| Sl. No. | IIT Ropar<br>List of Recent Publications with Abstract<br>Coverage: August, 2020 |
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| 1. | A hybrid multi-criteria decision approach to analyze key factors affecting sustainability in supply chain networks of manufacturing organizations<br>RK Sharma, PK Singh, P Sarkar, H Singh - Clean Technologies and Environmental Policy, 2020<br><br>**Abstract:** Companies are under increasing pressure to inculcate sustainability in their supply chain networks. However, the companies face significant amount of barriers in pursuit of implementing sustainability initiatives in their supply chain networks. The study helps to identify and understand the key factors (barriers and drivers) that impact the sustainability in the supply chain networks at the organizational level (intrinsic) and country level (extrinsic). The present research combines fuzzy-based analytical hierarchy process with fuzzy Technique for Order of Preference by Similarity to Ideal Solution methods to rank the barriers to the sustainability adoption in companies and the drivers that assist in overcoming these barriers, respectively. The barriers are ranked using the fuzzy AHP method, while the fuzzy TOPSIS method is used to prioritize the drivers. Prioritizing the drivers will aid the companies to focus on the top-ranked drivers and formulate strategies for effective sustainability implementation. The sturdiness of the proposed model is judged by a sensitivity analysis test. Lack of regulations, lack of top management commitment and financial constraints are identified as top three barriers, whereas product quality improvement, integration of sustainability principles into decision making, and pressure from consumers and investors are the three most significant drivers for achieving sustainability in supply chain networks. In this study, a significant number of barriers and drivers have been analyzed that will help sustainability managers to develop a better understanding of the severity of different barriers and significance of the drivers for improving the sustainability in their supply chain networks. |
| 2. | A Survey on Automatic Multimodal Emotion Recognition in the Wild<br>G Sharma, A Dhall - Advances in Data Science: Methodologies and Applications: Part of the Intelligent Systems Reference Library book series, 2020<br><br>**Abstract:** Affective computing has been an active area of research for the past two decades. One of the major component of affective computing is automatic emotion recognition. This chapter gives a detailed overview of different emotion recognition techniques and the predominantly used signal modalities. The discussion starts with the different emotion representations and their limitations. Given that affective computing is a data-driven research area, a thorough comparison of standard emotion labelled databases is presented. Based on the source of the data, feature extraction and analysis techniques are presented for emotion recognition. Further, applications of automatic emotion recognition are discussed along with current and important issues such as privacy and fairness. |
| 3. | A systematic review of urban sprawl studies in India: a geospatial data perspective<br>V Saini, RK Tiwari - Arabian Journal of Geosciences, 2020<br><br>**Abstract:** This paper reviews articles published in the English language and using geospatial data in analysing the state of urban sprawl in India. India is not far behind in the unparalleled global phenomenon of urbanization, with it adding the highest number of urban dwellers by 2050. We review a total of 153 articles involving the use of remote sensing data for studying urban sprawl in India since it was first reported in the 1980s to the present. We find an exponentially increasing trend of urban sprawl studies since the year 2010 attributing to 72% of the total publications. This review helped in finding preferences as regards the most frequently studied city, platforms/sensors used, journals and the most active group carrying out urban sprawl studies. We then group the studies decade wise and report the major findings. Earlier studies mainly focused on the post- |

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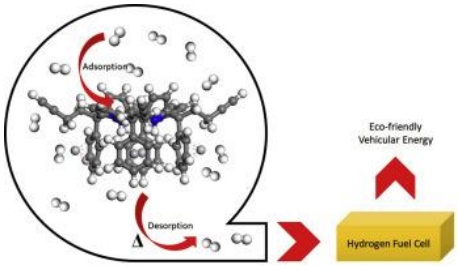
| | classification comparison of multi-temporal data. With the advancement of geospatial technology along with the ease of availability of satellite data, there has been a significant spurge in the number and quality of urban sprawl studies in the recent decades and involves advanced methods like spatial metrics, artificial neural network, object-based classification, and different kinds of modelling for future prediction of sprawl. Our findings suggest that sprawl research has evolved significantly over the years. With the availability of a large number of studies and copious amounts of data, the governmental agencies and large organizations should actively formulate a national-level database and incorporate these studies in various urban planning decisions. |
| 4. | Ab-initio investigation of hydrogen sorption in Ti functionalized modified calix [4] pyrrole-benzene<br>RY Sathe - International Journal of Hydrogen Energy, 2020<br><br>**Abstract:** Hydrogen is an ecofriendly and affordable alternative for fossil fuels. Storage of hydrogen with high hydrogen weight percentage is the prime obstacle to use it as a fuel. The hydrogen storage capacity in Ti functionalized modified calix[4]pyrrole-benzene is explored using density functional theory. Hydrogens are sequentially adsorbed over functionalized Ti atoms as well as over the π−complexes of acetylenic linkages and pyrrole rings. The host stores 28 H2 with a maximum H wt% of 10.1 and sorption energies in the range of 0.50–0.25 eV. Mechanism of the quasi-molecular adsorption is explained through the analyses of electrostatic potential, distance parameters, and charges. Findings of molecular dynamics, van 't Hoff desorption analysis, and the occupation number prove that the host is thermally stable and stores H2 reversibly. Ti functionalized modified calix[4]pyrrole-benzene proves to be a potential hydrogen storage candidate fulfilling the 2020 targets set by the US, DOE.<br><br>**Graphical Abstract:**<br>  <br> |
| 5. | ACA-CSU: A Carry Selection Based Accuracy Configurable Approximate Adder Design<br>A Kanani, J Mehta, N Goel - IEEE Computer Society Annual Symposium on VLSI (ISVLSI), 2020<br><br>**Abstract:** Approximate arithmetic circuits can be more effective if their accuracy can be controlled. In this paper, we propose a carry selection based accuracy configurable approximate adder. In the proposed design, longer carry chains provide better accuracy and CSU (Carry Select Unit) gives it better delay properties. The proposed design is generic so that multiple accuracy levels are possible at design time. Our experiments show that our design is considerably more accurate than the already proposed state of the art approximate adders. The latency of the proposed adder is also better than the state of the art adders. |
| 6. | Competitive Electrohydrodynamic and Electrosolutal Advection Arrests Evaporation Kinetics of Droplets<br>V Jaiswal, S Singh, AR Harikrishnan, P Dhar - Langmuir, 2020<br><br>**Abstract:** This article reports the hitherto unreported phenomenon of arrested evaporation dynamics in pendant droplets because of electric field stimulus. The evaporation kinetics of |

