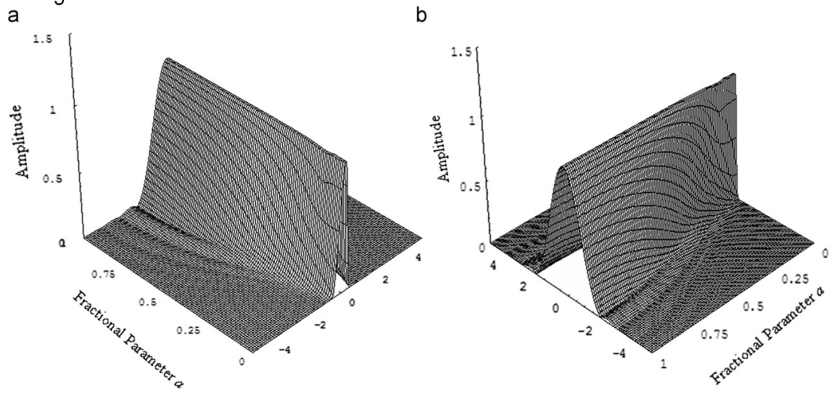

Fig. 2. The continuum of fractional Fourier transform of Hanning window function.

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Sanjay Kumar and Kulbir Singh, "Analysis of Dirichlet and Generalized "Hamming" window functions in fractional Fourier transform domains", Signal Processing, Vol. 91, No. 03, pp. 600-606, 2011.

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Monitoring Corrosion in Oxide and Chloride Environments Using Ultrasonic Guided Waves

Ultrasonic guided waves have been used for monitoring progression of rebar corrosion in concrete in chloride and oxide environments. The effect of rates of corrosion in the two environments on the ultrasonic signals is reported. Surface and core seeking guided wave modes were used to monitor beams undergoing accelerated impressed current corrosion in the presence (chloride corrosion) and absence of chlorides (oxide corrosion). Effective combination of guided wave modes could relate to the differences in corrosion mechanisms and rates in the two environments. Ultrasonic test results correlated well with that of the destructive tests.

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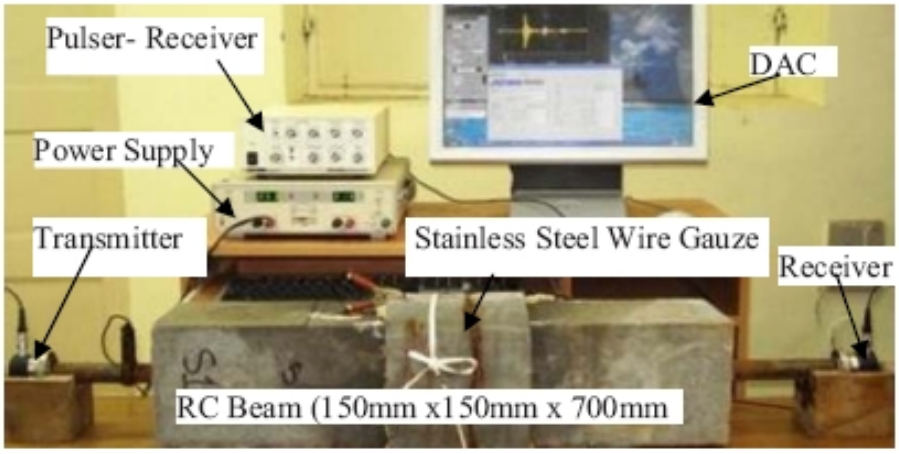

Experimental Set-Up

Reference

S. Sharma, A. Mukherjee Monitoring Corrosion in Oxide and Chloride Environments Using Ultrasonic Guided Waves, ASCE Journal of Materials in Civil Engineering, 23(2): 207-211, 2011.

Reviewer

A reviewer is one who gives the best jeers of his life to the author.

