

## Identity of cavity nesting honey bees of the Indian subcontinent with description of a new species (Hymenoptera, Apidae, Apinae, Apini, *Apis*)

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**ABSTRACT:** A new species of cavity nesting honey bees, *Apis karinjodian n. sp.*, endemic to the Western Ghats biodiversity hotspot is described and illustrated. *Apis indica* Fabricius, 1798 **status restored** is resurrected from synonymy with *Apis cerana* Fabricius, 1793. Key to distinguish the three native cavity nesting honey bee species occurring in the Indian subcontinent viz. *Apis cerana* Fabricius, 1793, *Apis indica* Fabricius, 1798 and *Apis karinjodian n. sp.* is provided. Distribution map is given for the native cavity nesting *Apis* species of the Indian subcontinent. The morphological description of the new species is supplemented with molecular and behavioral information. Radio-Medial Index (RMI), a new measure for species discrimination in *Apis*, is proposed. South India is proposed as the center of origin of the European honeybee, *Apis mellifera* Linnaeus, 1758. © 2022 Association for Advancement of Entomology

**KEY WORDS:** *Apis indica*, *A. cerana*, *A. karinjodian n. sp.*, distribution, DNA barcode, Radio-Medial Index

### INTRODUCTION

The honey bees of the genus *Apis* Linnaeus, 1758 are far the most famous of all insects owing to their production of honey, pollination of crop plants and advanced eusocial behaviour, which has attracted much attention from biologists. Unfortunately, the systematics of this small and highly visible group is not clearly understood, partly owing to the high levels of intraspecific variation as well as the recent divergence of taxa (Engel, 2002).

Beekeeping has been practiced since time immemorial in India. The honey bees (Apini) occurring in India include the single comb building giant honey bees (subgenus *Megapis* Ashmead, 1904): *A. dorsata* Fabricius, 1793 and *A. laboriosa* Smith, 1871; dwarf honey bees (subgenus *Micrapis* Ashmead, 1904): *A. florea* Fabricius, 1787 and *A. andreniformis* Smith, 1857; multiple parallel comb building cavity-nesting honey bees (subgenus *Apis* Ashmead, 1904): *Apis mellifera* Linnaeus,

Review

# Nanoparticles: Taking a Unique Position in Medicine

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**Abstract:** The human nature of curiosity, wonder, and ingenuity date back to the age of humankind. In parallel with our history of civilization, interest in scientific approaches to unravel mechanisms underlying natural phenomena has been developing. Recent years have witnessed unprecedented growth in research in the area of pharmaceuticals and medicine. The optimism that nanotechnology (NT) applied to medicine and drugs is taking serious steps to bring about significant advances in diagnosing, treating, and preventing disease—a shift from fantasy to reality. The growing interest in the future medical applications of NT leads to the emergence of a new field for nanomaterials (NMs) and biomedicine. In recent years, NMs have emerged as essential game players in modern medicine, with clinical applications ranging from contrast agents in imaging to carriers for drug and gene delivery into tumors. Indeed, there are instances where nanoparticles (NPs) enable analyses and therapies that cannot be performed otherwise. However, NPs also bring unique environmental and societal challenges, particularly concerning toxicity. Thus, clinical applications of NPs should be revisited, and a deep understanding of the effects of NPs from the pathophysiologic basis of a disease may bring more sophisticated diagnostic opportunities and yield more effective therapies and preventive features. Correspondingly, this review highlights the significant contributions of NPs to modern medicine and drug delivery systems. This study also attempted to glimpse the future impact of NT in medicine and pharmaceuticals.

**Keywords:** biomaterials; medicine; pharmaceuticals; diagnosis; biomaterials; biomedical; nanomaterials; nanoparticles



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## 1. Introduction

Nanoparticles (NPs) usually refer to particles 1 to 100 nm in size and the catalytic and adsorptive properties are very good for nanoparticles of certain materials. Nanomaterials are also known as “zero-dimensional” NPs. This definition is based on the fact that all of their dimensions are in the nanoscale, as opposed to one-dimensional nanomaterials (NMs) (such as nanowires and nanotubes), which have one dimension larger than the nanoscale, and two-dimensional NMs, which have two dimensions larger than the nanoscale (such as self-assembled monolayer films). They are categorized into numerous classes based on their properties, shapes, and sizes. Fullerenes, metal NPs, ceramic NPs, and polymeric NPs are among the different groups. Because of their large surface area and nanoscale size, NPs have distinct chemical and physical properties. Their optical properties are said to be size-dependent, imparting distinct colors due to absorption in the visible area. Many features that are unique to nanoparticles are directly related to particle size. As a result,