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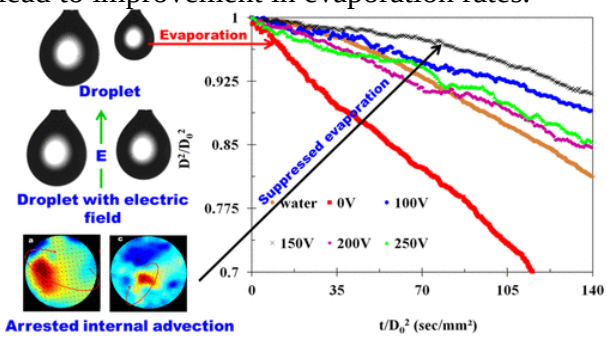
| | pendant droplets of electrically conducting saline solutions in the presence of a transverse, alternating electric field is investigated experimentally. While the increase of field strength reduces the evaporation rate, increment in field frequency has the opposite effect. The same has been explained on the solvation kinetics of ions in polar water. Theoretical analysis reveals that change in surface tension and the diffusion-driven evaporation model cannot predict the decelerated evaporation. With the aid of particle image velocimetry, suppression of internal circulation velocity within the droplet is observed under electric field stimulus, which directly affects the evaporation rate. A mathematical scaling model is proposed to quantify the effects of electrohydrodynamic circulation and electrothermal and electrosolutal advection on the evaporation kinetics. The analysis encompasses major governing parameters, namely, the thermal and solutal Marangoni numbers, the electrohydrodynamic number, the electro-Prandtl and electro-Schmidt numbers, and their respective contributions. It has been shown that the electrothermal Marangoni effect is suppressed by the electric field, leading to deteriorated evaporation rates. Additionally, the electrosolutal Marangoni effect further suppresses the internal advection, further reducing the evaporation rate by a larger proportion. Stability analysis reveals that the electric body force retards the stable internal advection. The stability mapping also illustrates that if the field strength is high enough for the electrosolutal advection to overshadow the solutal Marangoni effect completely, it can lead to improvement in evaporation rates.<br>  <br> |
| 7. | Depth resolved pulse compression favourable frequency modulated thermal wave imaging for quantitative characterization of glass fibre reinforced polymer<br>A Rani, R Mulaveesala - Infrared Physics & Technology, 2020<br><br>**Abstract:** InfraRed Thermography is an expeditiously growing non-destructive testing and evaluation technique widely used to estimate the subsurface defect details in fibre reinforced polymer materials due to its remote, fast, easy, safe and wide area monitoring abilities. In order to explore the details of subsurface anomalies in active infrared thermography, a modulated heat flux with a predefined intensity and bandwidth is employed to excite the test sample. Among various widely used active infrared thermographic techniques for non-destructive testing and evaluation applications, pulse based and modulated lock-in thermography are predominantly in use. However, these conventional techniques limits their applicability due to high peak power heat source requirements (pulse based techniques) and poor resolution (modulated lock-in thermography) for detecting the defects located at various depths of different lateral dimensions. The present paper highlights a pulse compression favourable frequency modulated thermal wave imaging which can be carried out with moderate peak power heat sources in a limited span of time with improved test resolution and sensitivity. Further the proposed experimentation is validated with the analytical as well as numerical simulations on glass fibre reinforced polymer samples having flat bottom hole defects. |

