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3. RESEARCH, INNOVATIONS AND EXTENSIONS

3.1. RESEARCH PUBLICATIONS AND AWARDS

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The 5I's of Virtual Technologies in Laboratory Teaching for Faculties of Higher Education in Kerala

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Abstract

In this paper, the effectiveness of training faculty in laboratory teaching (the teaching of science in a laboratory setting using experiments and similar exercises) through the use of Information and Communications Technology (ICT)—virtual technologies for faculties in institutions of higher education in the Indian state of Kerala—was evaluated and measured. The efficacy of employing ICT to train teachers in higher education is important, and we have identified 5I factors (innovative, interactive, involvement, informative, and influential) to help ascertain the effectiveness of such technology training during pandemic teaching. The laboratory learning using VL can describe the student's engagement in the online learning process. This work more specifically identifies how ICT helps in laboratory teaching and identifies the critical pedagogical aspects of the ICT. If the technology has these 5I factors, then it will be an effective teaching method for laboratory learning. Here, we used the ICT-virtual labs in science as the technology to evaluate these five factors. The research first began by conducting an ethnicity profile of science teachers in the middle and high/secondary stages of school consisting of classes VII, IX, and X (i.e., students of ages 11 to 15). To evaluate the use of VL in the 5I framework, the faculties in science were divided into experimental and control groups ($n = 101$). The experimental group practiced in a virtual lab in the first stage, but the control group did not. Test I was then performed on both groups. In the second stage, both groups practiced with real lab equipment, and test II was conducted on both groups. The tests and other data from the two groups were statistically analyzed using independent t tests. There were notable differences between the experimental and control groups: in terms of time for understanding the concepts behind the experiment, time for doing the experiment, and accuracy in results, with the experimental group performing significantly better. On the other hand, there was no significant difference between the two groups in task completion accuracy. Overall, there was a beneficial transfer of training from the virtual lab exercise to the real lab, with the experimental group's average score being higher.

Keywords Online learning · Pre-college science teachers · Virtual laboratories

Introduction

Online learning is sometimes portrayed as a less desirable choice that gives a lower-quality education than face-to-face instruction (Hodges et al., 2020), and an EDUCAUSE survey indicated similar negative sentiments toward totally online learning (Hodges et al., 2020; Pomerantz & Brooks, 2017).

Flow theory has been used to address concerns of student learning engagement, motivation, satisfaction, exploration, and performance (Auld, 2014; Santos et al., 2018). Teachers needed to assure students' capacity and motivation to work efficiently in their new learning online environments during the COVID-19 crisis (Hew & Cheung, 2010). Students can be motivated to better collaborate with multiple dimensions of the new virtual learning systems for better learning experiences (AlShamsi, 2021). Understanding visible and unseen heuristic techniques to identify underlying concepts is regarded difficult in the case of laboratory learning, particularly in science during pandemic times. Therefore, relationships between the teacher and the teaching environment will be the factors to get positive cognitive outcomes. Having a lab with multimedia-enhanced technology boosts

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Histopathological Impact of Acetaminophen on Liver of Nile Tilapia

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Abstract

This study is conducted to assess the histopathological effect of acetaminophen (paracetamol) on the histology of the liver of Nile Tilapia. The fishes were exposed to sub-lethal concentrations (1/10th and 1/5th of LC50 value) of paracetamol for 96 hours. A control was run along with it. The results indicate that the acetaminophen causes hepatotoxicity in experimental fish. The liver showed congestion and necrosis. The effect of acetaminophen on liver tissues increased with dose and duration of exposure. Fishes exposed to 1/5th of LC50 value of paracetamol showed more tissue damage in the liver, compared to the fish exposed to 1/10th of LC50 value of paracetamol. Study reveals that drug-induced hepatic injury has become a major challenge. .

Key words: pharmaceutical pollution, acetaminophen, hepatotoxicity.

Pharmaceutical pollution of the aquatic environment is an emerging crisis. Fishes are important tools for evaluating the impact of water pollution. Myriads of pharmaceutical products are used to treat human as well as animal diseases. As an inevitable consequence, many of these pharmaceutical drugs are reported in considerable amounts in water bodies worldwide. The accumulation of pharmaceutical pollutants in the environment have adverse ecological impacts and affect human and animal health. Acetaminophen - a derivative of para aminophenol is a widely used non-prescription drug, coming under the above category. In prescribed doses it is safe, but in overdose, it can be harmful in many ways.

