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Sabaragamuwa University of Sri Lanka

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Peer-reviewed Journal Articles

Synthesis of nano zero valent zinc-reduced graphene oxide nanocomposite using a novel electrochemical technique for the adsorptive degradation of methyl orange

Ruwanthi W. Ranaweera, Vimukthi Jayaweera, Nuwan De Silva, Hasintha Wijesekara, Sunethra Gunatilake, Azeez Mubarak, Chanaka Sandaruwan

Abstract

Indiscriminate disposal of effluent contaminated with persistent azo dyes has become a significant environmental issue. Since the conventional wastewater treatment processes are ineffective in removing azo dyes completely, many studies are currently being focused on finding effective methods to degrade azo dyes. We herein report a novel in-situ synthesis of a nanocomposite with nano-zero valent zinc (nZVZ) and reduced graphene oxide (rGO) that can effectively remove methyl orange, an azo dye, from an aqueous solution via adsorptive degradation. nZVZ-rGO nanocomposite was synthesized by electrochemical reduction of Zn^{2+} ions on rGO. The presence of nZVZ particles on rGO with an average metal-loading of 4 % was confirmed by SEM-EDS, TEM, XPS and XRD results. Batch experiments showed that a maximum removal efficiency of 99.6 % of methyl orange can be achieved with 25 mg L^{-1} initial dye concentration and by optimizing the pH, nanocomposite dosage and contact time. However, a noticeable reduction in removal efficiency was observed in the presence of anions such as Cl^-, SO_4^{2-} and CO_3^{2-}. The degradation of methyl orange was monitored using UV-Visible spectroscopy, HPLC and FTIR spectroscopy. The peaks corresponding to –N=N- group, –C-N bond and –SO_3Na group have completely disappeared in the product spectrum of FTIR analysis, indicating the degradation of methyl orange. The adsorptive degradation process of methyl orange obeys the Sips model (R^2=0.9820) indicating a complex heterogenous adsorption mechanism while the kinetic model was shown to be pseudo-second-order model (R^2=0.9999).

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Influence of Aging and the Presence of Dissolved Organic Matter on Caffeine Adsorption onto Microplastics in Aquatic Environments

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Abstract

Polyethylene (PE) microplastics and caffeine (CFN) are ubiquitous in water and wastewater systems; however, PE microplastic's ability to adsorb CFN in organic matter-rich waters and their interaction mechanisms are poorly understood. This study assessed the performance of aged PE microplastics for CFN adsorption in humic acid (HA)-mixed water compared to that of pristine PE microplastics. The effects of solution pH (pH 2−9), contact time (up to 72 h), and initial CFN concentration (1−30 mg/L) on the sorption performances of PE microplastics at different HA concentrations (0.5−2.5 mg/L) were assessed. A PE film was aged in sunshine for three months to obtain aged microplastics. Aged PE microplastics demonstrated the highest CFN adsorption (3.62 mg/g) compared to pristine PE microplastics (2.37 mg/g) at pH 6.0−7.0. The water mixed with the highest concentration of HA (2.5 mg/L) was found to be the most effective medium for sorption, suggesting that CFN adsorption onto PE microplastics is likely favorable in water enriched with HA. The cooperation of nucleophilic attractions, intermolecular hydrogen bonds, and van der Waals and π−π interactions would be prominent in CFN adsorption onto HA-bound PE microplastics. The adsorption results collectively suggested a multifaceted sorption mechanism for CFN adsorption onto PE microplastics through either chemisorption or physisorption. The poor desorption ability on slight changes in the pH further evidenced the existence of chemisorption of CFN and the minimal chance of bioavailability in bodily fluids after exposure. The results of this study indicate that the sorption dynamics within the CFN-microplastic-HA system could potentially impact the transport of CFN in aquatic environments. Further, aging of PE microplastics and HA concentration govern the vector potential of microplastics, which would have the most negative end-to-end impact on human health.