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| 8. | Estimating magnetic field strength in a porous fin from a surface temperature response<br>R Das, B Kundu - Electronics Letters, 2020<br><br>**Abstract:** This Letter demonstrates a non-destructive prediction methodology for determining the necessary magnetic field to be imposed in a porous fin satisfying a particular heat generation occurring within an electronic device. For the first time, all possible kinds of heat transfer have been incorporated here, which were otherwise ignored in other published studies of a similar kind. Just observing the surface thermal response, golden section search (GSS) solver, in conjunction with a forward numerical scheme, has been used in this work to determine the strength of the magnetic field. Estimations are done for various levels of additive white Gaussian noise and satisfactory reconstructions are noted for noise level even up to 12%. The numerical method has been convincingly validated with other schemes of the published literature. Sensitivity analysis reveals that the temperature distribution is per se a strong function of the fin porosity and governed by a mutual trade-off between the heat generation rate and the imposed magnetic field. The results obtained from the present analysis using GSS are proposed to offer assistance to design efficient porous fin based heat transfer surfaces for providing safety and better cooling in addition to a considerable weight reduction of the system. |
| 9. | Ferro-advection aided evaporation kinetics of ferrofluid droplets in magnetic field ambience<br>A Chattopadhyay, RK Dwivedi, AR Harikrishnan, P Dhar - Physics of Fluids, 2020<br><br>**Abstract:** The present article discusses the physics and mechanics of evaporation of pendant, aqueous ferrofluid droplets, and modulation of the same by an external magnetic field. We show experimentally and by mathematical analysis that the presence of a horizontal magnetic field augments the evaporation rates of pendant ferrofluid droplets. First, we tackle the question of improved evaporation of the colloidal droplets compared to water and propose physical mechanisms to explain the same. Experiments show that the changes in evaporation rates aided by the magnetic field cannot be explained on the basis of changes in surface tension or based on classical diffusion driven evaporation models. Probing via particle image velocimetry shows that the internal advection kinetics of such droplets plays a direct role toward the augmented evaporation rates by modulating the associated Stefan flow. Infrared thermography reveals changes in thermal gradients within the droplet and evaluating the dynamic surface tension reveals the presence of solutal gradients within the droplet, both brought about by the external field. Based on the premise, a scaling analysis of the internal magneto-thermal and magneto-solutal ferroadvection behavior is presented. The model incorporates the role of the governing Hartmann number, the magneto-thermal Prandtl number, and the magneto-solutal Schmidt number. The analysis and stability maps reveal that the magneto-solutal ferroadvection is the more dominant mechanism, and the model is able to predict the internal advection velocities with accuracy. Furthermore, another scaling model to predict the modified Stefan flow is proposed and is found to accurately predict the improved evaporation rates. |
| 10. | First Principle Analysis of Li-Doped Armchair Graphene Nanoribbons for Nanoscale Metal Interconnect Applications<br>VK Nishad, R Sharma - IEEE 70th Electronic Components and Technology Conference (ECTC), 2020<br><br>**Abstract:** In this paper, the effect of alkali metal, Li, as substitutional doping in armchair Graphene Nanoribbons (AGNRs) is investigated. Electronic and transport properties and structural stability of Li-doped AGNRs are investigated using density functional theory (DFT) and non-equilibrium Green's function (NEGF). First principle calculations have been performed on pristine (undoped), center Li-doped, one-edge Li- terminated and both-edge Li-terminated AGNRs. Our calculations reveal that all the structures analyzed are thermodynamically stable. Based on |

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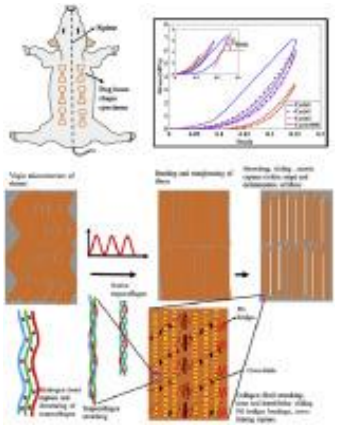
| | transmission spectrum and standard two-probe setup based I-V characteristics of all the considered configurations, center Li-doped AGNRs are found to be the most suitable candidate for on-chip interconnect applications. For center Li-doped AGNRs, kinetic inductance, L k , and quantum capacitance, C Q , are extracted as 12.51 nH/μm and 2.7 fF/μm, respectively, which results in nearly 7x, 2.5x and 1.1x higher current as compared to pristine, one-edge Li-terminated and both-edge Li-terminated AGNRs, respectively. We have also compared our results with center Fe-doped AGNRs, where center Li-doped AGNRs provide 1.71x higher current. Our study suggests about the substitutional doping of Li at the center in AGNRs make it an excellent metal that can be used in advanced nanoscale interconnect applications. In addition, this study can be extended towards the use of multiple layers of center Li-doped AGNRs in future that may further improve the interconnect performance. |
| 11. | Frequency dependent inelastic response of collagen architecture of pig dermis under cyclic tensile loading: An experimental study<br>KK Dwivedi, P Lakhani, S Kumar, N Kumar - Journal of the Mechanical Behavior of Biomedical Materials, 2020<br><br>**Abstract:** The evaluation of collagen architecture of the dermis in response to mechanical stimulation is important as it affects the macroscopic mechanical properties of the dermis. A detailed understanding of the processes involved in the alteration of the collagen structure is required to correlate the mechanical stimulation with tissue remodeling. This study investigated the effect of cyclic frequencies i.e. low (0.1 Hz), medium (2.0 Hz), and high (5.0 Hz) (physiological range) in the alteration of pig dermis collagen structure and its correlation with the macroscopic mechanical response of the dermis. The assessment of the collagen structure of virgin and mechanical tested specimens at tropocollagen, collagen fibril, and fiber level was performed using Fourier-transform infrared-attenuated total reflection (FTIR-ATR), atomic force microscopy (AFM), and scanning electron microscopy (SEM) respectively. After 103 cycles, a significantly higher alteration in collagen structure with discrete plastic-type damage was found for low frequency. This frequency dependent alteration of the collagen structure was found in correlation with the dermis macroscopic response. The value of inelastic strain, stress softening, damage parameter (reduction in elastic modulus), and reduction in energy dissipation were observed significantly large for slow frequency. A power-law based empirical relations, as a function of frequency and number of cycles, were proposed to predict the value of inelastic strain and damage parameter. This study also suggests that hierarchical structural response against the mechanical stimulation is time-dependent rather than cycle-dependent, may affect the tissue remodeling.<br><br>**Graphical Abstract:**<br>  |