# TT self-weighted Deep-AD<sub>3</sub>-Net: An AD stage and risk prediction

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## ABSTRACT

An age-related disease with memory deficits and cognitive decline is termed Alzheimer's Disease (AD). For AD prevention, the characterization of at-risk states and timely detection of AD is imperative. So, in this work, an efficient AD stage and risk prediction model is proposed. Afterward, by utilizing the Recursive Hypothesis-Creation Algorithm (RHCA), the crucial variables are selected and ranked via the tailored metric ranking techniques. Then, by employing the relevant variables obtained from the original ADAS Cog-13, the risk prediction score is calculated utilizing the True True Self-Weighting Mechanism (TT-SWM) and the ventricle volume weight assignment process. Next, by utilizing the Queue-Boltzman-Constant-Sphere (QBCS) approach, the volume and hippocampus area of the brain of an AD-affected person and the rate of shrinkage in the brain are gauged. At last, with the bilateral hippocampus, resting-state functional Magnetic Resonance Imaging (rs-fMRI) is evaluated for the whole brain utilizing the Phylogenetic Method (PM). In this, via the creation of one Gray-Level Co-occurrence Matrix (GLCM), the bilateral hippocampus features are obtained. Next, utilizing a Genetic Algorithm (GA), the features are extracted and inputted into the Deep-AD<sub>3</sub>-Net classifier for the classification of diverse AD stages.

## ARTICLE HISTORY

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## KEYWORDS

Recursive hypothesis-creation algorithm (RHCA); Alzheimer's disease (AD); resting-state functional MRI (rs-fMRI); Genetic algorithm (GA); Queue-boltzman-constant-sphere (QBCS); risk prediction score; classification

## 1. Introduction

As society ages, age-related diseases regarding personal and public health concerns also increase. A neurodegenerative disorder that is usually related to progressive memory loss is termed AD, which engenders dementia or ultimately death. The occurrence of AD augments extremely with age subsequently doubling up every 5 years after age 65, as per the statistics proven by the National Institute of Neurologic Communicative Disorders and Stroke/AD and Related Disorders Association (NINCDS-ADRDA) [1]. On the contrary, the prevalence of AD increases drastically with age. In the 70s, AD becomes quite common and becomes more intense in the 80s. It is quite indefinite whether the occurrence of AD continues to rise into the 90s; however, the occurrence of dementia increases promptly in that age range. In addition, more habitually, AD occurs in women and this likely reflects their greater longevity [2] Figure 1.

Metallostasis or fatigue of data trafficking are experienced by the AD-affected brain and this engenders in the redistribution of data into inappropriate sections [3]. Furthermore, the brain regions with the temporal and frontal lobes that are entailed in learning and memory processes are reduced in size in AD patients. So, this engenders the deterioration of synapses and even the death of neurons [4]. Also, in the brains of AD-affected patients, '2' characteristic lesions plaques and tangles are observed. Out of these two, tangles are chiefly composed of paired helical filaments, which encompass the

microtubule-associated protein tau. The key element of neurofibrillary tangles is Tau [5].

The (i) pre-dementia stage, (ii) mild dementia stage, (iii) moderate dementia stage, and (iv) severe dementia stage are the categories of the AD stage [6]. Pre-dementia stage is the 1st stage. Here, in Activities of Daily Living (ADL), the patients don't exhibit much deterioration. ADLs are tasks associated with personal care. The ADL score looks at 4 of these tasks, namely bed mobility, eating, transfer, and toileting. For all these tasks, the resident's self-performance along with the amount of staff support provided is assessed. Usually, in obtaining new information, it is diagnosed by means of mild impairment. Mild dementia is the next stage in which a considerable loss of learning along with memory is an exceptional clinical feature [7]. There will be a reduction in the ability of AD patients to plan, judge, and organize intricate tasks, and also in household chores (managing bank accounts; preparing meals, et cetera) at this stage. There is also a shrinkage in vocabulary, a decrease in word fluency, and less accuracy in expressive language during communication. Patients begin to 'live in the past' in the moderate dementia stage owing to the serious shrinkage in recent memory. Severe dementia is the last stage where almost every cognitive function is seriously damaged. Even earlier biographical memories also vanish and the language gets lessened to simple phrases or even single words [8, 9]. AD researchers have wielded diverse methodologies to