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Efficient Electroluminescence from Organic Fluorophore-Containing Perovskite Films

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Abstract

Two-dimensional perovskites containing an organic fluorophore can be a unique emitter for light-emitting diodes (LEDs). However, external quantum efficiencies (EQEs) of fluorophore-containing perovskite LEDs reported thus far are still very low. In this study, these are able to boost the EQE to ≈10% by choosing an organic fluorophore with appropriate energy levels for the perovskite structure organization. In the fluorophore-containing perovskite LEDs, carrier transport and exciton formation take place in the perovskite's metal halide framework, thereby avoiding the direct formation of nonradiative triplet excitons on the organic fluorophores. Subsequently, the bright triplet excitons formed in the metal halide framework are transferred to form the radiative singlet states of the organic fluorophores, leading to efficient electroluminescence (EL) from the organic fluorophores regularly dispersed inside the perovskite structure. Unexpectedly higher light-outcoupling efficiency, which is caused by the light scattering in the polycrystalline perovskite layer, will be another reason for efficient EL. These findings will contribute toward the fabrication of LED-based products with high performance at a low cost.

About the Journal

Advanced Materials

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Comparative study of magnetic field effect on fast plasma flow of heavy and light species investigated by spectroscopic measurement

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Abstract

To understand the effects of magnetic fields on the propagating plasma flows of heavy and light ion species, a laboratory-scale experiment was conducted using a pulsed-power discharge. The plasma drift velocity and electron temperature were estimated by time-of-flight and line-pair methods, respectively, using spectroscopic measurements. Ion current waveforms were measured using an ion collector. When a magnetic field was applied, the plasma drift velocity decreased and the electron temperature increased in both heavy and light plasmas. The magnetic Reynolds number, pressure balance between the plasma and magnetic field, and ion current waveforms show that heavy plasma has a high possibility of deforming the magnetic field and generating accelerated ions through interaction with the magnetic field.

About the Journal

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Conference Proceedings

Identification of tomato diseases effectively using an attention-based EfficientNet model

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Abstract

Computer vision enables machines to interpret and understand visual data. Deep convolutional neural networks (DCNNs), specifically designed to classify images, have revolutionized the field of computer vision. In spite of their success, these models often struggle to precisely localize critical regions of interest and encounter difficulties in distinguishing between images with highly similar characteristics, leading to classification errors. Agriculture plays a pivotal role in global sustainability. Therefore, accurate identification of plant diseases is crucial to mitigate substantial economic losses. Tomato is an economically important crop, and tomato diseases often exhibit symptoms that could be confusingly similar, making accurate diagnosis challenging. To address localization and similarity issues in tomato diseases, this study proposes a multi- head attention-based Efficient NetB0 model. The proposed model was trained and tested on field-condition images of tomato diseases. The tomato dataset consists of nine tomato diseases, including healthy images, and has a total of 8789 images. The proposed model achieved 97.4% test accuracy, which is a slight improvement compared to the baseline EfficientNetB0 model. Also, the proposed model exhibited the lowest rate of misclassifications. Furthermore, the Score-CAM technique was employed to evaluate the effectiveness of the proposed model, and explanations generated by the Score-CAM demonstrated the significant performance of the model in localizing disease symptoms.

About the Conference

2nd International Conference on Computer Vision and Internet of Things

10 &11 Dec 2024

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Revealing the Endophytic Fungal Diversity Associated with Freshwater Plants in Anuradhapura and Ratnapura Districts, Sri Lanka