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| 12. | Hybrid Nanoparticles Based Fluorescence Switch for Recognition of Ketoprofen in Aqueous medium.<br>A Kuwar, A Saini, M Kaur, N Kaur, N Singh - Molecular Systems Design & Engineering, 2020<br><br>**Abstract:** A rapid fluorescence method has been developed which describes the sensitive and selective determination of Ketoprofen by developing hybrid assembly composed of silver nanoparticles and organic nanoparticles. Different ligands L1-L3 were synthesized using various thiourea derivatives and these were processed to organic nanoparticles OL1-OL3 using single step re-precipitation method. Hybrid assemblies SH1-SH3 were developed which consisted of silver nanoparticles and organic nanoparticles OL1-OL3 respectively. These were further analysed for their response for various drug molecules and their fluorescence emission spectra were recorded. The studies for SH1 and SH2 exhibited non-selective response for drug molecules. However, for SH3 a turn-on fluorescence response with Ketoprofen was noticed. Titrations were carried out revealing that with subsequent addition of Ketoprofen gradual increase in fluorescence emission was noticed. Our sensor can effectively determine Ketoprofen up to a detection limit of 34 nM. Moreover, other drug molecules were found to have negligible interference in sensing of Ketoprofen in aqueous medium. |
| 13. | In-situ probing of Mn2O3 activation towards oxygen electroreduction by laser-induced current transient technique<br>TC Nagaiah, A Tiwari, M Kumar, D Scieszka… - ACS Applied Energy Materials, 2020<br><br>**Abstract:** Electrochemical transformation of Mn4+ into Mn3+ in Mn2O3 bixbyite structure is believed to activate this oxygen reduction catalyst for O2 electrosorption. The actual mechanism, however, still remains to be revealed and elucidated. This earth abundant Mn-based material viz., Mn2O3-rod catalyst was found to be more active than Pt/C (20%) in alkaline media. Intrigued by this observation, in-depth analysis was performed by combining different electrochemical techniques including laser-induced current transient technique. Deeper insight into the structure of electrical double layer and its properties were obtained by probing the electrode surface with a laser beam to record laser-induced current transients to estimate the potential of zero charge (pzc). The synthesized Mn2O3 was further found to be an efficient electrocatalyst alternative to Pt/C (20%), an expensive and limited noble-metal catalyst. |
| 14. | Multifunctional Thin Film Optically Graded Flexible Absorber<br>V Ghai, A Baranwal, H Singh, PK Agnihotri - Journal of Physics: Conference Series, 2020<br><br>**Abstract:** Flexible near perfect optical absorbers have many applications in the field of photovoltaic, energy harvesting and defence technologies. Even though flexible absorber coatings can be easily applied on the curved surfaces with complex geometry, the experimental realization of such absorbers having high absorption capacity in the broadband range is a challenging task. Here, we report the design and fabrication of a polydimethylsiloxane (PDMS) based optically graded thin (total thickness - 750 μm) assembly which shows near perfect absorption (95%) in the wavelength range of 300 to 2000 nm. The observed high absorbing capacity may be attributed to the presence of multiscale feature size in optically graded assembly which leads to efficient light trapping and multiple scattering of incident beam. The multilayer assembly comprises layers of PDMS reinforced with iron, zinc oxide (ZnO) and carbon nanotubes (CNTs). In addition to this, detailed fracture mechanism of fabricated absorber is studied. Moreover, contact angle study of fabricated thin film structure reveals that it is not only a near perfect absorber but also hydrophobic in nature. The ease of fabrication process combined with the excellent properties shown by the multilayer flexible assembly makes it an attractive option for industrial applications. |

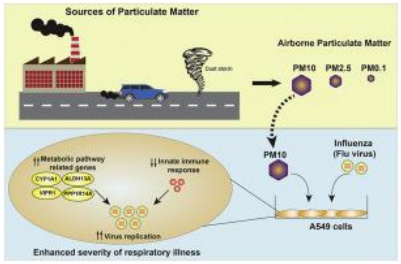
15.