## Does the Indian economy progress toward a cashless economy?

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### Abstract

The cashless payment system has been considered a critical driver for the country's economic growth and development. Recently, financial institutions and services have undergone drastic changes due to rapid digitalization. Over the last 10 years, substantial progress has been made toward transforming India into an inclusive digital financial system, cost-effective, convenient, transparent, accountable and secure, bringing underserved and excluded rural people into the economic mainstream. All these efforts led to the transformation of India into a greater cashless economy. Despite the rapid expansion of digital financial transactions in India, cash still accounts for a significant share of payment. India observed a simultaneous growth of the cash economy and digital payments, which created a paradoxical situation. This situation twisted a lesson for policymakers who imagined all cash was shady and that digital must necessarily dent the cash economy. This research paper analyzes the trends and progress of digital payment for transactions in India and the developments to make India a cashless economy. It also examines whether a long-promised cashless society will become a reality, or will currency continue to play a critical role in everyday transactions, as it had for decades?

*Keywords:* Cashless economy; digitalization; cash to GDP ratio; digital payment indicators.

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### 1. Introduction

A country's financial system is critical to its economy. It facilitates cash flow between savers and borrowers, efficiently distributing financial resources to promote economic growth and development. The accessibility and usage of financial services is the significant determinant of the financial sector's development. Expanding financial services is necessary for a more inclusive financial system

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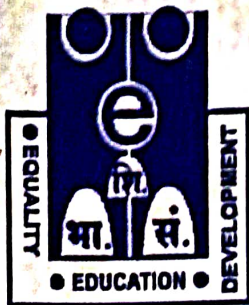
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# Community Participation in Curtail COVID-19 Pandemic: A Model from Kerala

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## Abstract:

Millions of individuals around the world have been impacted by the COVID-19 pandemic, creating an unparalleled global calamity. While other nations have used different approaches to battle the pandemic, Kerala in India has become well-known for its distinctive strategy of encouraging community involvement. Kerala, a state with a high population density and few healthcare facilities, has proven successful in controlling the virus's spread. The Kerala concept of community involvement in containing the COVID-19 outbreak is discussed in the essay. The concept combines community involvement with government-led actions. The government has taken a number of actions, including monitoring quarantine measures, disseminating information, and conducting door-to-door surveys. In order to establish COVID-19 hospitals, expand the number of testing facilities, and supply essential medical supplies, the government also worked with the business sector. The Kerala model's community participation component entails community members actively participating in preventing the spread of the virus. Community members received training on how to recognise COVID-19 signs, adhere to quarantine guidelines, and help individuals in need. In order to supply food for people in quarantine or who are unable to prepare their own meals, the government has organised community kitchens. The COVID-19 statistics for the state show how effective the Kerala model has been. Kerala has managed to keep its infection rate low despite being a state with a high population density. Also, the state has been successful in preventing communal transmission, which has been extremely difficult in other states. The World Health Organization (WHO) has acknowledged the Kerala model as a successful strategy for combating the COVID-19 pandemic.

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**Keywords:** COVID-19, Community Participation, Pandemic

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## Introduction:

This article provides a comprehensive overview of the response of Kerala to the COVID-19 pandemic, highlighting the state's experience and investment in emergency preparedness and outbreak response, as well as its successful implementation of Community resilience approaches. Kerala has implemented a number of measures to

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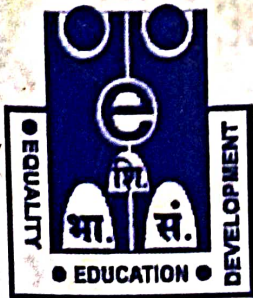
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# Migration: Return, Integration and the Economic Impact in Kerala: Analytical Study

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## Abstract:

The Kerala Model Development served as a template for economies around the world as well as for other nations and states. Investigating the effects of the COVID 19 epidemic, which has destroyed every financial sector in the world, on Kerala's wealth system is crucial in this situation. It has been reported that more people are leaving Kerala for other nations and states. For Kerala, the income of these migrants is a significant source of income. The data proves beyond a shadow of a doubt that Kerala's primary economic foundation depends on their income. In a circumstance like Covid-19, an investigation is required to determine how a Pandemic that has interrupted the global financial system has harmed Kerala's financial industry. Here is an investigation that clarifies the opinions of the government regarding what initiatives can be taken to address the collapse brought on by this epidemic in Kerala's economic sector. Given the scope and complexity of the study, a wealth system that adopts a development model like Kerala has to be thoroughly investigated. This study's true objective is to suggest a direction for future research because in this situation, more investigation is required.