-Anonymous

A new approach for ranking nonnormal p-norm trapezoidal fuzzy numbers

Amit et al. [1] In this paper, with the help of several counter examples it is proved that the results proposed by Chen and Tang [C.C. Chen, H.C. Tang, Ranking of nonnormal p-norm trapezoidal fuzzy numbers with integral value, Computers and Mathematics with Applications 56 (2008) 2340–2346] are applicable only for the nonnormal p-norm trapezoidal fuzzy numbers with equal heights and a new approach is proposed for the ranking of nonnormal p-norm trapezoidal fuzzy numbers with different heights. The results proposed by Chen and Tang are modified and to illustrate the proposed approach the counter examples are solved using the proposed approach. It is also shown that the proposed approach and the results, obtained by using the proposed approach, are valid.

A new approach for ranking of L–R type generalized fuzzy numbers

Amit et al. [2]Ranking of fuzzy numbers play an important role in decision making, optimization, forecasting etc. Fuzzy numbers must be ranked before an action is taken by a decision maker. Cheng (Cheng, C. H. (1998). A new approach for ranking fuzzy numbers by distance method. Fuzzy Sets and Systems, 95, 307–317) pointed out that the proof of the statement "Ranking of generalized fuzzy numbers does not depend upon the height of fuzzy numbers" stated by Liou and Wang (Liou, T. S., & Wang, M. J. (1992). Ranking fuzzy numbers with integral value. Fuzzy Sets and Systems, 50, 247–255) is incorrect. In this paper, by giving alternative proof it is proved that the above statement is correct. Also with the help of several counterexamples it is proved that ranking method proposed by Chen and Chen (Chen, S. M., & Chen, J. H. (2009). Fuzzy risk analysis based on ranking generalized fuzzy numbers with different heights and different spreads. Expert Systems with Applications, 36, 6833–6842) is incorrect. The main aim of this paper is to modify the Liou and Wang approach for the ranking of L–R type generalized fuzzy numbers. The main advantage of the proposed approach is that the proposed approach provide the correct ordering of generalized and normal fuzzy numbers and also the proposed approach is very simple and easy to apply in the real life problems. It is shown that proposed ranking function satisfy all the reasonable properties of fuzzy quantities proposed by Wang and Kerre (Wang, X., & Kerre, E. E. (2001). Reasonable properties for the ordering of fuzzy quantities (I). Fuzzy Sets and Systems, 118, 375–385).

RM approach for ranking of L–R type generalized fuzzy numbers

Amit et al. [3] In this paper, the shortcomings of existing approaches (Liou and Wang 1992; Chen and Chen 2009) are pointed out and a new ranking approach is proposed for finding the correct ordering of L–R type generalized fuzzy numbers. It is shown that proposed ranking function satisfies all the reasonable properties of fuzzy quantities proposed by Wang and Kerre (2001).

New method for solving fully fuzzy linear programming problems

Amit [4]Lotfi et al. [Solving a full fuzzy linear programming using lexicography method and fuzzy approximate solution, Appl. Math. Modell. 33 (2009) 3151–3156] pointed out that there is
no method in literature for finding the fuzzy optimal solution of fully fuzzy linear programming
problems and proposed a new method to find the fuzzy optimal solution of fully fuzzy linear programming problems with equality constraints. In this paper, a new method is proposed to find the fuzzy optimal solution of

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same type of fuzzy linear programming problems. It is easy to apply the proposed method compare to the existing method for solving the fully fuzzy linear programming problems with equality constraints occurring in real life situations. To illustrate the proposed method numerical examples are solved and the obtained results are discussed

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Influence of tube diameter on carbon nanotube interconnect delay and power output.

This paper address the influence of tube diameter on single walled carbon nanotube (CNT) bundle interconnect delay and power output in Very Large Scale application. We find that single-walled carbon nanotube (SWCNT) bundle interconnects are of lower delay than copper interconnect due to low resistance and inductance. Power dissipation decreases with increase in tube diameter of the constituent SWCNT. CNT interconnect resistance and inductance increases with increase in tube diameter. On the other hand, with increase in tube diameter interconnect capacitance decreases. There is a trade off between delay and power dependence on tube diameter.