Particulate matter (PM10) enhances RNA virus infection through modulation of innate immune responses

R Mishra, K Pandikannan, S Gangamma, AA Raut… - Environmental Pollution, 2020

**Abstract:** Sensing of pathogens by specialized receptors is the hallmark of the innate immunity. Innate immune response also mounts a defense response against various allergens and pollutants including particulate matter present in the atmosphere. Air pollution has been included as the top threat to global health declared by WHO which aims to cover more than three billion people against health emergencies from 2019 to 2023. Particulate matter (PM), one of the major components of air pollution, is a significant risk factor for many human diseases and its adverse effects include morbidity and premature deaths throughout the world. Several clinical and epidemiological studies have identified a key link between the PM existence and the prevalence of respiratory and inflammatory disorders. However, the underlying molecular mechanism is not well understood. Here, we investigated the influence of air pollutant, PM10 (particles with aerodynamic diameter less than 10 μm) during RNA virus infections using Highly Pathogenic Avian Influenza (HPAI) – H5N1 virus. We thus characterized the transcriptomic profile of lung epithelial cell line, A549 treated with PM10 prior to H5N1infection, which is known to cause severe lung damage and respiratory disease. We found that PM10 enhances vulnerability (by cellular damage) and regulates virus infectivity to enhance overall pathogenic burden in the lung cells. Additionally, the transcriptomic profile highlights the connection of host factors related to various metabolic pathways and immune responses which were dysregulated during virus infection. Collectively, our findings suggest a strong link between the prevalence of respiratory illness and its association with the air quality.

**Graphical Abstract:**




16.

Phase dependent radiation hardness and performance analysis of amorphous and polycrystalline Ga2O3 solar-blind photodetector against swift heavy ion irradiation

D Kaur, P Vashishtha, SA Khan, PK Kulriya, G Gupta, M Kumar - Journal of Applied Physics, 2020

**Abstract:** Solar-blind photodetectors are critically important for civil and military applications. Several of these applications, such as space exploration and nuclear energy infrastructure, demand the use of a photodetector under extreme environments. In this paper, we have studied the radiation hardness and device performance of amorphous and polycrystalline gallium oxide thin films against heavy ion (Ag7+) irradiation with a high energy of 100 MeV. Gallium oxide thin films show great tenacity against massive and highly energetic ions. The amorphous and polycrystalline phases undergo structural and morphological changes that initially induce degradation in the device performance. Nano-pore like structures are formed in the amorphous film, while the polycrystalline film shows the destruction of large crystallites. The responsivity of the photodetector device reduces fourfold in the amorphous phase; however, a sixfold reduction in the performance is observed in the polycrystalline phase of the gallium oxide photodetector. The degradation is attributed to the annealing of pre-existing optical defects that are otherwise

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| | responsible for the huge photoconductive gain in the detector and confirmed by photoluminescence studies. The effect of self-annealing at room temperature and annealing at moderate temperature is investigated to recover the irradiated photodetector devices. Partial recovery in the polycrystalline based photodetector and two orders of magnitude enhanced responsivity and an almost twice faster response time compared to the control photodetectors in the amorphous phase are observed. This work investigates the effect of heavy and energetic ions on the performance of gallium oxide based solar-blind photodetector and provides the guideline to use high energy irradiation as a tool for defect engineering. |
| 17. | Probing the optimal refractive index profile of disordered silicon nanowires for photon management applications<br>SK Saini, RV Nair - Optical Materials, 2020<br><br>**Abstract:** Controlling the light transport using photonic structures is essential for the deterministic control of light trapping and that depends on the nano-scale spatial modulation of refractive index. Here, we study the optimal effective refractive index profile (neff) of vertically-aligned disordered silicon nanowires using the measured spatial-and wavelength-dependent micro-reflectivity values across the nanowire length. A multi-layer model for the nanowire sample is employed to calculate the reflectivity values using the different neff profiles. The calculated reflectivity values are compared with the measured reflectivity values for different polarization states of light. The results validate that the silicon nanowires with an exponential neff profile suppress more than 90% reflectivity over a wide angular range for both polarization states of light. Moreover, the nanowires sample with an exponential neff profile shows a significant enhancement in light trapping and Raman scattering. |
| 18. | Pulse compression favorable thermal wave imaging methods for testing and evaluation of carbon fibre reinforced polymer<br>R Mulaveesala, V Arora, G Dua, A Rani… - Proceedings Volume 11409, Thermosense: Thermal Infrared Applications XLII, 2020<br><br>**Abstract:** Non-destructive testing and evaluation methods demand various efficient post processing approaches to enhance their defect detection capabilities of the adopted technique. Among them, widely used statistical methods are Eigen domain based post processing approach such as principal component analysis and recently proposed correlation based pulse compression approach. In this work, experiments have been carried out to highlight the capabilities of these data processing schemes for detection of subsurface defects in fibre reinforced polymer test samples. Obtained results clearly show that the defect detection capability of the correlation (matched filter) based post processing approach is far superior than that of the principal component analysis based data processing approach. Further, the similarities and differences between these proposed methods have been highlighted. |
| 19. | Quantum dot-sensitized O-linked heptazine polymer photocatalyst for the metal-free visible light hydrogen generation<br>S Samanta, S Kumar, VR Battula, A Jaryal, N Sardana… - RSC Advances, 2020<br><br>**Abstract:** Metal-free organic polymer photocatalysts have attracted dramatic attention in the field of visible light-induced hydrogen evolution reaction (HER). Herein, we showed a polymeric O-linked heptazine polymer (OLHP) decorated with S, N co-doped graphene quantum dots (S,N-GQDs) as a photosensitizer to generate hydrogen upon quantum dot sensitization. Both of these heptazine-based systems show effective photosensitization with strong π–π interactions and enhanced photocatalytic H2 generation (24 times) as metal-free systems. Electrochemical impedance and optical measurements show effective charge transfer kinetics with decreased charge recombination, which is responsible for the enhanced photocatalytic activity. As a result, a |