**Keywords:** Migration, Economic Impact, Kerala

## Introduction:

Kerala's development has a very essential and dynamic component called globalization. The migration of Keralites is rising along with the demand for unqualified, moderately and other types of employees for various infrastructural projects. Over the past ten years, return migration has increased as a result of a number of circumstances, including low pay, unpleasant working conditions, forced migration, and changes in national policies. The employment and living situations are impacted by their turn migration in various areas of Kerala. Additionally, it touches on social and economic issues. The study's primary goal is to identify the trends, patterns, and reintegration of returning migrants in Kerala's Malabar region.

Millions of migrants leaving Kerala for Gulf nations have been directly impacted by the COVID-19 outbreak. People who have returned from abroad after losing their jobs reportedly have to plan a new living arrangement. Estimates place the



# Macroeconomic determinants of emigration from India to the United States

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## Abstract

Aiming to discourage the brain drain and encourage brain gain in India, this study empirically explores the impact of economic growth, human capital development and population density on the high-skilled emigration from India to the United States. Such an interaction between the variables via short- and long-run analysis has been conducted by using the Autoregressive distributed lag bounds testing framework during 1995–2019. It concluded that there is a long-run relationship between the study variables. Further, the evolved outcomes expose that India's economic growth is able to reduce emigration from India to the USA, while the human capital development and population density foster it both in the short and long run. Based on the finding, the study suggests a set of policies for discouraging the brain drain and encouraging brain gain in India.

**Keywords** Emigration · India · Economic growth · Human capital · Population density · ARDL

## Introduction

In the world, India has the largest diaspora, with a diversified global presence of about 17 million [1]. It is observed that the North American region consists of nearly 3 million, while six Gulf Cooperation Council (GCC) countries contain 9

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# Unravelling the Multifaceted Dynamics of Healthcare Expenditure: Exploring the Interplay of Individual Health Status, Lifestyle Choices, and Socio-Economic Factors

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## **Author's contribution**

*This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.*

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**Original Research Article**

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## **ABSTRACT**

This study investigates the relationships between demographic factors and health expenditure based on 387 households in Malappuram district between September 2021 and April 2022. Rigorous statistical methodologies, including ANOVA and t-tests, were applied to scrutinize and quantify these relationships. The findings indicate that health status variations across religious affiliations were present but not statistically significant. Similarly, the regression analysis showed limited predictive power of lifestyle factors (low R-squared, non-significant F-statistics) in explaining health expenditure variations. However, it did reveal a significant correlation between intoxicant use and increased healthcare costs, emphasizing the influence of specific behaviors on healthcare expenses. Furthermore, the analysis emphasized the multifaceted nature of healthcare spending, influenced by socio-economic factors, healthcare accessibility, and unobservable variables,

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*This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.*

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## **SOCIO-ECONOMIC AND HEALTH CONDITION OF MIGRANT STREET VENDORS IN KOZHIKODE**

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### **ABSTRACT**

India is one of the fastest-growing economies and the most populated country in the world. As per ILO Report 2019, 90 percent of the entire workforce is in the informal sector. As per the government estimates, 14% of the total urban informal employment and around 10 million street vending are due to low-level financial investment, easy access to entry, and no need of higher education, skill, and expenditure compared to any other job. Street vendors are very hard working, but they earn a low level of income compared to other jobs. The majority of the street vendors are doing their business on their own and work more than 10 hours a day, but they earn a very low level of income, compared to other regular jobs. This occupation is already having poor employment statics but domestic and migrant street vendors are facing many problems in their working life. The intensity of socio-economic and health problems is comparatively higher among migrant workers than domestic street vendors. They face so many problems in their workplace as well as their family life. So this study aims to find out the working conditions of migrant street vendors in Kozhikode City.

