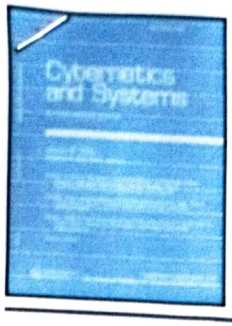

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Cloud Based Electric Vehicle's Temperature Monitoring System Using IOT

S. V. N. Sreenivasu, T. Sathesh Kumar, Omer Bin Hussain, Ajay Reddy Yeruva, Subash Ranjan Kabat & Abhay Chaturvedi

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Cloud Based Electric Vehicle's Temperature Monitoring System Using IOT

S. V. N. Sreenivasu[a], T. Sathesh Kumar[b], Omer Bin Hussain[c], Ajay Reddy Yeruva[d], Subash Ranjan Kabat[e], and Abhay Chaturvedi[f]

[a]Department of Computer Science and Engineering, Narasaraopeta Engineering College, Narasaraopet, Andhra Pradesh, India; [b]Department of EEE, Dr. Mahalingam College of Engineering and Technology, Pollachi, India; [c]Omer Bin Hussain, Department of Computer Science, College of Computer Science, King Khalid University, Abha, Kingdom of Saudi Arabia; [d]Independent Researcher, Pleasanton, CA, USA; [e]Department of Electrical Engineering, Radhakrishna Institute of Technology and Engineering, Bhubaneswar, Khordha, India; [f]Department of Electronics and Communication Engineering, GLA University, Mathura, Uttar Prades, India

ABSTRACT

The use of electric mobility must be part of transportation in the future. The detection, assessment, and scenario of defects in electric drives improve the trustworthiness of electric cars (EV). Permanent magnet synchronous motor (PMSM) drives are worn in a multiplicity of usage appropriate to their enhanced tactical suppleness, superior control thickness, and higher efficiency. In this learning, quick digital twins (i-DT) fashioned in MATLAB/Simulink are used to build PMSM monitoring system and prognosis. An artificial neural system (ANN) in addition to fuzzy logic be used to map the source expanse, point in point in time of EV take a trip, and outputs exterior temp, twisting hotness, moment to fill up the comportment lubricant, and division weakening of magnetic field in charge to determine the lingering constructive life (LCL) of a permanent magnet (PM).This is carried out within the context of linked vehicles and serves as an illustration of the possible advantages that cloud computing, traffic data, and intelligent transportation systems (ITS) may provide for enhancing PHEV energy management. A trend analysis of future advancements in optimization algorithm progress, development criteria, PHEV mixing addicted to the well turned-out grid, and convoy vehicle procedure is included in the study's end.

KEYWORDS

Artificial neural network (ANN); electric cars; electric motors; permanent magnet synchronous motor (PMSM)

Introduction

In order to decrease conservatory gas emissions, PM2.5 emissions, and fossil fuel usage, many governments and businesses are being pressured to focus more on EV marketing (B. Nykvist et al. 2019). Electric footing motors like generation motors and permanent magnet synchronous motors

CONTACT S. V. N. Sreenivasu drsvnsrinivasu@gmail.com Department of Computer Science and Engineering, Narasaraopeta Engineering College, Narasaraopet 522601, Andhra Pradesh, India.

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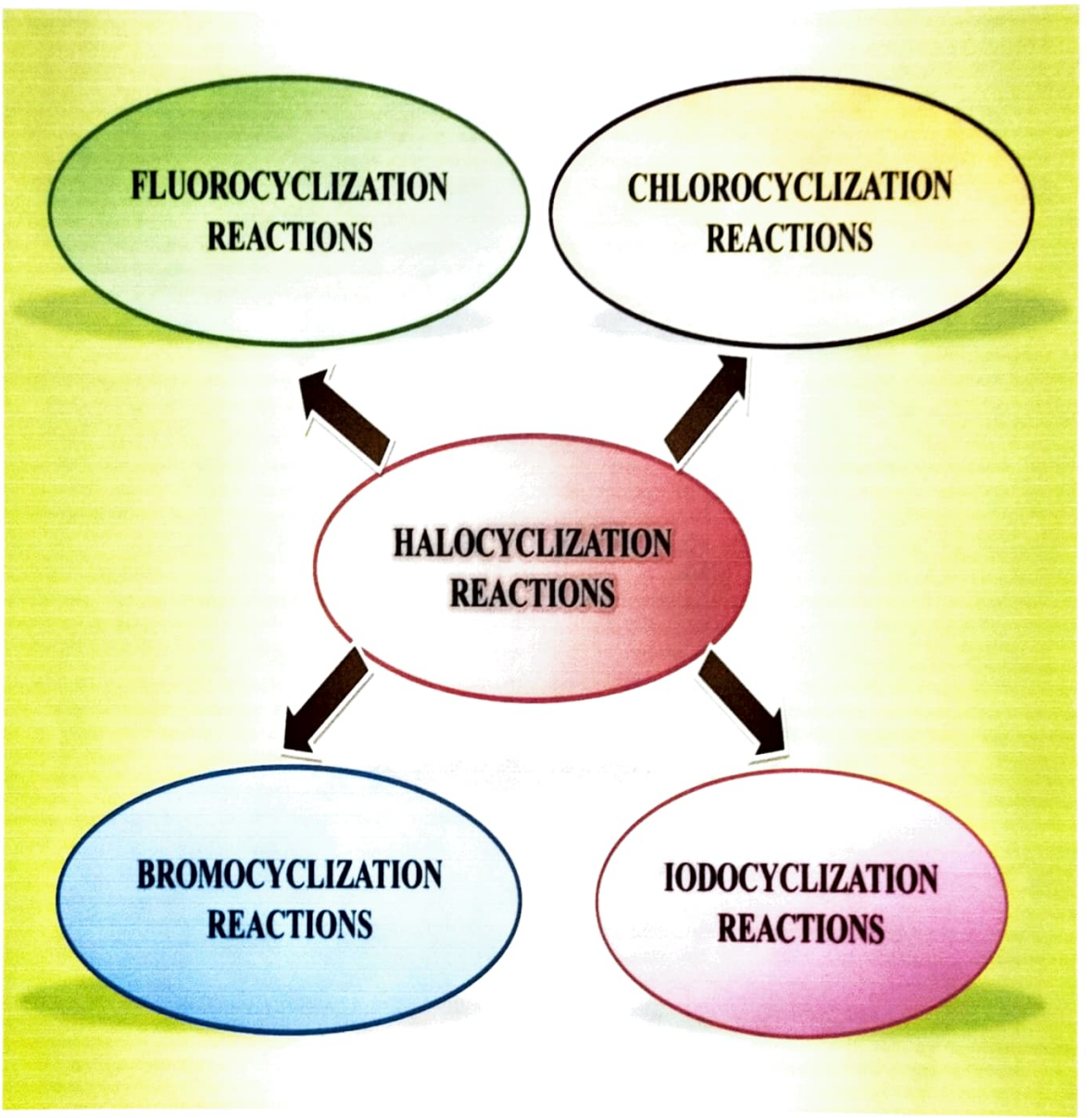
Asymmetric Synthesis of Halocyclized Products by Using Various Catalysts: A State-of-the-Art Review

Soumik De,[a] Aritra Kumar Dan,*[b] Raghaba Sahu,*[c] and Debadutta Das*[d]



Halogens play a crucial part in synthetic organic chemistry. Halo-cyclized products hold numerous applications in the pharmaceutical industries, agrochemicals, natural product synthesis, and material chemistry. Thus, this review will discuss the role of various catalysts, such as from metal-catalysts to organocatalysts, under different conditions to synthesize various halocyclized products. The synthesis and catalytic mechanisms underlying the different asymmetric transformations will also be covered by emphasizing the enantioselectivities, diastereoselectivities, and regioselectivities from the existing pieces of literature.

1. Introduction

Halogens play a critical part in the structural activation and structural framework of numerous organic compounds in diverse organic synthesis. This property can be attributed to the high electrophilicity and better-leaving ability of the halogen groups. The existence of a halogen atom in organic molecules can significantly alter their properties. Halogens improve lipophilicity, membrane permeability and absorption, and blood-brain barrier permeability in various drug molecules.[1] The structural reorganization of organic molecules has recently piqued the interest of synthetic chemists, and cyclization reactions induced by halogen groups can be used to produce a variety of targets.[2–5] Electrophilic halogen atoms are essential for synthesizing highly functionalized carbocycles and heterocycles. They do so by activating saturated and unsaturated hydrocarbons by forming halonium-ion intermediates, which are attacked by nucleophiles containing carbon, nitrogen, oxygen, and sulfur.[6–10] The existence of carbocyclic and heterocyclic scaffolds holds a huge significance in biological applications.[11–13] As a result, the halocyclization reactions are given much emphasis.