The liver being the major detoxification organ in the body, plays a major role in the detoxification of harmful substances and also plays a role in homeostasis and regulatory metabolic functions of the body (Mayuren *et al.*, 2010). Liver injury due to drugs is a major challenge in the drug development and drug industry (Heidari *et al.*, 2015). Disorders to this organ lead to serious health problems. Several metabolic disorders and even death can occur due to hepatotoxicity. Failure of liver function and consequent death in Pharmaceutical pollution of the aquatic environment is an emerging crisis.

Fishes are important tools for evaluating the impact of water pollution. Humans and experimental animals exposed to overdose of Acetaminophen has been reported by Hawkins *et al.* (2007) and Truong *et al.*, (2016). Velmurugan *et al.*, (2020) reported that the histopathological features are a marked indication showing the inflammatory and pro-inflammatory alterations in aquatic animals induced by xenobiotics. The present study is aimed to find out the impact of Acetaminophen in fish, which has no way to escape from this man made cocktail. Being an ideal vertebrate model organism, experiments designed to find out the impact of the drug on the liver of fish, can very well be extrapolated to human beings as well.

Materials and Methods

Sample collection

The male *Oreochromis niloticus* of mean length 15 ± 1 cm weighing about 100 g were collected from a fish farm at Maliankara, Ernakulam

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Insights into the role of *Moringa oleifera* in ameliorating acetaminophen induced hepatotoxicity in Nile tilapia, *Oreochromis niloticus*



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Abstract

The study was aimed to investigate the hepato-protective effect of *Moringa oleifera* in Nile tilapia (*Oreochromis niloticus*) exposed to acetaminophen. Fishes exposed to sub-lethal concentration of acetaminophen for 96 hours, were fed on feed incorporated with moringa leaf, for 21 days. Histological studies of liver of fish fed with *M. oleifera* leaf incorporated feed, for 21 days after 96-hour acetaminophen exposure showed significant reparative changes when compared to the control. The experiment indicates that dietary supplementation of moringa leaf had hepatoprotective effect in Nile tilapia exposed to acetaminophen.

Keywords: Acetaminophen, *Moringa oleifera*, histopathology, hepatoprotection

Running title: Role of *Moringa oleifera* in ameliorating acetaminophen induced hepatotoxicity

The presence of pharmaceuticals and active pharmaceutical ingredients (APIs) in the environment have become an emerging problem in recent decades (Heberer, 2002). Acetaminophen (N-acetyl-para-aminophenol, paracetamol, APAP) is one of the most widely used over-the-counter analgesic and antipyretic agent. Although acetaminophen has a good safety profile at therapeutic levels, it can cause severe hepatic and renal damage when administered in high dose in both in experimental animals and in humans (Agrawal and Khazaeni, 2020; Ghosh and Sil, 2007). Liver being the major organ involved in detoxification shows alterations in response to exposure to harmful components. Conventional hepatoprotective drugs used for the treatment of such adverse reactions are often inadequate. Traditional herbal drugs are significant repositories of chemical constituents which are hepatoprotective in nature. There is an increasing demand for phyto-drugs and therefore it is essential to explore new medicinal plants to ameliorate the hepatotoxic effects of acetaminophen.

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Seasonal diversity, distribution and abundance of Araneae in the Thattekkad Bird Sanctuary, Kerala, India

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ABSTRACT: The aim of the present study was to analyze the diversity of spiders across various parts of the Thattekkad Bird Sanctuary, Kerala, a tropical, semi evergreen, low-land forest located between the tributaries of the Periyar river. Survey of the spider fauna was carried out for a period of twelve months. In total, 3286 individuals were collected from the sanctuary, which consist of 89 species of spiders under 59 genera and 18 families. Araneidae was the most abundant family. The most abundant species was *Hippasa agelenoides* of Lycosidae family. Spiders belonging to six feeding guilds, i.e., orb - web weavers, stalkers, ground runners, scattered line weaver foliage runners and ambushers were identified. Relative abundances of spider community strongly differed with the pre-monsoon, monsoon and post monsoon seasons. Diversity indices - Margalef richness index, Pielou's evenness index, Shannon-Wiener and Simpson index were calculated. © 2022 Association for Advancement of Entomology