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| | significant high apparent quantum yield (AQY) with highest value of 10.2% was obtained for our photocatalyst OLHP/S,N-GQD10. |
| 20. | Rapid fair sampling of the XY spin Hamiltonian with a laser simulator<br>V Pal, S Mahler, C V Pal, S Mahler, C Tradonsky, AA Friesem… - Physical Review Research, 2020<br>**Abstract:** Coupled oscillators such as lasers, optical parametric oscillators, and Bose-Einstein-condensate polaritons can rapidly and efficiently dissipate into a stable phase-locked state that can be mapped onto the minimal energy (ground state) of classical spin Hamiltonians. However, for degenerate or near-degenerate ground-state manifolds, statistical fair sampling is required to obtain complete knowledge of the minimal-energy state, which needs many repetitions of simulations under identical conditions. We show that with dissipatively coupled lasers such fair sampling can be achieved rapidly and accurately by exploiting the many longitudinal modes of each laser to form an ensemble of identical but independent simulators, acting in parallel. We fairly sampled the ground-state manifold of square, triangular, and kagome lattices by measuring their coherence function and identifying manifolds composed of single, doubly degenerate, and highly degenerate ground states, respectively. |
| 21. | Rational design of a Zn (II)-MOF with multiple functional sites for highly efficient fixation of CO2 at mild conditions: A combined experimental and theoretical investigation<br>R Das, D Muthukumar, RS Pillai, CM Nagaraja – Chemistry – A European Journal<br>**Abstract:** The development of efficient heterogeneous catalysts suitable for carbon capture and utilization (CCU) under mild conditions is a promising step towards mitigating the growing concentration of CO2 in the atmosphere. Consequently, herein we report construction of a novel hydrogen-bonded 3D framework, {[Zn(hfipbba)(MA)].3DMF}n (HbMOF1) by utilizing Zn(II) center, a partially fluorinated, long-chain dicarboxylate ligand (hfipbba) and an amine-rich melamine (MA) co-ligand. Interestingly, the framework possesses two types of 1D channels decorated with CO2 -philic (-NH2 and -CF3) groups promoting highly selective CO2 adsorption properties to the framework which was further supported by the computational simulations. Further, the synergistic involvement of both Lewis acidic and basic sites exposed in the confined 1D pores along with high thermal and chemical stability rendered HbMOF1 an ideal heterogeneous catalyst for highly efficient fixation of CO2 with terminal/internal epoxides at mild conditions of RT and 1 bar CO2. Moreover, in-depth theoretical studies were carried out by periodic Density Functional Theory (DFT) to obtain the relative energy for each stage involved in the catalytic reaction and an insight mechanistic details of the reaction is presented. Overall, this work represents a rare demonstration of rational design of a porous Zn(II)-MOF incorporating multiple functional sites suitable for highly efficient fixation of CO2 with terminal/internal epoxides at mild conditions supported by comprehensive theoretical studies. |
| 22. | Role of Grain Size on the Effective Resistivity of Cu-Graphene Hybrid Interconnects<br>R Kumar, S Pathania, S Guglani, A Kumar, S Kumar…R Sharma - IEEE 70th Electronic Components and Technology Conference, 2020<br>**Abstract:** At sub-22nm technology nodes, size effects play a prominent role in the performance degradation of Cu interconnects. Several scattering mechanisms contribute to size effects, including surface roughness and grain boundary scattering as grain sizes in Cu decreases with reduced line widths. Due to these scattering phenomena, the resistivity of Cu interconnects increases drastically, which leads to electrical and thermal performance degradation and reliability issues. To address these limitations, researchers have proposed Cu- Graphene hybrid interconnects, where the line resistance due to Cu and Graphene is connected in parallel leading to smaller effective resistances. In this paper, we present analytical models of the reduction in effective resistivity obtained due to enlargement of grain size. The reduction in effective resistivity |