**Keywords: Domestic workers, Informal Sector, Migrant Workers, Street Vendors, Working Conditions.**

### **INTRODUCTION**

In India, most of the urban poor people survive by working in the informal sector. Poverty, lack of employment in rural areas, unemployment, and under employment are the main reasons for

migration of people to the informal sectors of the cities for work and their livelihood. Like other informal sectors, street vending is also characterized by a low level of initial investment, easy access to entry,



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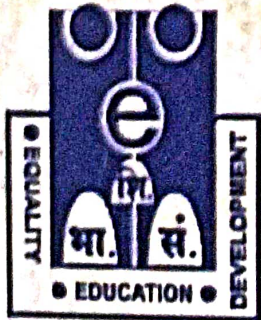
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# From Displacement to Assimilation: Culture and Identity in Zadie Smith's White Teeth

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## Abstract:

White Teeth conceives the whole idea of the literal racist colouring and the figurative uprooting. The concepts of identity and ideology are deliberately problematized with certain aspects of nostalgia and loss. The struggles of diaspora across generations and the identity establishment of each one among them are clearly portrayed through the narrative aspects of Zadie Smith. This paper is an attempt to familiarise the concept of Diaspora along with its different manifestations.

Keywords: Diaspora, Identity, Racism, Nostalgia, Cultural Difference, Multiculturalism

## Introduction to Diaspora:

Human history has witnessed innumerable mass movements of people from one place to another owing to different reasons. Natural calamities, tribal and communal conflicts, wars, political unrest, exile, trade, colonization, partitions of countries, globalization etc are some among them. These movements from one place to another are termed in common academic parlance as displacement. This displacement, in most cases has always been from one's home land to another alien, unknown and at times hostile cultural, religious, political landscapes. Displacement thus constructs the binaries of 'home' and 'alien' in the consciousness of the subjects who undergo the movement. The whole affairs of displacement, transition and encountering a new cultural fabric are what is referred to with the word diaspora. Literature produced based on the experiences and consciousness of the displaced subjects is called diasporic literature.

The social and cultural phenomenon of diaspora has been subjected to theoretical observation by different scholars. William Safran in his "Diasporas in Modern Societies: Myths of Homeland and Return" (1991) enumerates certain characteristics that make up diaspora. He derived these features from the dispersion of Jewish people. According to him a subject in displacement should have the characteristics in order to call it a diasporic one:



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# War Narratives and the Colonial Intrigues: An Analysis of the Fourth Anglo Mysore War

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## Abstract:

Narratives are used to construct discourses about people and communities. War narratives, a sub-category of narratives, are produced to justify the military action, to create legitimacy, and thus support the planned military involvement. It is a comparatively recent genre of literature. The war narratives about Tipu Sultan, who ruled the Kingdom of Mysore in India during the eighteenth century, by English East India Company portrayed him as a devilish king and religious fanatic. These were employed by the English East Indian officials as a weapon of justification and appropriation of the actions taken against Tipu Sultan. (Mis) represented as one of the treacherous kings of India, the war narrative of the Fourth Anglo Mysore War enabled the English military to impose the idea that Tipu Sultan must be defeated and destroyed rather than transformed. The intrigues planned and operated by Richard Wellesley, former Governor General of India, culminated in the Fourth Anglo Mysore War. This paper is an attempt to analyze the war narratives generated by the English East India Company to confirm the identity of Tipu Sultan as the greatest threat to the White Man's civilizing mission.

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**Keywords:** War Narratives, Colonial Intrigues, Mysore War

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War narratives are usually produced prior to military actions. It describes at length the ideological vision of the conflict; emphasizing on the reasons, the States, the nature of the conflict and the desired end-state. As it is presented before the actual war, the narratives help the government or political power mask the truth and establish support of the population in carrying out their military enterprise. It is the official story that competes with numerous stories from opponents. Legitimization is the sole cause for the war narratives. The war narratives had to contain good, persuasive stories, offering a framework for understanding the conflict and the political rhetoric. Amidst certain stories, a particular version of war narrative is emphasized to produce an appeal to support the soldiers and Knights of war.