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Abstract

Sri Lanka, a biodiversity-rich tropical island and hosts a remarkable diversity of aquatic ecosystems, including inland freshwater habitats spanning approximately 202,435 ha. The country supports over 370 species of aquatic and wetland plants, of which around 12% are endemic. Despite this rich plant diversity, research on endophytic fungi associated with freshwater plants has been relatively limited in Sri Lanka. This study aimed to uncover hidden fungal diversity associated with freshwater plants collected from both lentic and lotic habitats in the Anuradhapura and Ratnapura districts. Nine freshwater plant species were collected, including five species (i.e. *Hydrilla verticillata, Lagenandra ovata, Nymphaea pubescens, Persicaria glabra,* and *Vallisneria americana*) from the Ratnapura district, and four species (i.e. *Eichhornia crassipes, N. nouchali, Salvinia minima,* and *S. molesta*) from the Anuradhapura district. Three samples from each plant species were collected. Isolation was carried-out using the surface sterilization technique (70% ethanol and 2% sodium hypochlorite), resulting in the isolation of 21 fungal species (based on morpho-molecular and culture characteristics), including *Colletotrichum siamense, C. truncatum, C. chlorophyti, C. coccodes, C. gloeosporioides, C. nymphaeae, C. queenslandicum, C. scovillei, C. sojae, Chaetomella raphigera, Daldinia eschscholtzii, Microdochium musae, Montagnula donacina, Nemania primolutea, Nigrospora sphaerica, Phyllosticta capitalensis, Talaromyces pinophilus, T. stipitatus,* and *T. verruculosus. Ectophoma salviniae* and *Neottiosporina mihintaleensis* were introduced as new species. According to these isolates, the Ratnapura district showed the highest diversity of *Colletotrichum* species, which is more prominent compared to the Anuradhapura district. The Anuradhapura district exhibited potential for identifying novel fungal species. This study revealed hidden fungal diversity, including novel species, and new geographical and host records associated with freshwater plants in Sri Lanka.

About the Conference

The 14th Annual Research Session 2024

20 Dec 2024

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Exploring laccase producing fungi isolated from freshwater ecosystems in the Anuradhapura and Ratnapura Districts, Sri Lanka

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Abstract

Laccases, classified as blue multicopper oxidases, catalyze the one-electron oxidation of a wide range of substrates and play a crucial role in lignin degradation. Fungal laccases can degrade lignin in plant materials and are used in the decolorization and detoxification of effluents from industrial discharges, such as those from the food, textile, paper, and plastic industries, that pollute water. This is because fungal laccases have a higher redox potential compared to bacterial laccases. The aim of this study was to isolate fungi from lentic and lotic freshwater habitats in the Anuradhapura and Ratnapura districts of Sri Lanka and to identify laccaseproducing fungi. Single spore isolation (for saprobes) and surface sterilization method (for endophytes) were used to isolate the fungi. All isolates underwent morphological (macro and micromorphological characteristics), colony characteristics, and molecular characterization based on ITS gene region. The identification of laccase-producing fungi among 20 isolates involved qualitative analysis with 1-naphthol solution. Positive results were indicated by bluepurple coloration around the colony growth. Out of the 20 isolates, 14 fungal species showed laccase production, including *Aureobasidium melanogenum, Colletotrichum truncatum, C. siamense, Coniochaeta velutina, Lasiodiplodia pseudotheobromae, Microdiplodia sp., Montagnula donacina, Nemania primolutea, Neopestalotiopsis saprophytica, Neottiosporina mihintaleensis, Paraconiothyrium archidendri, Phyllosticta capitalensis, Rhytidhysteron neorufulum,* and *Talaromyces verruculosus.* Among these, *Neottiosporina mihintaleensis* showed the highest laccase production, represented by a 3.5 cm diameter blue-purple circle around the colony. The other isolates (*Chaetomella raphigera, L. crassispora, Lentinus tigrinus, Talaromyces stipitatus, Trichoderma harzianum,* and *T. koningii*) did not show laccase production. These identifications provide valuable insights into future biotechnological approaches for fungal applications.

About the Conference

Proceedings of the 44th Annual Sessions

27 Sep 2024

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Foliose lichens as essential hosts for Lichenicolous Fungi: Insights from Horton Plains, Sri Lanka