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| | is due to the hybrid interconnect geometry and grain size enlargement. We present a qualitative analysis for the resistivity, mean free path, delay and energy delay product of the three interconnect technology nodes from 22nm to 7nm Cu widths. Our analysis shows that Cu on-chip interconnects with Graphene as a barrier layers shows 47%, 30% and 19% improvement in resistivity, delay and energy delay product respectively due to grain size enlargement at 13nm technology node. |
| 23. | Seismic fragility curves using pulse-like and spectrally equivalent ground-motion records<br>M Surana - Earthquakes and Structures, 2020<br><br>**Abstract:** 4- and 8-storey reinforced-concrete frame buildings are analyzed under the suites of the near-fault pulse-like, and the corresponding spectrally equivalent far-fault ground-motion records. Seismic fragility curves for the slight, moderate, extensive, and complete damage states are developed, and the damage probability matrices, and the mean loss ratios corresponding to the Design Basis Earthquake and the Maximum Considered Earthquake hazard levels are compared, for the investigated buildings and sets of ground-motion records. It is observed that the spectrally equivalent far-fault ground-motion records result in comparable estimates of the fragility curve parameters, as that of the near-fault pulse-like ground-motion records. As a result, the derived damage probability matrices and mean loss ratios using two suites of ground-motion records differ only marginally (of the order of ~10%) for the investigated levels of seismic hazard, thus, implying the potential for application of the spectrally equivalent ground-motion records, for seismic fragility and risk assessment at the near-fault sites. |
| 24. | Shallow Domain Adaptation<br>S Sukhija, NC Krishnan - Domain Adaptation in Computer Vision with Deep Learning, 2020<br><br>**Abstract:** Supervised learning algorithms require sufficient amount of labeled training data for learning robust prediction models. The field of Transfer Learning (TL) (also known as knowledge transfer) deals with utilizing knowledge from data-rich auxiliary domains to learn a reliable predictor for the domain of interest. This chapter presents a condensed review of the shallow TL literature (prior to the deep learning era). The chapter motivates the need for TL using an application. After an informal introduction to TL, a categorization of TL approaches based on the characteristics of the domains is presented. Next, the different transfer settings along with the challenges in each setting are described. The TL frameworks are delineated using a generic optimization problem. The chapter also discusses a few real-world applications used for benchmarking experiments for each transfer setting. Finally, the chapter concludes with some unexplored avenues in the TL research. |
| 25. | Simulation of Classified Lane-Wise Vehicle Count at Toll Plazas Using Monte Carlo Simulation and Probability-Based Discrete Random Number Generation<br>VB Soorya, TM Rahul, SS Arkatkar - Recent Advances in Traffic Engineering: Part of the Lecture Notes in Civil Engineering book series, 2020<br><br>**Abstract:** The simulation-based prediction of traffic conditions based on current and past traffic observations is an important component in the intelligent transportation system (ITS) applications. Infrastructure, in the form of toll plazas, is inevitable for collection of revenue after the development of National Highways in India. Intelligent transportation systems utilize the advanced technologies and employ them in the field of transportation. The implementation of advanced traffic management systems (ATMS) at toll plazas will improve the toll plaza operations. A simulation model can help in the evaluation and optimization of toll operations of existing toll plazas as well as in the planning and design of similar systems. With this motivation, a lane-wise classified vehicle count prediction algorithm, which can simulate traffic conditions at any time interval, has been developed in this study based on Monte Carlo simulation (MCS). Vehicle arrival was modeled by assuming Poisson’s distribution, followed by classification. Lane selection was |

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| | done using the probability-based discrete random number generation. Radio-frequency identification (RFID)-based electronic toll collection (ETC) system gives timely varying traffic counts observed at the toll plaza, which has been utilized to develop and validate the simulation model. The flexibility with respect to the probabilities of the proposed algorithm makes it more applicable in the area of ITS. The observed vehicle count for each lane has been compared with the simulated values. The results of statistical tests show that there is no significant difference between actual and simulated traffic for each lane. |
| 26. | Some remarks on the Fourier coefficients of cusp forms<br>B Kumar, J Mehta, GK Viswanadham - International Journal of Number Theory, 2020<br><br>**Abstract:** In this paper, we consider the angular changes of Fourier coefficients of half integral weight cusp forms and sign changes of qq-exponents of generalized modular functions. |
| 27. | Studies of non-trivial band topology and electron-hole compensation in YSb<br>P Wadhwa, S Kumar, A Shukla, R Kumar - Solid State Communications, 2020<br><br>**Abstract:** In this article, we study non-trivial topological phase and electron-hole compensation in extremely large magnetoresistance (XMR) material YSb under hydrostatic pressure using first-principles calculations. YSb is topologically trivial at ambient pressure, but undergoes a reentrant topological phase transition under hydrostatic pressure. The reentrant behavior of topological quantum phase is then studied as a function of charge density ratio under pressure. From the detailed investigation of Fermi surfaces, it is found that electron to hole densities ratio increases with pressure, however a non-trivial topological phase appears without perfect electron-hole compensation. The results indicate that the non-trivial topological phase under hydrostatic pressure may not have maximal influence on the magnetoresistance, and need further investigations through experiments to determine the exact relationship between topology and XMR effect. |
| 28. | Surface wettability change on TF nanocoated surfaces during pool boiling heat transfer of refrigerant R-141b<br>S Deb, S Pal, DC Das, M Das, AK Das, R Das - Heat and Mass Transfer, 2020<br><br>**Abstract:** Experiments were performed to demonstrate the impact of surface wettability on the nucleate boiling heat transfer of Silicon Dioxide (SiO2) Thin Film (TF) nanocoated surfaces using the saturated refrigerant R-141b at atmospheric pressure. Six numbers of circular flat type test sections of copper material having thickness of 0 nm (plain surface), 125 nm, 250 nm 375 nm, 500 nm and 625 nm surface coating thicknesses were fabricated with the Sol-Gel method followed by spin coating process and characterized through atomic force microscope (AFM), field emission scanning electron microscopy (FE-SEM), Telescope Micro-Goniometer (TMG), and Energy – Dispersive X-Ray spectroscopy (EDX) etc. The experimental results from plain and nanocoated copper surfaces were validated with well-established correlations to predict the pool boiling curve. In comparisons with plain surface, results obtained from other surfaces show that the reduction of wall superheat and additional improvement of heat transfer coefficient (HTC), for all TF nanocoated surfaces at atmospheric pressure. It has been revealed that surface wettability improves the vapor bubble departure radius for hydrophilic surfaces and decreases the frequency of bubble emissions. |
| 29. | Synergetic utilization of Sentinel-1 SAR and Sentinel-2 Optical remote sensing data for Surface Soil Moisture estimation for Rupnagar, Punjab, India<br>A Tripathi, RK Tiwari - Geocarto International, 2020<br><br>**Abstract:** Due to improper agricultural and soil management, there has been a drop in crop yield over the last few years and food security has become a major issue. For a country like India, with a huge population to cater, the problem becomes more serious. Since the inception of remote |