Intramolecular cyclization reactions induced by halogens convert a linear molecule to a cyclic molecule for a long time. In the late nineteenth century, Fittig and Stobbe reported the first-ever intramolecular reactions induced by halogen atoms in the form of bromolactonization reaction of olefinic acids.[14] Halolactonization of olefinic acids and amides and haloetherification of olefinic alcohols were reported in the mid-twentieth century.[15,16] However, significant advances in halogen chemistry have occurred in the twenty-first century, with halogens being discovered, contributing to controlling the high selectivities for cyclization reactions.[17,18] The halogen-controlled protocols that significantly enhance selective transformations are given the utmost importance in modern halogen chemistry and synthetic organic transformations.[19,20] Nowadays, a wide range of selective halogenating reagents are available, allowing the late-stage functionalization of complex molecules in cascade reactions. The halogenating reagents are very well adaptable to mild reaction conditions and are classified as electrophilic, nucleophilic, or maybe radical in nature.[21–23] In recent years, organocatalysts are explored various catalytic transformations to induce high levels of diastereoselectivity and enantioselectivity.[24] The organocatalysts include Cinchona alkaloid derivatives, chiral phosphoric acids, amines, and phosphines, as well numerous bifunctional catalysts like thiourea-or squaramide-based are very well utilized to introduce one or more chiral centers in a single synthetic strategy.[25] The intramolecular cyclization reactions that take place with the involvement of halogens are much encouraging from the standpoints of green and pharmaceutical chemistry.[26] Intramolecular cyclization reactions induced by halogens are classically supported under mild reaction conditions that result in the formation of lactones and lactams.[27] In contrast, intramolecular cyclizations that are considered condensation protocols typically require water-sensitive reagents like Lewis acids and condensation reagents potentially operate under standard heating conditions.[28,29] Furthermore, the halogen-induced cyclization strategy prevents the formation of unwanted bimolecular and intermolecular side reactions. The above strategy is beneficial because the halocyclized products can be functionalized further.[2]

This review will address all the catalytic asymmetric Halocyclization reactions such as fluorocyclization reaction, chlorocyclization reaction, bromocyclization reactions, and iodocyclization reactions by categorizing them in four sections. Each section will be sub-divided into the various catalysts reported in the last few years to form various halocyclized products. The role of different catalysts such as the organocatalysts and metal-catalysts involved in forming different enantioenriched and diastereoselective products will be discussed, along with the mechanism involved in the reactions.

2. Asymmetric fluorocyclization reaction

Fluorocyclization reactions are considered an important strategy for synthesizing various cyclic-fluorinated products. The cyclic-fluorinated products have vast applications in many fields, such as in the manufacturing of various pharmaceuticals,

[a] S. De
Department of Chemistry,
National Institute of Technology,
788010 Silchar, Assam, India
[b] A. Kumar Dan
School of Biotechnology,
Kalinga Institute of Industrial Technology (Deemed to be University),
751024 Bhubaneswar, Odisha, India
E-mail: aritradan34@gmail.com
1560015@kiitbiotech.ac.in
[c] Dr. R. Sahu
College of Pharmacy,
Seoul National University,
08826 Seoul, Republic of Korea
E-mail: raghabasahu@gmail.com
raghabasahu@snu.ac.kr
[d] Dr. D. Das
Department of Chemistry, Basic Science & Humanities,
Radhakrishna Institute of Technology and Engineering,
Jagannathpur, 752057 Khorda, Odisha, India
E-mail: deba.chemistry@gmail.com
debadutta_bsh@riteindia.edu.in

Agrochemicals, and medicinal as well as material chemistry.[30,31] The asymmetric Fluorocyclization reaction has several medicinal values, such as discovering and developing various drugs.[32] The advantage of this strategy is that multiple bonds can be constructed in one step.[33] Many researchers have concentrated on the organo-catalytic version of it using the cinchona alkaloid-based catalyst in the existence of an anionic phase transfer catalyst (PTC). However, in recent years, the iodine-mediated reaction was frequently reported. For instance, Nevado and his group first reported chiral iodine(III) fluorides to synthesize various asymmetric fluorinated scaffolds such as piperidines and azepanes.[34] The numerous asymmetric Fluorocyclization reactions catalyzed by different catalysts are discussed in the upcoming sections:

2.1. Asymmetric fluorocyclization reactions catalyzed by PTC

PTCs have been established as a divergent protocol in synthetic organic chemistry due to a wide range of advantages. The PTCs are cost-effective, operate at moderate reaction conditions, and are environmentally friendly.[35,36] The asymmetric phase-transfer catalysis based on structurally well-defined chiral, non-racemic catalysts has become a topic of countless scientific curiosity over the last 2 decades. Under moderate reaction circumstances, phase-transfer catalysis has produced surprising outcomes, resulting in various major bond-forming techniques.[37,38]

In 2011, the first-ever chiral anionic phase transfer catalyzed fluorocyclization strategy was reported by Toste and his group.[39] The authors carried out an enantioselective fluorocyclization reaction of olefins using a chiral phosphate catalyst and a cationic fluorinating agent. In 2015, Hiramatsu and his group developed an enantioselective and diastereoselective Fluorocyclization reaction catalyzed by a double axially chiral anionic PTC. The scope of this reaction is that it can yield two drug scaffolds known as dihydroquinazolone and benzooxazinone, both of which are important in the pharmaceutical sector.[40–42] The authors have successfully fluorinated a variety of enamides to yield the two drug scaffolds with excellent enantioselective excess (up to 98% *ee*) and diastereoselective ratio (> 20:1 *dr*). The authors successfully achieved excellent diastereoselectivities of the fluorocyclized compounds after optimizing the synthesis process and modifying the catalyst with (*R*)-PhDAP and (*R*)-Ph-PhDAP. (Scheme 1).[43]

In 2019, Rouzo and his group reported an enantioselective 5-*exo*-fluorocyclization reaction of ene-oxime compounds using the PTC. The authors used a binaphthyl dicarboxylic acid as a pre-catalyst in this reaction to produce different fluorinated isoxazolines with enantioselectivity of roughly 84% *ee*. The controlled experiments displayed that the reaction rate got improved with the hydrogen-bond interaction of the oxime moiety. In addition, the enantioselectivity of the reaction also increased with this hydrogen-bonding interaction. The stereochemistry of this reaction is found to be that the *S*-isomer is the major product (Scheme 2).[44]

Egami and his group investigated the reaction with a newly developed dianionic PTC. They observed that the utilization of the catalyst could efficiently synthesize the fluorocyclized product with outstanding enantioselectivity. Thus, providing the scope to synthesize various fluorinated compounds with such high enantioselectivity. Moreover, they also observed that trisubstituted acyclic alkenes proceeded with better diastereoselectivity. However, it was low for the linear disubstituted alkenes. Further, they obtained that the mechanism of the strategy goes via a fluoro-carbocation intermediate (Scheme 3).[45]

In 2020, Egami and his group extended their work and published an asymmetric dearomatizing fluoroamidation of various indole groups. They catalyzed the reaction in the existence of dicarboxylate ions as the anionic PTC (same as discussed above). The employment of a PTC offers the benefit of Selectfluor solubility in the liquid phase, as Selectfluor is hardly soluble in non-polar solvents. The reaction operates under a very mild condition to yield high enantioselective

Soumik De received his B.Sc. degree from Utkal University, Odisha, India, and completed his M.Sc. in Applied Chemistry from the Department of Chemistry, National Institute of Technology, Silchar, Assam, India. His research interests are in the intersections of organic synthesis to medicinal chemistry and natural product synthesis via green synthetic strategies. Further, he is also involved in various catalytic asymmetric organic transformations.

Aritra Kumar Dan has completed his B. Tech and M. Tech (Dual Degree) in Biotechnology from the School of Biotechnology, Kalinga Institute of Industrial Technology, Bhubaneswar, Odisha, India. His research is focused on the interface between fundamental and applied research, by combining the principles of Biochemistry, Tissue engineering, Biomaterials, Cancer research, Drug delivery, Medicinal, pharmaceutical science, and natural products.