KEYWORDS: Araneidae, dominance, guild, seasonal diversity indices

INTRODUCTION

Spiders are scattered everywhere and are found in almost all habitats. They are also considered indicators of ecosystem health (Mathew *et al.*, 2009). They play a key role in maintaining the ecosystem balance due to their high abundance and insectivorous feeding habits (Wise, 1993). The data on the relative abundance, distribution and richness of taxa serve as a reference for ecological studies and as a basis for conservation planning (Raven and Wilson, 1992; Magurran, 2004). For conservation planning efforts, there should be an

understanding of the patterns of diversity on regional scales (Uniyal and Shrivastava, 2012). Spiders can be classified into different guilds based on the similarity in their foraging behavior (Cardo *et al.*, 2011; Mansoor lone *et al.*, 2015). Spiders belonging to different foraging guilds and populations were high during the monsoon and winter seasons (Deshmukh and Raut, 2014). Prey density mainly depends on the season and the type of vegetation, which can constantly change throughout the year that, in turn affects the diversity and abundance of spiders (Deshmukh and Raut, 2014). The present work aims to examine the spider population and its

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Band gap engineering of TiO₂ by Mn doping and the effect of p-TNT: Mn/n-MnO₂ heterojunction on photocatalytic applications

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Abstract

The present study reports the achievement of improved photocatalytic performance of Titanium dioxide nanotubes (TNTs) by manganese doping and the subsequent formation of a p-TNT: Mn/n-MnO₂ heterojunction. The nanotubes and junctions are prepared by simple and cost-effective electrochemical anodization and doping techniques. The influence of doping and junction formation on the structural, optical, morphological and electrical properties of TNTs are analysed in detail. Energy dispersive x-ray mapping together with X-ray photoelectron spectroscopy is used to confirm the composition of the samples, while atomic force microscopy, field emission scanning electron microscopy and transmission electron microscopy are used for morphological assessment. The TNT/MnO₂ junction shows a photocatalytic degradation efficiency of ~98.6% with good cyclic stability for Rhodamine B dye. Manganese doping tailors the optical band gap of TNT from ~3.04 eV to ~2.73 eV enabling the absorption of visible photons for carrier production and induces p-type conductivity in the sample. While valence band photoemission spectra give insight into the Fermi level positions of doped and undoped samples and confirm the p type conductivity of the latter, the photoluminescence measurements give an idea regarding the defect states. The reduction in the band gap of TNT on Mn doping along with the formation of an n-MnO₂ layer with a band gap ~1.50 eV on its top play a crucial role in the improvement of the photocatalytic performance of the pn- heterojunction device.

Keywords TiO₂ · Heterojunction · Mn doping · Photocatalysis · Band gap tailoring

1 Introduction

The wide usage of dyes in many textile and cosmetic industries and their unethical discharge into water bodies have resulted in water pollution which has a serious impact on

the ecological balance [1–3]. The release of pharmaceuticals into aquatic environment is also a serious threat to the quality of water [4]. Researches are being conducted to arrive at economical and eco-friendly ways to remove unwanted organic and inorganic pollutants from water [5–7]. Investigations on photocatalysts that can degrade the contaminants in water to non-toxic products in the presence of sunlight stand out top on this list [8–11]. Scientists encounter several challenges, including the fact that often the fabrication processes are quite expensive, or it is challenging to remove the photocatalysts themselves from water to reuse them. Worse yet, the by-products that remain after degradation are toxic [12–16].