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| | sensing in scientific agriculture management, optical remote sensing along with field data has been used for soil health monitoring and mapping. SAR or microwave remote sensing has an all-weather and high temporal data availability which has found applications for various domains. For soil health studies of multiple soil classes and sub-classes of same type, both aerial and spaceborne SAR remote sensing is currently in use for a multitude of monitoring and parameter modelling approaches. This study utilizes Sentinel 1A, C-band SAR remote sensing data with VV and VH polarization channels for surface soil moisture estimation for alluvial soil and its sub-types in Rupnagar of Punjab state in India. While Index based OLS Regression method for soil moisture estimation was done using backscatter from Sentinel-1A SAR data, it was validated using Normalized Differential Moisture Index (NDMI) generated from Sentinel 2 optical datasets. This approach though did not consider the actual soil moisture data from field yet gave a low Root Mean Squared Error (RMSE) of 0.5 and R2-statistics of 0.72 (72%) in training and testing phases. The Index based OLS (Ordinary Least Squares) Regression method for soil moisture estimation aims to establish a technique for cases when field data is either not available or the study area is not easily accessible. In the statistical approach with field data, the same OLS model, when replaced by on-field surface soil moisture data gave a RMSE of 1.9 and R2-statistics of 0.968 and 0.948 in training and testing phases respectively at 97.5% confidence level. The study is significant for using freely available optical and SAR remote sensing data parameters synergistically, in a simplified manner for surface soil moisture estimation. The results have comparable accuracies given by studies using commercial data and complex modelling approaches. |
| 30. | Vertically aligned carbon nanotubes-coated aluminium foil as flexible supercapacitor electrode for high power applications<br>V Ghai, K Chatterjee, PK Agnihotri - Carbon Letters, 2020<br><br>**Abstract:** Vertically Aligned Carbon Nanotubes (VACNTs)-coated flexible aluminium (Al) foil is studied as an electrode for supercapacitor applications. VACNTs are grown on Al foil inside thermal Chemical Vapor Deposition (CVD) reactor. 20 nm thick layer of Fe is used as a catalyst while Ar, H2 and C2H2 are used as precursor gases. The effect of growth temperature on the structure of CNTs is studied by varying the temperature of CVD reactor from 550 °C to 625 °C. Better alignment of VACNTs arrays on Al foil is recorded at 600 °C growth temperature in comparison to other processing temperatures. Cyclic voltammetry results shows that VACNTs-coated Al foil has a specific capacitance of ~ 3.01 F/g at a scan rate of 50 mV/s. The direct growth of VACNT array results in better contact with Al foil and thus low ESR values observed in impedance spectroscopy analysis. This leads to a fast charge–discharge cycle as well as a very high value of power density (187.79 kW/kg) suitable for high power applications. Moreover, wettability study shows that the fabricated VACNT electrode has a contact angle of more than 152° which signifies that it is a superhydrophobic surface and hence shows lower specific capacitance in comparison to reported values for VACNT array. Therefore, it is necessary to develop suitable post-processing strategies to make VACNTs hydrophilic to realize their full potential in supercapacitor applications. |
| 31. | WiTPy: A Toolkit to Parse and Analyse Wikipedia Talk Pages<br>AA Verma, SRS Iyengar, N Gandhi - Proceedings of the ACM/IEEE Joint Conference on Digital Libraries , 2020<br><br>**Abstract:** In this article, we propose an opensource toolkit to extract, parse, and analyze the Wikipedia talk pages. The core parser uses a tree-based approach to parse the unstructured comments and a JSON(JavaScript Object Notation) structure to store them in a NoSQL(not only SQL) database. User-friendly and high-level analysis methods are created on the top of NoSQL database, which can be used to understand the collaboration dynamics on article talk pages. |

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