H. Dangalla, C. M. Nanayakkara, R.G.U Jayalal, D. Q. Dai, N. Wijayawardane

Abstract

Lichenicolous fungi, which exclusively inhabit lichen thalli, can be parasitic adversely affecting lichen growth or benign, simply finding a niche. Typically found on the upper surfaces of their host lichens, these fungi often manifest as discolored patches or oddly colored spots, indicating the development of fruiting structures. In this study, we investigated the diversity of lichenicolous fungi within Horton Plains National Park (HPNP), a region in Sri Lanka's Central Province, located at an elevation of 2100-2300m, which provides an ideal environment for lichen growth. Corticolous lichens showing signs of lichenicolous growth were collected across 22 localities along the trail to World's End from the park entrance. Lichen samples were identified using morphological characteristics and standard chemical methods. Each lichen thallus was meticulously examined under a stereoscopic microscope to identify lichenicolous fungi, focusing on discolorations, oddly coloured patches, and unique fruiting structures distinct from the host lichens. Based on those morphological differences, our observations revealed 15 different species of lichenicolous fungi and most of them are lichenicolous Basidiomycota. The majority (80%) of host lichens supporting lichenicolous growth were foliose, with the remainder being fruticose, squamulose, or crustose. Among the foliose lichens, species from the genera *Parmotrema, Heterodermia, Cococarpia*, and *Lobaria* were the most common hosts for lichenicolous fungi. These findings highlight that the HPNP area is rich in lichenicolous fungi, with foliose lichens serving as the primary hosts. This study underscores the ecological significance of foliose lichens in supporting lichenicolous fungi biodiversity in Horton Plains National Park. Furthermore, this study helps to observe the bioactivities of the secondary metabolites of the lichenicolous fungi, offering insights into their potential applications in various fields. Also, Future DNA-based identification methods will greatly improve the discovery and classification of lichenicolous fungi at the species level. The results contribute valuable knowledge to the understanding of lichen-fungi interactions and the role of lichens in supporting diverse fungal communities.

Variation of non-volant mammalian communities along a sub-montane elevational gradient in Sri Lanka

D. Maduranga, A.S. Adikari, S.J. Perera, S.S. Seneviratne

Abstract

A group of mammals consisting of populations of individuals with direct and indirect interactions is called a mammalian community. Elevational gradients profoundly affect such mammalian communities, shaping diverse patterns across altitudinal ranges. To investigate these elevation-associated effects on non-volant mammalian communities and to understand the factors driving these variations, we studied the elevational gradient from the Samanalawewa basin (480 meters Above Mean Sea Level) to Hawagala Peak (1420 AMSL) within the Issengard Biosphere Reserve, Belihuloya, in the Sabaragamuwa Province. Data collection, including camera trapping, scat and pellet sampling, small mammal sampling, and opportunistic observations, were conducted from November 2021 to April 2024 along 10, 50m transects along the contour lines in every 100m intervals spanned along the one-kilometer elevational gradient. A total of 20 mammal species were recorded during the study period. The mammalian community parameters considered were total abundance, average abundance, species richness, and Shannon and Simpson diversity indices. Scatter plot analysis indicated that all five community parameters exhibit a curved relationship with elevation. Spearman correlation revealed low negative correlations for total abundance and average abundance with the elevational gradient, and low positive correlations for other parameters. None of the community parameters showed a significant correlation with elevation ($p > 0.05$). All five community parameters exhibited hump-shaped variation patterns along the elevational gradient, indicating the mid-domain effect. However, there was a significant and unexpected decline in all parameters between 1000 m and 1200 m elevations probably due to the high steepness and predominantly grassland habitat in this region. All parameters showed low values at lower elevations, highlighting the negative anthropogenic effect towards mammalian communities, as the low elevation range is dominated by human activities, including hunting.

A novel carbon-based electrochemical sensor for fenobucarb detection

A.M. Hasara, W.S.D. De Mel, H.S.M. Soysa

Abstract

The excessive application of carbamate pesticides showed relatively high toxicity due to inhibiting the acetylcholinesterase enzyme in the neutral system of insects. This study explores the potential of using a pencil led electrode to detect fenobucarb, a carbamate insecticide of environmental concern, through cyclic voltammetry (CV) and differential pulse voltammetry (DPV). In this research, bare HB-grade pencil lead was employed for the detection of fenobucarb. The pencil lead electrode, serving as the working electrode, was selected for its simplicity, cost-effectiveness, and easy accessibility, making it suitable for electrochemical sensing applications. The alkaline hydrolysis of fenobucarb results in the formation of 2-sec-butyl phenol, a more readily oxidizable compound than the parent pesticide, and can be electrochemically detected under more favorable conditions. Notably, fenobucarb itself does not generate a detectable signal at the electrode using DPV within the potential range of +0.3 to +0.85 V. Investigations into optimal conditions for quantitative hydrolysis revealed that a 0.1 M NaOH concentration is adequate for complete hydrolysis of fenobucarb. Additionally, the optimal measurement conditions were established at pH 7, with a scan rate of 100 mV s^{-1}, resulting in a limit of detection (LOD) and quantification (LOQ) of 46.15 mg l^{-1} and 153.14 mg l^{-1} for CV, and 8.29 mg l^{-1} and 27.63 mg l^{-1} for DPV, respectively. These findings demonstrate that both CV and DPV methods are effective for detecting fenobucarb, with DPV showing superior sensitivity. The electrode developed has proven efficient in detecting fenobucarb, and future work will focus on modifying the bare electrode to further enhance sensitivity and conduct additional characterization.