War narratives have a much resonating effect in historical narratives. The narratives thus produced and established by the political power decided the fate of the opponent. The history was often narrated by the winner and not the loser. The political



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### RESEARCH ARTICLE

#### A REVIEW ON PREVALENCE OF BIODEGRADABLE PLASTIC IN CURRENT LIFE

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##### Key words:-

Biodegradable Plastics, Municipal Solid Wastes, Bio-Degradation

#### Abstract

Plastics have become an integral part of our lives. The problem of conventional plastics is taking decades to degrade in nature. Plastic waste is increasing every year and the precise time needed for biodegradation is unknown. Environmental awareness has driven the development of new biodegradable materials, especially for single use plastic items. Synthetic plastics provide a range of utilities in the civilization of mankind, at the same time the accumulation of these nonbiodegradable plastic in the environment is a menacing drawback increasing day by day. So that the management of plastic waste is a worldwide concern and also a substitute for plastic has become essential to us.

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#### Introduction:-

Plastics are advantageous as they are strong, lightweight, and durable (1). The diverse group of chemicals used in the making of plastic is known to be highly toxic and poses a serious threat to the biosphere. These substances besides hitting hard on the ecosystem can also cause an array of problems like birth defects, cancer, and damage to the nervous and immune systems (2). Because of economic growth and changing consumption and production pattern plastic waste generate highly in the world. This implies that on one hand, more sources are being used to meet the increased demand for plastic, and on the other hand, more plastic waste is being generated. Due to the increase in generation, waste plastics are becoming a major stream of solid waste. This rise has posed a significant problem for local authorities in charge of solid waste management and sanitation. The production and use of bioplastics are generally regarded as a more sustainable activity when compared with plastic production from petroleum (petro plastic), because it relies less on fossil fuel as a carbon source and also introduces fewer, net-new greenhouse emissions if it biodegrades. They significantly reduce hazardous waste caused by oil-derived plastics, which remain solid for hundreds of years, and open a new era in packing technology and industry (3).

Bioplastic or organic plastics are a form of plastics derived from renewable biomass sources such as vegetable oil, corn starch, and pea starch unlike fossil-fuel plastics derived from petroleum. Bioplastics provide the twin advantages of the conservation of fossil resources and reduction in carbon dioxide emissions, which make them an important innovation for sustainable development. Bacteria serve as an excellent feedstock for plastic production owing to its many advantages such as high yield and the ability to grow in a range of environments (4). Bioplastic is not just a single substance, they comprise a whole family of materials with different properties and applications (5).

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# High Sensitive and Reusable SERS Substrate Based on Ag/SnO<sub>2</sub> Nanocone Arrayed Thin Film

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## Abstract

The preparation of reusable surface-enhanced Raman scattering (SERS) substrates having high sensitivity and stability is important for practical SERS applications. In this work, a SERS substrate based on silver-decorated SnO<sub>2</sub> nanocone arrayed thin film (Ag/SnO<sub>2</sub>) is prepared using cost-effective techniques involving chemical spray pyrolysis and thermal evaporation. The SERS substrate exhibited excellent performance with an enhancement factor of  $1.47 \times 10^9$  and a limit of detection value of  $10^{-12}$  M for the detection of rhodamine 6G (R6G). The observed SERS performance is attributed to the electromagnetic enhancement due to the localized surface plasmon resonance of silver nanoparticles along with the synergetic and efficient charge transfer between silver nanoparticles, SnO<sub>2</sub> nanocones, and R6G molecules. Ag/SnO<sub>2</sub> nanocone arrayed thin film-based SERS substrate also evinced good homogeneity and the SERS performance was maintained even after 60 days of substrate preparation. The sunlight-assisted photocatalytic activity of Ag/SnO<sub>2</sub> thin film effectively removed the R6G molecules adsorbed on the surface after SERS analysis, making it reusable for practical applications.

**Keywords** Tin oxide thin film · Spray pyrolytic deposition · Hybrid material · Photocatalysis · Sensing · Plasmonics

## Introduction

Surface-enhanced Raman scattering (SERS) has emerged as a non-destructive and high sensitive analytical technique for the detection of trace molecules, food adulterants, environmental pollutants, explosive materials, etc. [1–6]. SERS has potential biomedical applications especially for the diagnosis of cancer, label-free detection of DNA, and fast detection of pathogens like bacteria, respiratory track viruses, and microbes [7–9]. The large Raman signal enhancement observed in SERS arises primarily from electromagnetic mechanism (EM) and chemical mechanism (CM) [10, 11]. EM enhancement is attributed to the collective electronic oscillations under the influence of an external radiation in association with the excitation of localized surface plasmon resonance (LSPR) of metallic nanostructures [12]. CM