Raghaba Sahu has completed his Ph.D. in chemistry from the Indian Institute of Technology Bombay, Mumbai and presently he is an Associate with the College of Pharmacy, Seoul National University, Republic of Korea as a Post-doctoral researcher. His research focuses on the synthesis of bioactive molecules and small molecules through Oxidative Dearomatization, cycloaddition reactions, and cascade radical cyclization reactions.

Debadutta Das completed his Ph.D. in chemistry from the department of chemistry, Sambalpur University & CSIR-IMMT, Odisha, India. He is currently working as an Associate Professor at Radhakrishna Institute of Technology and Engineering, Odisha, India. His current research focuses on green chemistry, catalyst reaction, biocatalysis, natural product, bioorganic, and industrial process.

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Insights into the transport phenomena of iron ore particles by utilizing extracted Bio-surfactant from *Acacia concinna* (Willd.) Dc

Mandakini Behari [a], Ardhendu Mouli Mohanty [a], Debadutta Das [b,*]

[a] Department of Mechanical Engineering, Centurion University of Technology and Management, Bhubaneswar 752050, Odisha, India
[b] Department of Chemistry, Basic Science & Humanities, Radhakrishna Institute of Technology and Engineering, IDCO-01, IDCO Industrial Estate, Barunei, Khorda, Odisha 752057, India

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ABSTRACT

The prime goal of this investigation is to study the effectiveness of the saponin extracted from the fruit of *Acacia concinna* (Willd.) Dc. as a dispersing agent in the pipeline stream of iron ore–water slurry. By varying saponin dosages, iron ore percentage, pH, temperature, and the shear stress-shear rate correlation on the rheological properties of iron ore water slurry has been investigated. The isoelectric point of iron ore water slurry is specified by altering the pH with zeta potential. Interaction between saponin of *Acacia concinna* (Willd.) Dc. and iron ore particles have been described using a suitable mechanism based on the hydrophobic and hydrophilic character of both iron ore particles and saponin molecules. The change in electrostatic force induces by the surface charge on each particle results in enhanced dispersion behavior in the aqueous solution for the surface-modified particles. Based on pressure drop and energy consumption, the economic influence of the dispersant has been assessed for the proposed iron ore water slurry pipeline that will be put into practicable operation.

1. Introduction

The stability of highly concentrated iron ore water slurry(IOWS) has appeared as a cutting-edge investigation in mineral processing techniques [1]. Slurry pipeline transport is undoubtedly a long-term option that has been well investigated to replace the traditional method of transporting IO (iron ore), [2] which harms the environment. IO typically transported by rail, road, or both. The loading and unloading of iron ore at sidings influence air quality due to dust generation [3–6].To decrease particle–particle associations and enhance the rheological properties of slurry during pipeline transportation, various physical [7, 8] and chemical [9–11] modification techniques have been employed. This resulted in the surface modification of the IO particle for better rheological improvement. There is a general understanding that the additive (dispersant or surfactant) effectively increases the stability of a slurry by reducing the particle–particle contact and increasing electrostatic or steric repulsions of iron particles, as stated by Derjaguin, Landau, Verwey, and Overbeek (DLVO) hypothesis [12]. Melorie and Kaushal [9]investigated that the yield point and viscosity value of slurry are considerably reduced in the presence of varying dosages of sodium hexametaphosphate. It was observed that the quantity of the charge density on the particle surface and the pH of the suspension both had a significant impact on the quantity of surfactant that was adsorbed on the IO particle surface. Wang et al. [13] used infrared spectral data, thermogravimetric, and zeta potential(ζ) analysis to investigate the adsorption of two surfactants, sodium oleic(SO) and sodium dodecyl benzene sulphonate(SDBS) on magnetite surface. The experimental results showed that SO molecules were chemically bound to magnetite particles which constitute the first layer. The second layer is formed by the adsorption of SDBS molecule through vander Waals attraction with initially SO-coated magnetite particles. According to Lee et al., [10] significant adsorption of the anionic surfactant SDBS occurs on magnetite particles at the pH range below the isoelectric point (pI).Mabuza et al. [14] used different concentrations of polymeric dispersant (DP001) to make ferrosilicon and magnetite slurry less dense. The viscosity of the suspension decreased by roughly 20% at minimal polymer concentrations and by even more than 50% at varying densities and slime contents. Although commercial additives were capable of stabilizing IOWS, their chemical activity had an inescapable negative influence on the environment. In addition, natural additives may be an alternative for IOWS stability in both economic and environmental concerns. According to the above-cited literature, most of the dispersants utilized in the stabilization of slurry are in a synthetic form, which may be hazardous to the environment [15]. Plant saponins are the potential bioactive molecules with the most surfactant characteristics [16]. Saponins are amphiphilic compounds extracted readily from living sources and used as a replacement for synthetic surfactants in various industrial applications. Saponins can be found in a wide variety of plants and animals.

* Corresponding author.
E-mail address: deba.chemistry@gmail.com (D. Das).

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Review

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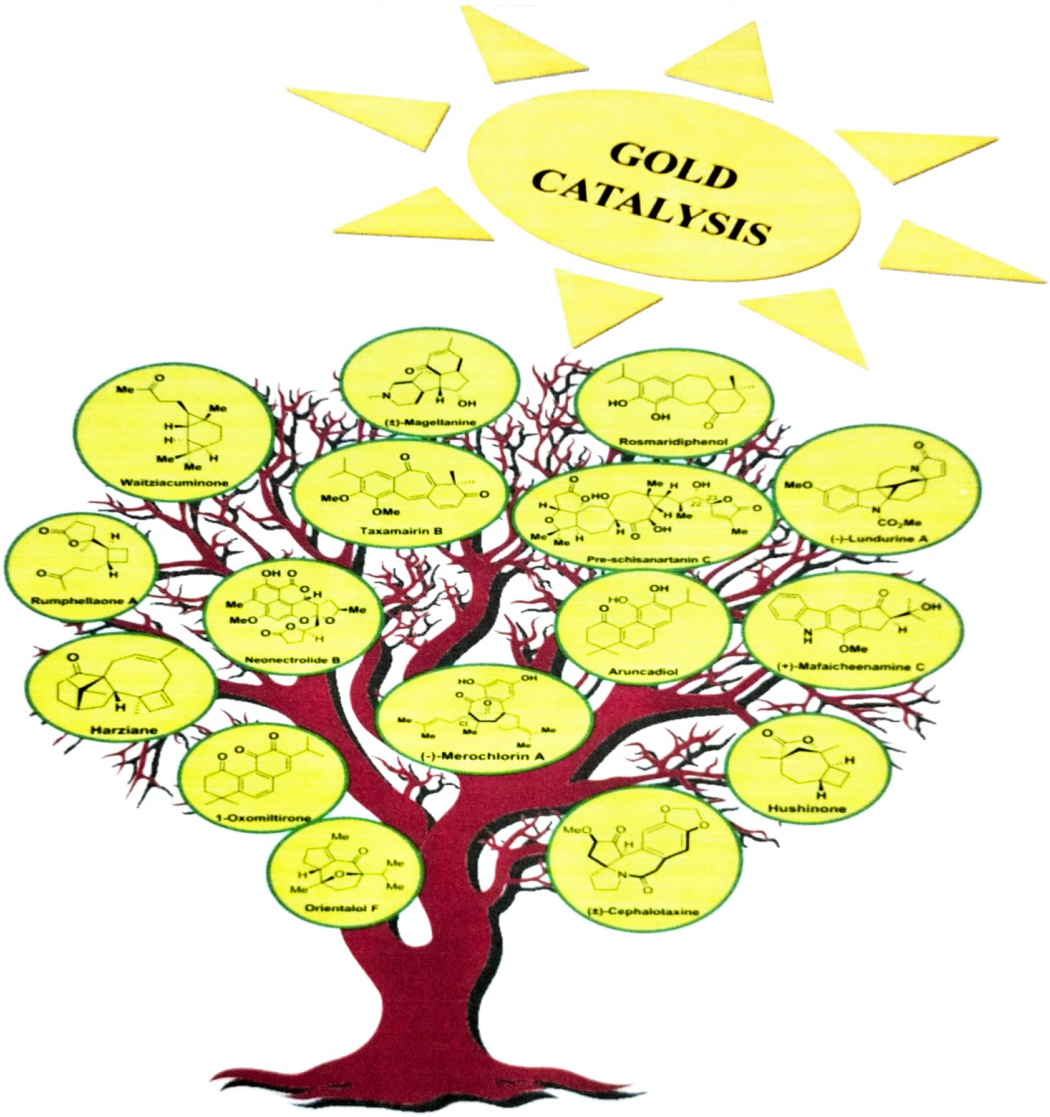
Total Synthesis of Natural Products using Gold Catalysis

Soumik De,[a] Aritra Kumar Dan,*[b] Raghaba Sahu,*[c] Sagarika Parida,*[d] and Debadutta Das*[e]



Abstract: Gold catalysis is an extremely enthusiastic field of investigation in the catalysis area. The development of alternative, highly inventive, precompetitive techniques based on gold catalysis has paved the way for executing a broad spectrum of chemical transformations from uncomplicated starting materials. The total synthesis of natural products is a complex and more complicated task. An amalgamation of natural product synthesis through gold-catalysis has been a thought-provoking job. The protocol has solved several problems related to the synthesis of numerous complicated natural products. Thus, this review has outlined some of the most notable benchmarks from the last seven years (2015–2021) on gold catalysis and their application in the total synthesis of numerous natural products. The strategy acquired by the authors to accomplish the total synthesis will be elaborately discussed by emphasizing the role of the gold-catalyzed reactions.