Semiconducting metal oxides like TiO₂ and ZnO, have caught considerable attention as effective photocatalysts due to their non-toxicity and good photochemical stability [17–21]. But the band gap of pure TiO₂ around 3.2 eV [22, 23] allows absorption only in the UV region and extension of the band gap to the visible range of the solar spectrum is one of the greatest challenges faced by researchers on TiO₂. Doping with

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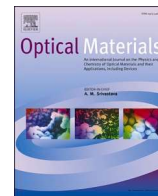
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Research Article

Influence of sodium doping on the material properties and photocatalytic activity of anatase titanium dioxide nanotubes prepared by anodization

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ABSTRACT

The properties of semiconducting materials can be altered to meet our needs by tuning their bandgap with suitable methods. Here bandgap tailoring of anatase TiO₂ nanotubes prepared by anodization technique is achieved by sodium doping at variant concentrations. The doped nanotubes with their reduced band gaps that match the visible range of solar spectrum exhibit greater photodegradation efficiency of methylene blue dye (97.3% in 180 min) than the undoped (56.8% in 180 min) with band gap in the UV region. Structural and morphological characterizations of the samples by X-ray diffraction, X-ray Photoelectron Spectroscopy, Raman Spectroscopy, Atomic Force Microscopy and Field Emission Scanning Electron Microscopy reveal that the doping-induced surface changes and increased Ti⁴⁺ to Ti³⁺ reduction play an active role in increasing the photocatalytic efficiency of the samples. Analysis of valence band photo emission spectra indicate shifting of fermi level away from conduction band edge with doping of Na¹⁺ at Ti⁴⁺ site producing defect induced super radical formation for photocatalysis.

1. Introduction

The development of modern industry has resulted in serious pollution of water bodies by organic compounds like dyes, pharmaceuticals and pesticides [1–3]. The toxicity and persistence of these compounds are matters of concern to the existence of aquatic as well as human life. The degradation of the organic pollutants has become a topic of interest among the researchers over the decades. The emergence of semiconductor photocatalytic technology has opened new windows in solving this environmental issue [4,5]. If the semiconductor materials can be engineered effectively to degrade the pollutants with the help of solar radiation, the threat caused by the organic pollutants can be reduced to a greater extent [3,6].

Titanium dioxide (TiO₂) is one of the widely investigated semiconductor material for its non-toxicity, low cost, optical, chemical and photocatalytic properties [3,6–12]. These materials find their applications in sensors, dye sensitized solar cells (DSSC), microelectronics,

catalysis and biomedical field [4,13–17]. Since photocatalytic reaction is a surface phenomenon, it is very sensitive to the surface structure. The reaction rate will be higher for catalysts with higher surface area [18]. When compared to nanoparticles and nanorods, nanotubes are having high surface to volume ratio. This facilitates higher interaction between the surfaces and the reactive species resulting in enhanced photocatalytic activity [19]. The TiO₂ nanotubes prepared by anodization have the advantage of providing higher surface area to enhance the efficiency of the device at low cost [19–21].

Typically, the band gap of anatase TiO₂ is 3.2eV which corresponds to the UV region [4,8,22]. This can lead to a decrease in dye degradation rate when employed for photocatalysis under sunlight. The spectral response of this wide band gap semiconductor can be improved through doping with suitable elements or by heterostructure formations [6,13,23] [–] [25]. Bandgap tailoring of this semiconductor can enhance the optical absorption, reduce carrier recombination rate, improve carrier life time and charge transfer mechanism. Intense research is going on in

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Colocasia esculenta stems for the isolation of cellulose nanofibers: a chlorine-free method for the biomass conversion

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Abstract

The reuse of waste products is the green key to sustainability. The extraction of cellulose nanofibers from *Colocasia esculenta* stems is presented in the paper. The study proved that the waste biomass could be effectively re-engineered into highly valued cellulose nanofibers (CNFs). Cellulose nanofibers were extracted via a chemo-mechanical route. The pre-treatments included mild alkali hydrolysis (2% NaOH) and chlorine-free bleaching (peroxide bleaching in an alkaline medium). Cellulose I_β structure was confirmed using ¹³C solid-state nuclear magnetic resonance spectroscopy and X-ray diffraction analysis. The elemental analysis of CNFs detected the elements, carbon and oxygen. The CNFs had a crystallinity and transmittance of 71.72% and 60%, respectively. Microscopic studies verified the elimination of non-cellulosic components and the fibrous nature of CNFs. Moreover, the fiber diameter of CNFs was 20–40 nm. Thermal analysis revealed good thermal stability of 335.8 °C (T₅₀) for nanofibers. Long-term aids are numerous in eco-friendly technology. Developing an eco-design will support zero waste ideals, lowers carbon dioxide emissions, and encourages a circular economy. Owing to the merits of natural fibers, they can be adopted in various sectors including packaging, automobile, aerospace, electronics, biomedical, construction, and furniture.