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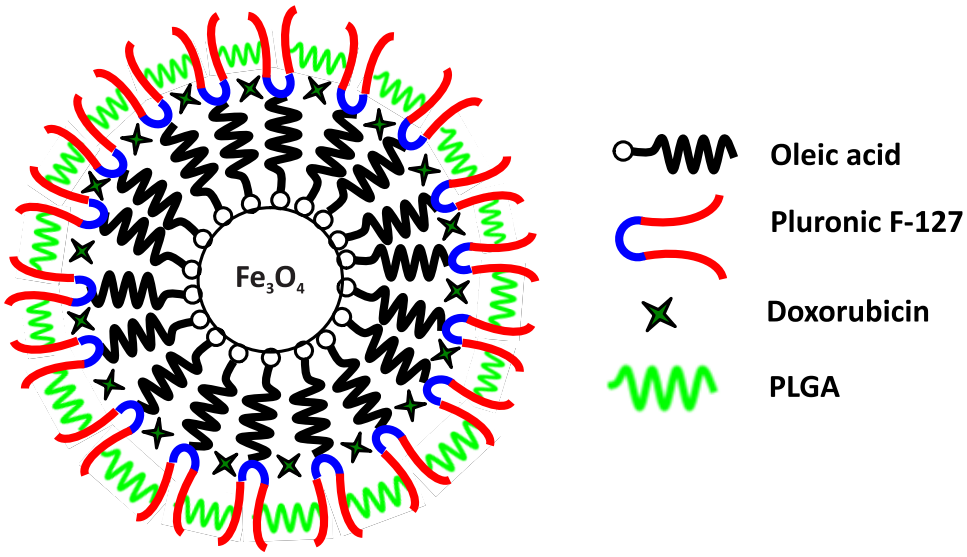
Reference

Mayank Kumar Rai Sankar Sarkar Physica Status Solidi (A) 208 (3) 735–739, 2011

Biodegradable thermoresponsive polymeric magnetic nanoparticles: a new drug delivery platform for doxorubicin

The use of nanoparticles as drug delivery systems for anticancer therapeutics has great potential to revolutionize the future of cancer therapy. The aim of this study is to construct a novel drug delivery platform comprising of a magnetic core and biodegradable thermoresponsive shell of tri block-co-polymer. Oleic acid coated Fe_3O_4 nanoparticles and hydrophilic anticancer drug 'doxorubicin' are encapsulated with PEO-PLGA-PEO (polyethylene oxide - poly D,L lactide-co-glycolide - polyethylene oxide) tri block-co-polymer. Structural, magnetic and physical properties of Fe_3O_4 core are determined by X-ray diffraction, VSM and TEM techniques, respectively. The hydrodynamic size of composite nanoparticles is determined by DLS and is found to be ~ 36.4 nm at 25ºC. The functionalization of magnetic core with various polymeric chain molecules and their weight proportions are determined by FTIR spectroscopy and TGA analysis, respectively. Encapsulation of doxorubicin into the polymeric magnetic nanoparticles, its loading efficiency and kinetics of drug release are investigated by UV-vis spectroscopy. The loading efficiency of drug is 89 % with a rapid release for the initial 7 h followed by the sustained release over a period of 36 h. The release of drug is envisaged to occur in response to the physiological temperature by deswelling of thermoresponsive PEO-PLGA-PEO block-co-polymer. This study demonstrates that temperature can be exploited successfully as an external parameter to control the release of drug.