1. Introduction

Gold catalysis is the most intriguing and proactive site in catalysis investigations.[1–4] Since ancient generations, gold has always been believed to be a synonym for strength, purity, magnificence, and assets. On the other hand, it was chemically neglected for a long time and misinterpreted as an inert element.[5] Over time, gold catalysts have become known for their superior biocompatibility, functioning group toleration, and environmentally friendly attributes.[6] As correspond to different transition metals, these specific characteristics are particularly interesting to synthetic organic chemists who have designed gold-catalyzed-based organic modifications and other mechanistic discoveries.[7–10] The development of alternative, highly inventive, precompetitive techniques based on gold catalysis has paved the way for executing a broad spectrum of chemical modifications from uncomplicated starting materials.[11] The existence of electron-donating and electron-accepting substituents that show noticeable effects in gold catalysis and, for example, offer up efficient paths to heterocyclic systems is the essential function of substituents in gold catalysis.[12] Furthermore, the actions of counter anions and additives are crucial for effective gold catalysis.[13,14]

Between the ending of the 20th and the start of the 21st century, the "gold rush" in synthesis[15] was initiated with the original investigations published by Fukuda and Utimoto (1991),[16] Teles et al. (1998),[17] and Mizushima et al. (2002)[18] on the homogeneous gold-catalyzed collation of water and alcohol to alkynes. The investigation of Hashmi et al. (2000) demonstrated the catalyst mobility of $AuCl_3$ on cycloisomerization approaches of alkyne-based compounds, leading to furans and arenes, which were the foundational contributions that ignited curiosity in gold catalysis in the late 21st century.[19,20] Since then, there has been a significant surge in interest in this metal, as seen by the extensive number of articles published on gold catalysis.[21–30]

However, the first review on the gold-catalyzed total synthesis of natural products was described by Hashmi et al. (2008).[31] From this review, the authors emphasized the manner of activating various substrate molecules with the aid of a gold catalyst that ultimately synthesizes several natural products. Later in 2012 and 2016, Hashmi et al. updated the report on the gold-catalyzed total synthesis of natural products. Through their reviews, the authors highlighted numerous synthetic strategies involved in one of the key steps to acquiring the desired natural product. The numerous key synthetic strategies involve bis-spiroketalization, hydroalkoxylation, hydrocarboxylation, hydroamination and hydroarylation of alkynes, hydrocarboxylation of allynes, oxidation reactions, glycosylation reactions, and other rearrangement reactions.[32,33] The diverse strategies of gold-catalysis have opened up a new dimension for the fruitful synthesis of natural products and their analogs. Zhang et al. (2014) reported a strategic innovation of gold catalysis to synthesize several natural product analogs.[34] Sugimoto et al. (2017) reported a digest paper that primarily focussed on the cascade reactions of gold catalysis that enabled the total synthesis of natural products.[35] The literature is of high practical significance because the gold-catalyzed cascade transformations proceed to synthesize carbocyclic and oxygen- and nitrogen-containing heterocyclic frameworks. The carbocycles and the heterocyclic compounds are important in discovering numerous drug molecules and in biochemical applications.[36] Quach et al. (2017) reported a review that focussed on the synthesis of diverse spiro, bridged, and ketal-based natural products by employing gold catalysis.[37] The review holds huge practical significance as it collectively accounts for the late-

[a] S. De
Department of Chemistry,
National Institute of Technology,
Silchar, Assam – 788010 (India)

[b] A. K. Dan
School of Biotechnology,
Kalinga Institute of Industrial Technology (Deemed to be University),
Bhubaneswar, Odisha – 751024 (India)
E-mail: aritradan34@gmail.com
1560015@kiitbiotech.ac.in

[c] Dr. R. Sahu
College of Pharmacy,
Seoul National University,
Seoul – 08826 (Republic of Korea)
E-mail: raghabasahu@gmail.com
raghabasahu@snu.ac.kr

[d] Dr. S. Parida
Department of Botany, School of Applied Sciences,
Centurion University of Technology and Management,
Bhubaneswar, Odisha – 752050 (India)
E-mail: parida.sagarika@gmail.com
sagarika.parida@cutm.ac.in

[e] Dr. D. Das
Department of Chemistry, Basic Science & Humanities,
Radhakrishna Institute of Technology and Engineering,
IDCO-01, IDCO Industrial Estate, Barunei, Khordha, Odisha – 752057 (India)
E-mail: deba.chemistry@gmail.com
debadutta_bsh@riteindia.edu.in

Principal
Radhakrishna Institute of Technology
and Engineering, Bhubaneswar

stage installation of spiroketal compounds in complex natural products.

Synthetic organic chemists still encounter difficulties in total synthesis of natural products via the evolution of effective pathways for the scalable preparation of complicated molecules.[34,38] Likewise, the synthesis of diverse natural product families and analogs can significantly boost our capacity to design and invent these combinations as biochemical probes and novel therapies.[39–41] In an organic synthesis of natural products, transition-metal catalytic reactions have had a tremendous influence. These have influenced the critical transitions in forming various chemical bonds.[42–46] Natural products with architectural complexity are frequently the motivating factor behind the design of innovative ways for constructing the expected scaffold.[47,48] In principle, designing a pathway for the total synthesis of two or more natural products via a standard intermediate would be more tenacious than designing a synthesis pathway for a single natural product. Specific rules should be evaluated during the design of the synthetic pathways for the total synthesis of natural products. To begin with, we need to be aware of the structural differentiation of the natural product categories, including oxidative states, substitutions, stereo-centers, and skeletal structures. In addition to their bio-synthetic routes and retro-synthetic connections. This valuable report specifies the target preference and synthesis approach. Secondly, the most critical stage is to develop an appropriate standard intermediate that can efficiently be altered into the expected natural product. In most circumstances, the desired natural products are the members of one or more biosynthetic classes that allocate the identical biosynthetic intermediate.[39] Furthermore, natural product and their structural analogs have played a crucial function in pharmacotherapy, particularly in the medication of cancer and infectious disorders.[49–52]

In this review, we have highlighted the contribution of several gold-catalyzed reactions, reported from 2015 to 2021 for the total synthesis of natural products. The review has been classified into sections based on the distinct classes of gold-catalyzed reactions, Including tandem/cascade/domino reactions, glycosidations, hydroarylation, alkoxycyclization, cyclo-isomerization, biscyclopropanation, cycloaddition, metathesis, and oxidative cyclization. Our review will address distinguished

Soumik De received his B.Sc. degree from Utkal University, Odisha, India, and completed his M.Sc. in Applied Chemistry from the Department of Chemistry, National Institute of Technology, Silchar, Assam, India. His research interests are in the intersections of organic synthesis with medicinal chemistry and natural product synthesis via green synthetic strategies. Further, he is also involved in various catalytic asymmetric organic transformations.

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Raghaba Sahu has completed his Ph.D. in chemistry from the Indian Institute of Technology Bombay, Mumbai and presently he is an Associate with the College of Pharmacy, Seoul National University, Republic of Korea as a Post-doctoral researcher. His research focuses on the synthesis of bioactive molecules through oxidative dearomatization, cycloaddition reactions, and cascade radical cyclization reactions.

Sagarika Parida completed her Ph.D. in Botany from the department of botany, Utkal University, and Post Doctorate from the CSIR-Institute of Minerals and Materials Technology (IMMT), Odisha, India. She is currently working as an Associate Professor at the Department of Botany, School of Applied Sciences, Centurion University of Technology and Management, Odisha, India. Her current research focuses on Medical Biology, Cell Biology, Microbiology, Diseases Biology, and Nanobiotechnology.