Keywords Acid hydrolysis · Cellulose nanofibers · *Colocasia esculenta* stems · High crystallinity

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Ethylene-propylene-diene (5-ethylidene-2-norbornene) terpolymer/aluminium hydroxide nanocomposites: Thermal, mechanical and flame retardant characteristics

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ABSTRACT

Ethylene-propylene-diene rubber (EPDM) composites were fabricated by incorporating aluminium hydroxide (ATH) and high abrasion furnace (HAF) carbon black using two-roll mill mixing strategy. The thermal stability, flammability and mechanical properties of the composites were investigated by thermogravimetric analysis (TGA), limiting oxygen index (LOI), horizontal burning test (UL94 HB), mechanical testing (UTM) and dynamic mechanical analysis (DMA). TGA profiles showed that, EPDM/ATH composites presented incremented char residue and reduced mass loss rate compared to control EPDM. The incorporation of ATH was found to benefit the flame retardancy of composites. The storage modulus (E') of composites peaked due to the increased stiffness of the material with filler loading. Investigation of visco-elastic properties showed the existence of strong polymer - filler interaction. The morphology of the composites under study and the corresponding char residue obtained after their LOI testing were investigated by scanning electron microscopic studies (SEM).

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1. Introduction

Ethylene-propylene-diene terpolymer (EPDM) proved to be a versatile material for their properties depend mainly on their chemical composition, microstructure of their copolymer, diene present. Based on the propylene unit content, amorphous to semicrystalline matrices may be formed. Besides, presence of diene facilitates cross-linking of the EPDM chains through sulfur vulcanization or peroxide cure. EPDM is extensively used in fields such as automobile industry, cables, electronic equipments etc., owing to its electric properties, heat resistance, ozone resistance, chemical resistance, and low temperature flexibility etc. [1,2]. However, main drawback for almost all thermo plastic elastomers (TPEs),

including Ethylene-propylene-diene terpolymer, is their flammability, which restricts the realms of their application leaving security at stake. Hereforth, EPDM must be modified with flame retardant fillers. There has been much research on the flame retarding properties of EPDM-based blends such as EPDM/polypropylene (PP) [3,4] and EPDM/polyethylene (PE), [5,6] instead of control EPDM. Most of these research on flame-retardant EPDM/PP and EPDM/PE, focussed on halogen based additives, such as decabromobiphenyl oxide (DBBO), and antimony trioxide (Sb_2O_3), [4] and aluminium hydroxide (ATH) [7]. Halogen based flame retardants emits toxic gases on combustion posing health hazards and under this present scenario of environmental and health concerns, the development of effective halogen-free flame retardants became one of the most popular topics. [8].

In this work, flame retardant EPDM composites were fabricated using aluminium hydroxide. The thermal, flame retardancy, and

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Extragalactic UV radiation at different galactic latitudes

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ABSTRACT

We have studied extragalactic UV radiation at two different galactic latitudes using Galaxy Evolution Explorer and Spitzer-SWIRE space observations. The total extragalactic contributions are estimated at the fields of ELAIS N2, ELAIS S1 regions of the sky by using aperture photometric technique. The number counts of UV sources in two ultraviolet bands were taken from the produced catalog and calculated their fluxes in the absolute magnitude of 18-28 ranges. Results obtained here are consistent with existing models of galaxy evolution and different factors are identified that might affect the total extragalactic radiation. The extragalactic UV radiation to diffuse background at ELAIS N2 and ELAIS S1 were obtained as 35 ± 5 photons $\text{sr}^{-1} \text{s}^{-1} \text{cm}^{-2} \text{\AA}^{-1}$, 23 ± 5 photons $\text{sr}^{-1} \text{s}^{-1} \text{cm}^{-2} \text{\AA}^{-1}$ & in FUV and 42 ± 8 photons $\text{sr}^{-1} \text{s}^{-1} \text{cm}^{-2} \text{\AA}^{-1}$, 30 ± 15 photons $\text{sr}^{-1} \text{s}^{-1} \text{cm}^{-2} \text{\AA}^{-1}$ in NUV band respectively.