enhancement is due to the polarizability change induced by resonant charge transfer between the SERS substrate and analyte molecules [13, 14]. EM mostly gives an enhancement factor (EF) value up to  $10^{11}$  compared to the CM which has an EF in the range of  $10$ – $10^3$  [12]. SERS “hot spots” may form when two noble metallic nanoparticles are brought into immediate vicinity and their plasmonic fields are combined together to produce exceptional EM enhancement [15, 16]. Such hot spots will be mostly generated in the interstices and nano-junctions between metal nanoparticle aggregates, which can greatly enhance the SERS signal enabling single-molecule level detection [17, 18]. In order to obtain effective surface plasmon resonance, the metal should possess a negative real and a small positive imaginary dielectric constant [19]. These conditions are satisfied only in the case of a few metallic nanoparticles such as Ag, Au, and Cu, in which Ag has the strongest surface plasmon resonance under visible light irradiation [18]. However, pure noble metallic SERS substrates are very expensive limiting their usage in practical applications.

SERS substrates are also developed based on semiconductor nanomaterials such as ZnO, SnO<sub>2</sub>, TiO<sub>2</sub>, MoO<sub>2</sub>, MoS<sub>2</sub>, and  $\alpha$ -Fe<sub>2</sub>O<sub>3</sub>, using different preparation techniques [20–26]. Compared to noble metals, semiconductor materials are

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# An improved frequent pattern tree: the child structured frequent pattern tree CSFP-tree

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## Abstract

Frequent itemsets are itemsets that occur frequently in a dataset. Frequent itemset mining extracts specific itemsets with supports higher than or equal to a minimum support threshold. Many mining methods have been proposed but Apriori and FP-growth are still regarded as two prominent algorithms. The performance of the frequent itemset mining depends on many factors; one of them is searching the nodes while constructing the tree. This paper introduces a new prefix-tree structure called child structured frequent pattern tree (CSFP-tree), an FP-tree attached with a child search subtree to each node. The experimental results reveal that the CSFP-tree is superior to the FP-tree and its new variations for any kind of datasets.

**Keywords** FP-tree · CSFP-tree · Frequent itemset mining · Data mining · CSFP-tree mining · Improved FP-tree

## 1 Introduction

The frequent itemsets mining algorithm demands an efficient data structure to store frequent itemsets for further processing. FP-growth uses a prefix tree to store the frequent itemsets and mines frequent itemsets without generating candidate itemsets. It achieves much better performance and efficiency than Apriori-like algorithms. To avoid the costly candidate generation, FP-growth algorithm uses a frequent pattern tree (FP-tree) with a header table. FP-growth algorithm scans the database two times. After the first scan frequent 1-itemsets are stored in the header table in decreasing order of their frequencies. FP-tree is a tree-like data structure constructed during the second scan. After the second scan, the transactions in the transaction database are stored in the FP-tree in a compressed form. The first instance of each item in the FP-tree is linked with the corresponding item in the header table. Nodes of FP-tree with similar items are connected by a link. In FP-growth method FP-tree construction is the first step. In the second phase, frequent itemsets are mined from the FP-tree. Mining starts from the least frequent item to the most frequent item. Conditional FP-trees

are constructed by using paths with the same prefix item. Using the conditional FP-tree, the algorithm can generate frequent itemsets.

Most of the recent proposals based on FP-tree, concentrate on the improvement of the Mining phase, whereas improvement in FP-tree structure is of great significance, as a better tree structure would reduce the runtime as well as memory requirement. Hence, we explored the possibility of modification in the basic FP-tree structure.

Consequently, in this paper an improved tree structure called child structured frequent pattern tree (CSFP-tree) is proposed. In the proposed algorithm the child list of each node is replaced with a child search tree (CST) to improve the searching.

## 2 Related work

Frequent itemset mining finds specific itemsets with supports higher than or equal to a minimum support threshold. Many frequent itemset mining methods have been introduced by various authors, but Apriori and FP-growth are still regarded as the favored algorithms. Apriori is the oldest frequent itemset mining algorithm [45]. Many algorithms, such as DP-Apriori [9], AGM [23, 62], Parallel Apriori [60] and YAFIM [46], are based on Apriori algorithm. Apriori first generates candidate itemsets, then scans the database to confirm whether the candidates are frequent or not. This

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