Debadutta Das completed his Ph.D. in chemistry from the department of chemistry, Sambalpur University & CSIR-IMMT, Odisha, India. He is currently working as an Associate Professor at Radhakrishna Institute of Technology and Engineering, Odisha, India. His current research focuses on green chemistry, catalyst reaction, biocatalysis, natural product, bioorganic, and industrial process.

Principal
Radhakrishna Institute of Technology
and Engineering, Bhubaneswar

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Review

Influence of Surfactant for Stabilization and Pipeline Transportation of Iron Ore Water Slurry: A Review

Mandakini Behari, Debadutta Das,* and Ardhendu Mouli Mohanty

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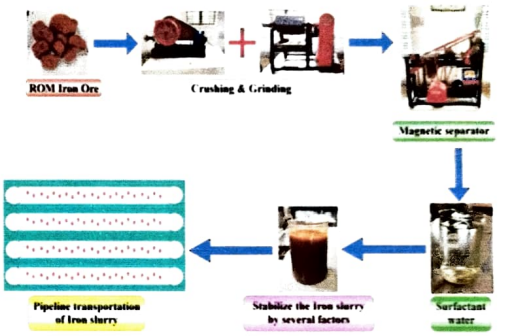
ABSTRACT: Iron ore is generally transported using a traditional method that releases significant amounts of dust into the environment. In contrast, the pipeline transportation of slurry is noticeably a sustainable approach for efficiently transporting iron ore by reducing the environmental pollution. The interparticle interaction of the iron ore particles should be mutually repulsive for steady dispersion. Surfactants and polymers adsorb efficiently at the solid/liquid interface due to their amphiphilic character, rendering the surface hydrophilic or hydrophobic to create a stable dispersion. The present review discusses the interaction of surfactants on the stabilization of solid particles for the ease of pipeline transportation using various types of stabilization mechanisms. In addition to the effect of surfactant alone, its combination with some other parameters such as particle size distribution, temperature, solid concentration, etc. has been discussed. The review also describes the detailed classification of iron ore, surfactant, and characteristic properties of surfactants.



1. INTRODUCTION

Slurry pipeline systems are widely utilized around the world as a feasible alternative to large-scale solids transport for conveying minerals such as fly ash,[1] iron ore (IO), coal,[2,3] lime stone,[4] copper concentrate, zinc tailings,[5,6] and other materials. IO fines play an important role in sintering[7,8] and palletization.[9,10] Currently, a large amount of IO fines have been transported from mining sites to the plant through the pipeline,[11] which is both economically and environmentally beneficial. The slurry pipelines will go a long way toward decreasing pollution and traffic congestion. It is necessary to prepare a well-dispersed uniform suspension of IO particles in water as the transport medium before conveying the bulk slurry through pipelines. To negotiate the pumping power with the lowest specific energy, the rheological behavior of the concentrated slurry demands careful analysis concerning viscosity and other slurry flow parameters.[9,12−15]

The rheology of the slurry has been identified as an important criterion for determining the pressure drop requirements. As a result, studying the rheology of the slurry to predict the pressure drop and thus pumping efficiency would be beneficial.[16−18] Surfactants have a significantly important role in the slurry transportation system. In addition, other parameters such as the temperature, solid concentration, slurry viscosity, and particle size distribution (PSD)[19−21] affect the flow behavior of the iron water slurry (IWS).[22−24] The interaction of dispersant or surface-active agents with the slurry particle impacts the flow behavior of the slurry. Therefore, surfactant selection is critically important. This study reviews and reports on the process by which the dispersant interacts with the slurry to reduce viscosity, the behavior of the slurry during transport, and the stabilization of various IWS systems.[11,25] Although commercial surfactants are frequently used in slurry stabilization, greener approaches, such as the use of natural surfactants, seem to be promising and offer several benefits.[11] The temperature affects fluid viscosity in addition to surfactant and PSD. The impact of temperature change on the apparent viscosity of CWS was examined using saponin as a dispersant that was extracted from *Sapindus laurifolia*.[26] An increase in the kinetic energy of solid particles and rapid movement of the connected hydrophilic sugar unit chain of saponin may be the primary causes of viscosity reduction of the slurry.[20]

Different types of slurries, such as coal−water slurry, fly ash water slurry, oil−water emulsion, clay water slurry, and food slurry, have drawn interest in industrial applications.[27−29] Coal−water slurry is a potential replacement for oil in several industrial applications and as an alternative fuel for the power sector.[27] Because coal is a heterogeneous mixture of carbonaceous and

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in viscosity. The reduction in apparent viscosity is due to the lowering of surface tension and interparticulate forces.[136,137]

The current study aims to generate an extensive experimental data set from the pilot plant test and CFD analysis for a better understanding of the flow behavior of IWS pipelines flow.[138] The report presents experimental data from 12 m long iron ore slurry flow through a 105 mm diameter pipe with flow rates ranging from 1.35 to 5.11 m/s and efflux concentrations ranging from 2.63 to 31%. The acquired findings are validated using a CFD model that is appropriate for the situation. In addition to utilizing simulated findings, a qualitative study of iron ore slurry flow instances has been reported.

Kaushal et al.[13] carried out the computational fluid dynamics to investigate the flow behavior of a high concentration IWS flowing through a pipeline. The tests were conducted on a 3 m long horizontal pipe with a diameter of 54.9 mm. Glass beads with a mean particle diameter of 125 μm and a flow velocity of up to 5 m/s were used in the experiment. The efflux concentration varied from 1 to 50% (by volume) in the presence of sodium hexametaphosphate as a dispersant. Applying two models, namely, Eulerian and mixture models, Kaushal et al.[13] estimated the pressure drop and velocity distribution at various iron and surfactant concentrations.[13,139] Sodium hexametaphosphate being an anionic surfactant developed an intense negative charge on each iron particle, which caused particle−particle repulsion in IWS. Therefore, apparent viscosity, pressure drop, and yield stress were reduced drastically.

8. CONCLUSION

The use of minerals poses challenges that are more significantly addressed by the enhanced processing techniques of mineral sources and their prospective produced technologies. IO fines play an important role in sintering and palletization. The easy transportation of IWS from the mine to the steel and pellet factory, as well as its easy storage in the steel and pellet plant before use, makes this procedure more viable than the traditional one. Currently, a large amount of IO fines has been transported from the mining site to the plant through the pipeline, which is both economically and environmentally beneficial in comparison to the conventional transport system. Slurry pipeline systems are widely utilized around the world as a feasible alternative to large-scale solids transport via pipelines for conveying minerals such as fly ash, IO, coal, lime stone, copper concentrate, zinc tailings, and other materials. Apart from, the ease of distribution via pipeline, another main benefit of IWS is the reduction of iron dust explosions and the pollution generated by them, which might not only minimize health risks but also dramatically lower the lifetime risk among employees engaged in iron processing operations. Surfactants can increase the stability of IO particles by inducing electrostatic or steric repulsion when adsorbed on them. Thus, a well-dispersed slurry is formed in comparison to bare IO particles. The surface-modified iron particles coated with charged surfactants showed good long-term stability, which is an important factor for long-distance pipeline transportation. PSD of IO significantly affects the economy of slurry transportation by increasing the packing efficiency and decreasing the viscosity of the slurry. In addition to the effect of surfactant, PSD, temperature, IO concentration, pH, etc. have an important role in improving the flow behavior of IWS. The selection of the equipment and the estimation of corrosion-erosion are equally important to the hydraulic design. Future works should be more focused on minimizing corrosion-erosion during long pipeline transportation of IO and the extraction and transportation of iron resources that are located far away. From a safe and economical perspective, more research should be carried out on stabilizing IWS in the presence of natural surfactants.