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1. Introduction

Ultraviolet surveys have been used to totally resolve extragalactic light using galaxy number-counts, and the strong foreground galactic emission is perhaps the most compelling limitation. Deep field data have now been gathered spanning the full spectrum from the far UV to far IR, thanks to space-based facilities such as Galaxy Evolution Explorer (GALEX) and Spitzer. The findings from the Galaxy Evolution Explorer could alter our perception of the extragalactic UV sky. As Henry hypothesized, UV radiation, which has been attributed to a variety of extragalactic sources, can be found in higher galactic latitudes [1]. GALEX deep observations (exposure period 50,000 sec) have begun ambitious surveys to examine extragalactic radiation, with the first of them being studies of an area of ELAIS N2– ELAIS S1. The Spitzer SWIRE merged catalog incorporates all source lists obtained to date in ELAIS fields at various wavelengths and red shifts [2]. The fields of the European Large Area Survey (ELAIS), where infrared cirrus emission is unusually small were selected expressly to investigate distant sources in an area [3].

In this paper, we study about 15 DIS observations of UV-GALEX which are overlapped with Spitzer SWIRE surveys for ELAIS N2 & S1 fields. The source counts in six Spitzer Wide-field Infrared Extragalactic (SWIRE) fields were done at $24 \mu\text{m}$ [4]. Many previ-

ous studies were suggested that brilliant infrared galaxies are evolving rapidly [5–7]. Combining these two surveys, we present here the extragalactic number counts from two different high galactic latitudes. The SWIRE study covers the N2 field, a northern ELAIS field centered at RA = 249.2; Dec = 41.0, and the S1 field, a southern ELAIS field located at RA = 8.7; Dec = -43.5. We have looked at the Spitzer-detected sources and estimated their fluxes in UV and try to find the contribution to the extragalactic UV background [8].

2. Observations of GALEX

GALEX, working in ultraviolet was launched in 2003 and covers 80% of the UV sky. A telescope is 50 cm high and uses a dichroic mirror to divide and collect photons in two UV bands from different parts of the sky [9].

The effective spatial resolution of GALEX (5 – 7") across the sky with 1.5 degree FOV, detectors with less noise delay-line records photons in both UV bands. Morrissey et al. provide a detailed overview of GALEX data products [10]. The observation log of GALEX in ELAIS field includes 9 observations from N2 and 6 observations of S1 are tabulated (Table 1).

The high galactic latitude imaging surveys, especially SWIRE observations are used to detect galaxy populations that cover 65 square degrees in the northern and southern sky [11]. The SWIRE fields are expected to be the next generation of huge extragalactic windows. They were specifically chosen to reduce infrared cirrus

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Structural and optical characterization of reactive evaporated $\text{Sn}_2\text{Sb}_4\text{Se}_8$ thin films

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ABSTRACT

The present report is a comprehensive characterization of the optical properties of tin antimony selenide ($\text{Sn}_2\text{Sb}_4\text{Se}_8$) thin films prepared by reactive evaporation. $\text{Sn}_2\text{Sb}_4\text{Se}_8$ is a common crystalline phase belonging to the Sn-Sb-Se ternary system or TAS system whose optical properties are not discussed in detail in literature. X-Ray Diffraction (XRD) confirms the polycrystalline nature of the as-prepared thin film. The film exhibited good photo response, high absorption coefficient $\sim 10^5 \text{ cm}^{-1}$ and a direct band gap of $1.54 \pm 0.02 \text{ eV}$. These factors point out its potential use as an absorber in thin film solar cells. The optical parameters of the film were also investigated to validate its use in optical devices. On further tailoring of optical properties, the $\text{Sn}_2\text{Sb}_4\text{Se}_8$ thin film can be considered as a promising material for photovoltaic (PV) industry.