Schematic representation of structure of PLGA-DOX-PLU-OA-Fe_3O_4 magnetic polymeric nanoparticles

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CENTRE OF RELEVANCE AND EXCELLENCE (CORE) IN AGRO & INDUSTRIAL BIOTECHNOLOGY

The Centre of Relevance and Excellence (CORE) in Agro & Industrial Biotechnology, established in 2000 with the support of (TIFAC) and Department of Science & Technology (DST), has the major objectives as under:

- To achieve excellence in technical education in the areas of Biotechnology, Biochemical and Chemical Engineering and Environmental Science & Technology
- To offer Short-term training courses for Industrial personnel, entrepreneurs and researchers engaged in teaching and research in the academics as well as industry
- To pursue research in the areas of Agro-Biotechnology and Industrial Biotechnology

CORE in Agro & Industrial Biotechnology is oriented towards development of innovations in the niche areas of plant biotechnology including plant tissue culture, developing transgenic plants, mycorrhiza, microbial bioremediation, molecular taxonomy of microbes, bioinoculants for crop protection and enhancing crop yield, bioprospection of plant and microbial secondary metabolites, bioremediation of pesticides and toxic metals through fungal and bacterial systems and microbial concrete filler development. Many research projects in different areas supported by different funding agencies such as DBT, CSIR, UGC, DST, AERB have been undertaken at CORE.

TIFAC-CORE constitutes eight major state-of-the-art labs including a pilot plant tissue culture facility. The laboratories include: Tissue Culture Working Laboratories (3), Chromatography Room, Molecular Biology Laboratory, Fermentation & Analytical laboratory, Polyhouses for acclimatization of micropropagated plants and Molecular Biology Laboratory. An area of five acres of land is also available for field oriented research work and for carrying out enterprise activities.

Major equipments available for research include Real-Time PCR, ELISA Reader, Bioanalyzer, Nanodrop, HPLCs, Graphite AAS, High resolution spectrophotometer, Vapour pressure osmometer, GC-Mass Spectrophotometer, Atomic Absorption spectrophotometer, Walk in Chamber (cold room), Fermenter, Gas Chromatographs, Refrigerated high speed Centrifuges etc.

The Centre has conducted some 35 training programmes as per the needs of the participating organisations, which have been attended by over 700 personnels. The major areas of manpower training are: Microbial Biotechnology: Molecular and Bioanalytical techniques, Plant Tissue Culture and Plant Biotechnology, Molecular Taxonomy and fungal Biodiversity, Food Technology, Environmental management and Waste water analysis, *In vitro* antimicrobial susceptibility testing etc.

The Plant tissue culture pilot plant facility at CORE has the capacity of annual production of 2 million plants of different species. It has developed the propagation protocols for many crop species, horticulture and forestry species and medicinal plants. It has a tie-up with different industries such as PEPSICO India Holdings Ltd., McCain Foods, nursery men and apple growers for the production and supply of planting material. It annually supplies about 2-3 million propagules to these industries with the annual revenue generation of about Rs. 3.0 million. These funds are used for the sustenance of CORE and for various research activities. The CORE has successfully conducted many national and international seminar and symposia. The activities of the CORE are monitored by a joint committee of TIFAC-DST and Thapar University.

Thapar University - *proud past promising future*

Thapar University (formerly known as Thapar Institute of Engineering and Technology) founded by Late LalaKaram Chand Thapar in 1956 is a premier educational and research institute located in the 250-acre campus, in the historic city of Patiala. TU became 'Deemed University' in December 1985, and, is, today recognized among the leading privately managed grant-in-aid engineering institutions of the country and the best of its kind in the north-western region of India; it runs undergraduate, postgraduate, and PhD programs in all the disciplines.

At TU, an aptitude for learning and growth is well reflected through a vibrant student life. TU provides modern, spacious, and architecturally striking hostels as well as excellent sports facilities. The students are encouraged to participate in multifarious extra-curricular and co-curricular activities, such as movie making, fine arts, photography, dance, music, literary, drama on one side and helping the needy including the children of the unprivileged and underprivileged class on the other. The students are also provided opportunities to express their views on a plethora of academic and non-academic issues through University magazines and TnI – a student newspaper. In fact, TU understands that the educational innovations certainly do not come about automatically. It is the environment which influences and changes the standards of learning.