AUTHOR INFORMATION

Corresponding Author

Debadutta Das − *Department of Chemistry, Basic Science & Humanities, Radhakrishna Institute of Technology and Engineering, Khordha, Odisha 752057, India;* orcid.org/0000-0001-6983-1740; Email: debachemistry@gmail.com

Authors

Mandakini Behari − *Department of Mechanical Engineering, Centurion University of Technology and Management, Bhubaneswar, Odisha 752050, India*

Ardhendu Mouli Mohanty − *Department of Mechanical Engineering, Centurion University of Technology and Management, Bhubaneswar, Odisha 752050, India*

Complete contact information is available at: https://pubs.acs.org/10.1021/acsomega.2c02534

Notes

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ABBREVIATIONS

IWS:iron water slurry
CMC:critical micelle concentration
PSD:particle size distribution
SDBS:sodium dodecyl benzenesulfonate
DDAB:didodecyl ammonium bromide
SDS:sodium dodecyl sulfonate
IO:iron ore
TFC:transitional fines content

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ORIGINAL PAPER

Multi-response optimization of FSW process parameters of dissimilar aluminum alloys of AA2014 and AA6061 by response surface methodology (RSM)

Husain Mehdi[1] · Lalit Batra[2] · Abhendra Pratap Singh[3] · Chandrabhanu Malla[4]

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Abstract
This work aims to establish the mathematical model to predict the hardness, UTS, and % elongation of the FSW joints of AA6061 and AA2014 using RSM. The experiment was designed with three factors and three levels, resulting in 20 experimental runs. The model's adequacy was checked using analysis of variance at a 95% confidence level, and input parameters, i.e. Tool tilt angle (TTA), Tool rotational speed (TRS), and welding speed (WS), and output responses, i.e. hardness, UTS, and % strain were considered. This work perceived that TRS and WS were the most significant parameters affecting the mechanical characteristics of the weldments. The maximum UTS (235.76 MPa) and percent strain (19.35) was achieved at a TRS of 1200 rpm, a WS of 100 mm/min, and a TTA of 2°. On the other hand, the lowest UTS (136.92 MPa) and microhardness (63 HV) were observed at a WS of 70 mm/min, a TTA of 2°, and a TRS of 900 rpm. The plastic deformation observed by the stirring action of the tool, accompanied by the high temperature, leads to the DRX of grains. The grains are shattered into a refined structure due to the rotation and movement of the tool during welding. The average grain size for sample numbers 7, 10, 2, and 12 was observed as 11.56 µm, 9.86 µm, 5.63 µm, and 4.12 µm. The formation of sub-grains was found to be essential in improving the UTS of FSW joints. The sub-grains can act as obstacles to dislocation motion and enhance the material's strength and toughness. The refined grain structure observed in the stir zone of the FSW weldments of AA2014 and AA6061 at high rotational tool speeds might be attributed to the mutual effect of high temperature, DRX, and plastic deformation.

Keywords Tensile strength · % elongation · Microhardness · Microstructure

1 Introduction

Friction stir welding (FSW) has developed as an auspicious solid-state joining procedure for similar and dissimilar light metal alloys. This process was patented and developed by TWI, U.K., in 1991 and granted in 1993 by Wayne M. Thomas [1]. Aluminum alloys can have coarse microstructures and poor solidification and porosity when joined using fusion welding methods, which can negatively affect the tensile properties of the weldments. As a result, FSW is often used as a preferable alternative for joining different aluminum alloys [2, 3]. FSW uses frictional heat and plastic deformation to form a solid-state joint between the materials, avoiding the issues associated with re-solidification and melting. This process may lead to a high-quality, defect-free joint with desirable mechanical properties, making it an attractive option for joining dissimilar aluminum alloys [4]. The FSW tool performs two important operations, which are frictional heating and plastic deformation of the material. These two operations facilitate the materialization of a high-quality, defect-free joint between dissimilar metals or alloys, which makes FSW a promising joining process

✉ Husain Mehdi
husainmehdi4u@gmail.com

1 Mechanical Engineering Department, Meerut Institute of Engineering and Technology, Meerut, India

2 Department of Applied Science, Bharati Vidyapeeth College of Engineering, New Delhi, India

3 Department of Mechanical Engineering, Sharda university, Greater Noida, India

4 Mechanical Engineering department, Radhakrishna Institute of Technology and Engineering, Bhubaneswar, India

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TECHNICAL ARTICLE

Effect of Intermetallic Compounds on Mechanical and Microstructural Properties of Dissimilar Alloys Al-7Si/AZ91D

Husain Mehdi, Sumit Jain, Velaphi Msomi, Sipokazi Mabuwa, and Chandrabhanu Malla

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AZ91D (Mg alloy) and A356 (Al-7Si) were fabricated by friction stir welding (FSW) at different process parameters, affecting the welded joints' mechanical properties. The results demonstrated that preferred properties were observed when AZ91D was placed on the advancing side. Mechanical properties, microstructure, elemental mapping, and fractography were analyzed by optical microscopy (OM), scanning microscopy (SEM), and energy-dispersive x-ray spectrograph, etc. The primary Al and Mg diffraction peaks were present, and $Al_{12}Mg_{17}$ and Al_3Mg_2 were intermetallic in all of these joints. This occurred due to the inter-diffusion performance of Al and Mg atoms in the welding and formed intermetallic compounds. The $Al_{12}Mg_{17}$ phase mixed with the Mg phase has preferentially lowered to the weld surface where the AZ91D plate was placed, and legitimate liquation may occur and be observed in the eutectic microstructures. The maximum ultimate tensile strength (UTS) of 90.57 MPa was perceived at tool rotational speed (TRS) of 900 rev/min with a traverse speed (TS) of 100 mm min^{-1}, and the lower UTS (76.63 MPa) was found at TRS of 700 mm min^{-1}.

Keywords friction stir welding, microhardness, microstructure, tensile strength

1. Introduction

Important structural metals such as Mg and Al alloys are extensively employed in various automobile and aerospace applications. Mg and Al have combined to create greater design flexibility for their wide-ranging uses (Ref 1). In the past, several fusion welding procedures have been tried. However, their significant coarser grains, welding defects, intermetallic compounds (IMCs), and loss of strength have made them unsatisfactory (Ref 2, 3). It is not easy to join Al and Mg alloys using fusion welding due to the massive differences in their metallurgical and physical characteristics. Due to the formation of micro-defects and brittle IMCs in the welded zone, the fusion joining process cannot produce sound Mg-Al hybrid joints as a result of the dispersion of IMCs being disseminated under the combined action of high strain rate, low processing temperature, and severe plastic deformation during FSW. The worst strength of Mg-Al welded joints was observed due to brittle failure and IMCs. Although IMCs' elimination was quite challenging, reducing their thickness may be feasible (Ref 4). Much work has focused on the metallurgical characterization and materialization of the IMCs in the welded area. The FSW process has been primarily applied to join non-ferrous materials such as Mg and Al alloys. Both alloys have many attractive mechanical and physical properties. Al-7Si and AZ91D are widely used in automotive transmission pulleys, fuel tanks, aircraft joints, household equipment, aerospace, shipbuilding, and automotive sectors and have many applications for using joints between these metals (Ref 5-7). Various research articles have reported on different welding alloys by FSW (Ref 8-10).

While joining Al-Mg alloys, the main disadvantage is the materialization of brittle IMCs. The influence of TS and rotational speed on the FSWed joints of Al-Mg alloys was studied, where Mg alloys were kept on the advancing side (AS). The welding parameters (TRS, TS, tool offset, and material position) affected the joint efficiency of the FSWed joints of Mg-Al alloys. AZ31 should be kept on the retreating side (RS), while AA2024 should be placed on AS to improve joint efficiency (Ref 11). While aluminum alloy 6064 should be on the RS in the FSW of AZ31 and AA6064 (Ref 12), various cracks and defeats were observed when the FSW tool was placed at the center of both plates (Ref 4). The sharp edges of the parent metals are kept under high pressure during the FSW. Metallurgical bonds with each other can form due to the oxygen-free surface. However, a small oxide layer will remain in the welded region (Ref 13). The past work contains several reports on joining Al to Mg (Ref 14-19) by FSW and observing the materialization of the brittle IMC at the Mg-Al welded region, resulting in high residual stresses and microhardness at the welding interface. Numerous studies have been done on heterogeneous materials' interfaces to analyze their mechanical efficiency. Under certain conditions, the FSW may produce a complex nonlinear weld interface. The FSW with a tortuous weld was reported in the Mg-Al

Husain Mehdi, Mechanical Engineering Department, Meerut Institute of Engineering and Technology, Meerut, India; **Sumit Jain**, Mechanical Engineering Department, Delhi Technological University, New Delhi, Delhi, India; **Velaphi Msomi** and **Sipokazi Mabuwa**, Mechanical Engineering Department, Cape Peninsula University of Technology, Cape Town, South Africa; and **Chandrabhanu Malla**, Mechanical Engineering Department, Radhakrishna Institute of Technology and Engineering, Bhubaneswar, India. Contact e-mail: husainmehdi4u@gmail.com.