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1. Introduction

In recent years, compound semiconducting thin films based on chalcogenide (Group VI) have attracted the attention of researchers due to their remarkable optoelectronic properties appropriate for PV applications [1]. Two prominent binary compounds belonging to this category are SnSe (IV-VI group) and Sb_2Se_3 (V-VI group). Both of them are layered semiconductors with orthorhombic structure and exhibit good photovoltaic properties [2,3]. Later on, most of the researches were directed towards synthesizing a semiconducting compound that incorporates the properties of SnSe and Sb_2Se_3 . One such compound that was successfully developed after thorough research is the ternary Sn-Sb-Se system or TAS system. This compound is interesting for future research because its constituent elements are of low cost and is easily available. However, extensive research is necessary to optimize its properties for energy related applications. To the best of our knowledge, reports on systematic work on TAS system are very scarce in literature. The only reports available are those discussing about their stoichiometric and non-stoichiometric compositions [4], glass-crystalline boundary forming regions [5] and optical properties in amorphous state [6,7]. Hence to understand the potential of TAS system in photo-

voltaics it becomes necessary to carry out a critical evaluation on the optical properties of any one of its particular crystalline phases.

Therefore, in the present work, a detailed analysis is carried out on the structural and optical properties of polycrystalline thin films of TAS system with phase $\text{Sn}_2\text{Sb}_4\text{Se}_8$ [5] about which no systematic work on optical properties is available in literature. The as-prepared $\text{Sn}_2\text{Sb}_4\text{Se}_8$ thin films were characterized by X-ray diffraction (XRD), energy dispersive analysis of X-rays (EDAX), atomic force microscopy (AFM), UV-Vis-NIR spectrophotometer and photoconductivity measurements.

2. Materials and methods

An alternative of Gunther's three temperature method [8] termed "Reactive Evaporation" was used to deposit polycrystalline thin films of $\text{Sn}_2\text{Sb}_4\text{Se}_8$ on the glass substrates. The deposition was carried out at a substrate temperature of $548 \pm 5 \text{ K}$ and pressure of 10^{-5} mbar . Sn was evaporated from a molybdenum boat whereas Sb and Se were evaporated from separate glass crucibles taken in molybdenum baskets. Sn, Sb and Se used were of high purity (99.999%). The experimental procedure has been described elsewhere [9]. The experimental set up and specifications used for recording XRD pattern, EDAX spectrum, AFM image and optical transmission spectrum are described in the reference [9]. An FSH lamp (82 V, 300 W) and Keithley 2611A source meter was used

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Dynamic Rheological Behavior of Thermoplastic Elastomers from PA6,66 /EPDM Blends: Effect of Blend Ratio, Compatibilization and Dynamic Vulcanization

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Abstract: *In this work rheological behavior of PA6,66/EPDM blends have been investigated. Viscoelastic properties such as complex viscosity(η^*), Storage modulus and loss modulus of uncompatibilized, compatibilized and dynamically vulcanized blends on the rheological behavior is discussed in detail. The effect of compatibilisation on the interfacial tension between the polymers is also discussed. Attempts were done to correlate the phase morphology with rheological data.*

Keywords: Rheology, Complex viscosity, Storage modulus, loss modulus

I. INTRODUCTION

Rheological studies are useful for understanding the effect of various parameters on flow behaviour of materials for optimising the processing conditions. For the fabrication of articles of good finish and dimensional stability, knowledge about the processability of the material under high frequency is required. Dynamic rheological measurements offers several advantageous over the conventional steady shear rheometry because of its unique ability to assess and provide important dependence of rheological properties of the materials without disturbing the conformation of the material.

The rheological properties of the components in immiscible polymer blends affect the processing, morphology and property relationships[1]. A large number of studies have been reported on the melt flow behavior of thermoplastic elastomers [2]–[10]. Utraki and Kamal[11] have reviewed the rheological behavior of many polymer blends. Increase in the viscosity upon the incorporation of rubber in a plastic phase has been reported in various systems[12][13]. Melt rheology and morphology of nylon6/ethylene propylene rubber (EPR) blends was studied as a function of composition, and compatibilizer loading by Oommen et al.[14]. The structure-rheology relationship of polyvinylidene fluoride/hydrogenated nitrile rubber blends with special reference to the effect of mixing time was studied by Anil K.Bowmick et al. [15], Recently many researchers reported about the rheological investigations of different polymer blends [16][17][18][19][20].