Effect of strength training on selected physical fitness and anthropometric variables of school's kabaddi players

Jayasingha R. T., Jayasekara D. C. and Joniton S

Abstract

Kabaddi is a vigorous sport that is done entirely on the basis of body strength, techniques and it requires high physical fitness. The present study was to find out the effect of strength training on selected physical fitness and anthropometrical variables of kabaddi players. Thirty male school kabaddi players with age ranging from 17-20 years were randomly selected from Sabaragamuwa province in Sri Lanka. The subjects were randomly divided into an experimental group (n=15) and a control group (n=15). The selected physical fitness parameters (agility, explosive strength, strength endurance and maximum strength) and anthropometric parameters (thigh, arm and chest circumferences) were carried out before (pre-test) and after the twelve weeks training period (post-test). The experimental group underwent specific strength training sessions for three (03) days in a week for a total twelve (12) weeks. The control group did not participate in any specific training as the experimental group. Paired t-test was used to determine the mean differences of the physical fitness and anthropometric parameters in pre and post-test, where the significant variables were selected based on p-value (<0.05). The results showed a significant difference between the improvement in the experimental group after strength training when compared to pretest. Therefore, strength training has a positive effect on enhancingthe agility, explosive strength, strength endurance, maximum strength and body circumferences namely, thigh, arm, and chest. The findings suggest the potential of using strength training to improve agility, explosive strength, strength endurance and maximum strength, and thigh, arm, and chest circumferences particularly in male school kabaddi players.

Prediction of playing ability in Taekwondo from selected anthropometrical physical fitness and physiological characteristics among varsity Taekwondo sparring players in Sri Lanka

Jayasekara D. C, Joniton S, Jayasingha R. T and Kumara R

ABSTRACT

Taekwondo sparring is an exciting part of training that allows practitioners to put theirpunches and kicks into one-on-one or multiple-person situations. As the sport grows in popularity. understanding the complex nature of player performance becomes critical. Therefore, this study aimed to predict the Taekwondo playing ability of varsity Taekwondo sparring players using their anthropometrics, physical fitness, and physiological parameters. To achieve the purpose, thirty female Taekwondo players, aged between 20 to 25 were selected from the universities of Sri Lanka. All the players had atleast three years of playing experience and represented their university teams. In this study, thirteen anthropometric factors (standing height, weight, leg length, foot length, hand length, calf girth, thigh girth, chest girth, waist girth, forearm girth, upper arm girth, thigh skinfold, calf skinfold), nine physical fitness qualities (muscular endurance, muscular strength, cardiovascular endurance, flexibility, power agility, speed, coordination, hand and foot reaction time), and three physiological parameters (resting heart rate, breath hold time, and peak expiratory flow rate) were selected as independent variables. All the variables were examined by a standardized test using scientifically approved equipment. The dependent variable of playing ability was assessed by the three qualified Taekwondo referees and it was determined by four skills; kicking, punching, attacking, and blocking during the match situation. The collected data was analyzed by stepwise multiple regression analysis with SPSS software. The results revealed that cardiovascular endurance, coordination, reaction time, flexibility, leg length, foot length, resting heart rate, breath hold time, and peak expiratory flow were highly correlated with playing ability. From the results it was concluded anthropometrical, physical fitness physiological parameters positively impact the Tackwondo playing ability of varsity taekwondo sparring players in Sri Lanka.

About the Conference

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Healthy Delights

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