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ORIGINAL ARTICLE

Mechanical and thermal properties of *Careya arborea* bast fiber–reinforced chitosan composites for packaging industries

Subhakanta Nayak[1] · Jagannath Mohapatra[1] · Kamalakanta Muduli[2] · Sujit Kumar Khuntia[1] · Chandrabhanu Malla[3] · Saroj Kumar Patra[4] · Bijaya Bijeta Nayak[5] · Priyaranjan Samal[6] · Suchismita Swain[7] · Pradeep Kumar Jena[8]

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Abstract
This study examines the mechanical and thermal properties of composite made of chitosan and careya arborea bast fiber (CA) that was chemically treated in alkaline solution. Six different types of composite samples were created by changing the proportions of CA fiber during the hand lay-up procedure. According to ASTM standards, tensile, flexural, compression, and impact tests were carried out. After the tensile test was conducted, the fractured surface was examined by a scanning electron microscope. It was observed that the composites with treated CA fiber show improved mechanical properties as compared with untreated CA fiber as reinforcement. Further, it was noticed that the mechanical properties increase with increase in CA fiber loading till optimum (20 wt%) and thereafter declines. The mechanical properties obtained at 20 wt% fiber loading was found to be 58.95 MPa tensile strength, 48.29 MPa of flexural strength, and 27.89 kJ/m^2 impact strength. Analysis methods included X-ray diffraction, Fourier transform infrared spectroscopy, differential thermal analysis, and thermogravimetric analysis. Overall, the findings demonstrate that chemically treated CA fiber reinforcement in chitosan matrix enhances the properties of fabricated composite materials. In comparison to other fabricated composites, it was discovered that composites with a 20 wt% fiber content exhibit improved static, dynamic, and thermal properties and can be useful for packaging industries.

Keywords Chitosan · Bark fiber · TGA · FTIR · XRD · Chemical treatment

✉ Subhakanta Nayak
subhanayakvssut@gmail.com

Jagannath Mohapatra
jagannathiitbbsr@gmail.com

Kamalakanta Muduli
kamalakanta.muduli@pnguot.ac.pg

Sujit Kumar Khuntia
sujit_khuntia@yahoo.com

Chandrabhanu Malla
chandrabhanu.malla@gmail.com

Saroj Kumar Patra
sarojkumarpatra@gmail.com

Bijaya Bijeta Nayak
bijaya.nayakfme@kiit.ac.in

Priyaranjan Samal
prsamal91@gmail.com

Suchismita Swain
suchismitaeast@gmail.com

Pradeep Kumar Jena
praadeep1900@gmail.com

[1] Department of Mechanical Engineering, College of Engineering Bhubaneswar, Bijupatnaik University of Technology, Bhubaneswar 751021, India

[2] Department of Mechanical Engineering, Papua New Guinea University of Technology, Lae, Morobe Province, Papua New Guinea

[3] Department of Mechanical Engineering, Radhakrishna Institute of Technology and Engineering, Bhubaneswar, Odisha 752057, India

[4] School of Engineering and Technology, BML Munjal University, Gurugram, India

[5] Department of Mechanical Engineering, School of Mechanical Engineering, KIIT University, Bhubaneswar, India

[6] Department of Mechanical Engineering, Koneru Lakshmaiah Education Foundation, Vaddeswaram, Andhra Pradesh, India

[7] Department of Operations and IT, ICFAI Business School, IFHE University, Hyderabad, India

[8] Department of Mechanical Engineering, Gandhi Institute of Technological Advancement (GITA) Autonomous College, Bhubaneswar, India

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Principal
Radhakrishna Institute of Technology
and Engineering,Bhubaneswar

Soft Computing
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APPLICATION OF SOFT COMPUTING

Intelligent fault diagnostic system for rotating machinery based on IoT with cloud computing and artificial intelligence techniques: a review

Manisha Maurya[1] · Isham Panigrahi[1] · Dipti Dash[1] · Chandrabhanu Malla[2]

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Abstract
The important part of mechanical equipment is rotating machinery, used mostly in industrial machinery. Rolling element bearings are the utmost dominant part in rotating machinery, so even small defects in these components could result in catastrophic system failure and enormous financial losses. Hence, it is crucial to create consistent and affordable condition monitoring and fault diagnosis systems that estimate severity level and failure modes and to create an appropriate maintenance strategy. The studies reveal that the fault diagnostic system focuses on single fault diagnosis of the shaft-bearing system. However, in real scenarios, the occurrence of a single fault is very unlikely. Thus, multifault diagnosis of the shaft-bearing system is of greater significance. This paper aims at steadily and broadly summarizing the development of the intelligent multifault diagnostic and condition monitoring systems. In addition, there is a rapid development of application of Internet of things, cloud computing and artificial intelligence techniques for fault diagnosis. In this paper, we summarize the study of various fault diagnostic system built on the architecture and application of these cutting-edge technologies for predictive maintenance of mechanical equipment.

Keywords Fault diagnosis · Rotating machinery · Artificial intelligence · Internet of things · Cloud computing

1 Introduction

The evaluation of the lifespan of various industrial items and equipment involves the crucial concept of reliability. In the context of manufacturing, reliability can be understood as a possibility which machine or system will consistently execute its projected function over the period of its useful life cycle without degrading or failing. An improved product/machine design is a key factor in its high reliability. However, despite the excellent design, it degrades with time, as these products/machines run under unfavorable circumstances for some applications, for example high surrounding temperature, high humidity and overload, which can eventually lead to failures and significant financial losses and safety expenses. Therefore, maintenance is the primary factor that will provide a satisfactory level of reliability over the asset's lifetime.

Almost all industrial operations involve some machinery, and rotating machinery is increasingly important in transportation, manufacturing, power, electric, and other industries. Rolling element bearings are considered the critical mechanical component. Therefore, it is very essential to examine the quality of rolling element bearings. Failures due to the bearing faults are approximately 45% according to the survey by Electric Power Research Institute (EPRI). Malla and Panigrahi (2019) have described that the bearing failure can have a variety of causes, including cracks, excessive load, mechanical damage, wear and tear, misalignment, unbalance, corrosion, inadequate lubrication, etc.

Rai and Upadhyay (2016) described that preventive maintenance, corrective maintenance, and predictive maintenance are frequently employed for industrial machinery maintenance as shown in Fig. 1. However, condition-based maintenance or predictive maintenance is gaining interest in almost all the sectors of industries. Predictive maintenance (PdM) is a potential method to

✉ Dipti Dash
dipti.dashfcs@kiit.ac.in

[1] Kalinga Institute of Industrial Technology, Bhubaneswar, India

[2] Radhakrishna Institute of Technology and Engineering, Bhubaneswar, India

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Enhancement of Mechanical, Thermal and Morphological Properties of *Eleusine Indica* Grass Fiber Reinforced Epoxy Composites

Subhakanta Nayak[a], Priyaranjan Samal[b], Chandrabhanu Malla[c], Manoj Kumar Pradhan[d], Sujit Kumar Khuntia[a], Jagannath Mohapatra[a], Pradeep Kumar Jena[d], Saroj Kumar Patra[e], Bijaya Bijeta Nayak[f], and Suchismita Swain[g]

[a]Department of Mechanical Engineering, College of Engineering Bhubaneswar, Biju Patnaik University of Technology, Bhubaneswar, India; [b]Department of Mechanical Engineering, Koneru Lakshmaiah Education Foundation, Vaddeswaram, India; [c]Department of Mechanical Engineering, Radhakrishna Institute of Technology and Engineering, Bhubaneswar, India; [d]Department of Mechanical Engineering, GITA Autonomous College, Bhubaneswar, India; [e]School of Engineering and Technology, BML Munjal University, Gurugram, India; [f]School of Mechanical Engineering, KIIT Deemed to be University, Bhubaneswar, India; [g]Department of Operations and IT, ICFAI Business School, Hyderabad, India

ABSTRACT

This research focuses on developing a new material by reinforcing chemically treated *Eleusine Indica* (EI) fiber with epoxy resin as matrix. Composites using varying wt% of treated EI fibers were fabricated taking epoxy as matrix. The effect of chemical treatment and fiber loading on various mechanical properties, thermal, and morphology using a scanning electron microscope (SEM) was investigated. From the results obtained, it is obvious that the mechanical and thermal properties of composites reinforced with chemically treated fibers were enhanced due to fiber surface modification which helps in better bonding with matrix. Moreover, the composites with 20 wt% fiber concentration shows good tensile strength, Young's modulus, impact strength and was found to be 79.31MPa, 3.84 GPa, 32.24 KJ/m^2 respectively. At this fiber loading the composites were characterized by Fourier transform infrared spectroscopy (FTIR), X-ray diffraction (XRD), and thermogravimetric (TGA) and compared with untreated fiber reinforced composites and neat epoxy. Finally, the failure analysis of fracture surface due to delimitation, pull-out of the fibers, percentage of voids, and composite fracture has been verified using scanning electron microscope. The findings provide manufacturers and engineers with a general concept of how to employ the composites to make low-weight automotive parts for improved fuel efficiency.