Effect of graphite micro structure on the melt rheology on interfacially compatibilized PP-EPDM vulcanizate was studied by AA Katbab et al.[21]. Several researchers have studied the effect of dynamic vulcanization on the rheological behavior of rubber/plastic blends[22] [3][23]. N Ghahramani et al.[17] extensively studied the rheology of Thermoplastic vulcanizates (TPVs) especially PP/EPDM rubber system. According to them TPVs exhibit complex rheological fingerprints similar to those of soft elastic solids due to the presence of crosslinked rubber particles. They made an attempt to draw correlation between the rheology with morphology. Kumar et al.[24]studied the effect of various vulcanizing agents on the rheological behavior of nylon/NBR blends.

In this paper the effect of blend ratio, compatibilization and dynamic vulcanization on rheology of PA6,66 (Nylon 6,66) and Ethylene Propylene diene EPDM blends are narrated in detail.

II. EXPERIMENTAL

2.1 Materials

PA6, 66 (Nylon6,66) supplied by SRF Ltd. Madras, India. EPDM with E/P ratio 58/37.5 wt % and DCPD content 4.5wt % was obtained from DSM (Netherlands). The EPM-g-MA was supplied by Exxon Chemical Company. All the rubber grade chemicals such as Zinc oxide, stearic acid, Tetramethyl thiuram disulphide, mercaptobenzothiazole, triallyl cyanurate, Sulphur and dicumyl peroxide were purchased from the local market.



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A novel taxon of the genus *Ischaemum* (Poaceae: Andropogoneae: Ischaeminae) from southern Western Ghats, Kerala, India

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Abstract

Ischaemum sunilii, a new grass species from Nelliampathy hills of southern Western Ghats, Kerala, India, is described and illustrated. The new species is allied to *I. rangacharianum*, but differs in many attributes. Description of the new species with distribution, ecology and comparison with its allied taxa are provided.

Keywords: Distribution, Ecology, *Ischaemum commutatum*, Palakkad, *sp. nov.*, Taxonomic affinity

Introduction

The genus *Ischaemum* Linnaeus (1753:1049) is classified under the tribe Andropogoneae Dumortier (1824:84) in the sub-family Panicoideae Link (1827: 202) (Clayton *et al.* 2006). The genus comprises about 84 species with a native range of tropical and subtropical regions (Mabberley 2008; POWO 2021). Sur (2001) and Srivastava and Nair (2010) worked on Indian *Ischaemum* and reported 56 taxa from the country. Recent checklist of Kellogg *et al.* (2020) states that India harbours 49 species and is mostly concentrated in the Peninsular region, with more dominance in the states of Kerala and Maharashtra (Sunil *et al.* 2017; Bokil *et al.* 2021). With the high grass diversity in these states, the tribe Andropogoneae forms the largest group, in which the genus *Ischaemum* exhibited more diversity and high degree of endemism (Kiranraj *et al.* 2003; Bokil *et al.* 2021). In Kerala, the genus is represented by 33 species, with 18 endemics (Nayar *et al.* 2006; Sasidharan 2011; Sunil *et al.* 2017).

While exploring the floristic diversity of the hill ranges of Nelliampathy forest region of Kerala, the authors came across an unknown population of *Ischaemum* in Govindamala, which was morphologically distinct from hitherto known species. The collected specimen was found to be allied to *I. rangacharianum* Fischer (1933: 352) in its distinctly petiolate lower leaves, glabrous nodes and in having lower glume of pedicelled spikelet broadly winged on one margin. Critical analysis of the specimen with available literature, novel species (Hooker 1897; Cooke 1908; Fischer 1934; Bor 1960; Karthikeyan *et al.* 1989; Vajravelu 1990; Sreekumar & Nair 1991; Lakshminarasimhan 1996; Srivastava & Nair 2010; Bokil *et al.* 2020, 2021) and comparison with *I. rangacharianum*, revealed its distinctness and therefore described and illustrated here as *Ischaemum sunilii sp. nov.*