KEYWORDS

Eleusine Indica; surface modification; mechanical properties; Thermogravimetry analysis (TGA); Fourier transform infrared spectroscopy (FTIR); Scanning electron microscopy (SEM)

关键词

表面改性; 机械性能; 热重分析; 傅里叶变换红外光谱; 扫描电子显微镜

摘要

本研究的重点是开发一种以环氧树脂为基体，通过化学处理的Eleusine Indica（EI）纤维增强的新材料. 以环氧树脂为基体, 制备了使用不同重量百分比处理过的EI纤维的复合材料. 利用扫描电子显微镜（SEM）研究了化学处理和纤维负载对各种力学性能、热性能和形态的影响. 从所获得的结果可以看出, 由于纤维表面改性有助于更好地与基体结合, 化学处理纤维增强的复合材料的机械和热性能得到了提高. 此外, 纤维浓度为20 wt%的复合材料显示出良好的拉伸强度、杨氏模量和冲击强度, 分别为79.31MPa、3.84GPa和32.24 KJ/m2. 在此纤维负载下, 通过傅里叶变换红外光谱（FTIR）、X射线衍射（XRD）、热重分析（TGA）对复合材料进行了表征, 并与未处理的纤维增强复合材料和纯环氧树脂进行了比较. 最后, 利用扫描电子显微镜验证了断裂表面由于划界、纤维拉出、空隙百分比和复合断裂而导致的失效分析. 研究结果为制造商和工程师提供了如何使用复合材料制造低重量汽车零件以提高燃油效率的一般概念.

CONTACT Subhakanta Nayak subhanayakvssut@gmail.com Department of Mechanical Engineering, College of Engineering Bhubaneswar, Biju Patnaik University of Technology, Bhubaneswar, 751021 India

Principal
Radhakrishna Institute of Technology
and Engineering, Bhubaneswar

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Characterization of natural fiber extracted from *Bauhinia vahlii* bast subjected to different surface treatments: A potential reinforcement in polymer composite

Sibakanta Sahu[a], Saipad B B P J Sahu[a], Subhakanta Nayak[b], Jagannath Mohapatra[b], Sujit Kumar Khuntia[b], Chandrabhanu Malla[c], Priyaranjan Samal[d], Saroj Kumar Patra[e], and Suchismita Swain[f]

[a]Department of Mechanical Engineering, Gandhi Institute of Technological Advancement (GITA) Autonomous College, Bhubaneswar, India; [b]Department of Mechanical Engineering, College of Engineering Bhubaneswar, Biju Patnaik University of Technology, Bhubaneswar, India; [c]Department of Mechanical Engineering, Radhakrishna Institute of Technology and Engineering, Bhubaneswar, Odisha, India; [d]Department of Mechanical Engineering, Koneru Lakshmaiah Education Foundation, Andra Pradesh, India; [e]School of Engineering and Technology, BML Munjal University, Gurugram, India; [f]Department of Operations and IT, ICFAI Business School, Hyderabad, India

ABSTRACT

Bauhinia vahlii (BV) is a great source of cellulosic biomass, and it is gaining popularity as a renewable resource. BV bast fiber is proposed to have the potential to replace synthetic fibers in biopolymer composites as a reinforcing material. This investigation deals with the extraction, surface modification and comprehensive characterization of BV bast fibers which could be used for the production of sustainable fiber-reinforced polymer composites. The extracted fibers were chemically treated with sodium hydroxide, sodium chlorite, and benzoyl chloride. Then, the chemical properties, mechanical properties, surface morphology and thermal properties were investigated. An improvement in chemical and mechanical properties was observed after surface modification of fibers. Benzoylation treated BV bast fibers revealed highest tensile strength of 128.56 MPa and Young's modulus of 8.34 GPa. In addition, after treatment, the fibers had rougher surface as seen from SEM images. The surface treatments removed a specific quantity of hemicelluloses, lignin, and pectin from the natural fiber surface, according to FTIR analysis. The surface treatments had a good impact on the crystallinity index of the natural fibers, according to XRD analysis. The characterization results confirmed that BV bast fibers could be used for the production of sustainable fiber reinforced polymer composites.

KEYWORDS

Bauhinia vahlii; cellulose fiber; chemical treatment; mechanical properties; XRD

关键词

紫荆花; 纤维素纤维; 化学处理; 机械性能

摘要

紫荆(Bauhinia vahlii, BV)是纤维素生物质的重要来源, 作为一种可再生资源越来越受欢迎. BV韧皮纤维被认为有潜力取代生物聚合物复合材料中的合成纤维作为增强材料. 本研究涉及BV韧皮纤维的提取、表面改性和综合表征, 可用于生产可持续纤维增强聚合物复合材料. 提取的纤维用氢氧化钠、亚氯酸钠和苯甲酰氯进行化学处理. 然后, 对其化学性能、力学性能、表面形貌和热性能进行了研究. 在纤维表面改性后, 观察到化学和机械性能的改善. 苯甲酰化处理的BV韧皮纤维显示出128.56MPa的最高拉伸强度和8.34GPa的杨氏模量. 此外, 在处理后, 如SEM图像所示, 纤维具有更粗糙的表面. 根据FTIR分析, 表面处理从天然纤维表面去除了特定数量的半纤维素、木质素和果胶. 根据XRD分析, 表面处理对天然纤维的结晶指数有很好的影响. 表征结果证实BV韧皮纤维可用于生产可持续纤维增强聚合物复合材料.

CONTACT Subhakanta Nayak subhanayakvssut@gmail.com Department of Mechanical Engineering, College of Engineering Bhubaneswar, Biju Patnaik University of Technology, Bhubaneswar, 751024 India

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An EOQ model for Inventory System dependent upon on hand inventory without shortages

D. Samal,[1] M. R. Mishra,[1*] A. Kalam[2]

[1]Department of Mathematics, O P Jindal University, Raigarh, Chhattisgarh. India. [2]Department of Mathematics, RadhaKrishna Institute of Technology and Engineering (RITE), Bhubaneswar, Odisha. India.

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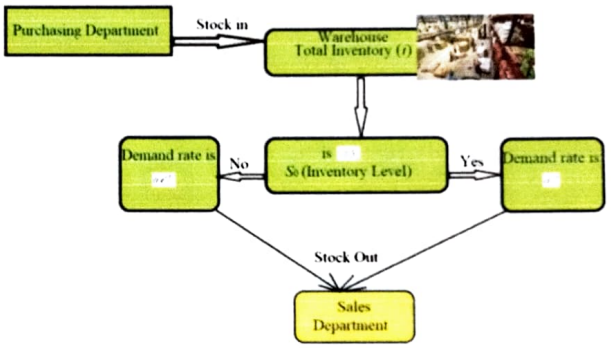
ABSTRACT

The inventory management in supply chain remain crucial for the proper availability of all goods. The mathematical and computer algorithms are implemented to channelize the distribution and availability of stock at particular time and specific point of chain supply. The cumulative impact of all algorithms and models describes the physical stock availability under different situations arising because of high demand, variable stock, distributed inventory and all other alike factors. In this paper we present a model to study a situation where the demand rate declines along with stock level down. The demand rate is different for different situations i.e, the demand rate is αi^{β} when $i \geq s_0$ and $\alpha e^{-\beta i}$ when $0 \leq i \leq s_0$ where i is the inventory level. Numerical examples and sensitivity analysis are presented to illustrate the model developed.



Keywords: Inventory, demand and storage, mathematical algorithms, supply algorithms, Economic Order Quantity

INTRODUCTION

The inventory management algorithms and model have been crucial in proper management of large stocks with the proper supply at the end point. To meet the future demand most of the existing inventory models in the literature assume that items can be stored indefinitely. However, in the course of time certain types of commodities either deteriorate or become obsolete. Deterioration is also known as damage or spoilage in inventory models is now of immense practical importance, which is gaining attention from the researchers. Deterioration occurs with passage of time depending upon the kind of items considered. For example: food stuffs, alcohol, vegetables, meat, photographic films, etc, where deterioration is usually observed during their normal storage period. As reported by Levin et al (1972)[12] and Silver and Peterson (1985),[25] sales at the retail level tend to be proportional to inventory displayed and a large piles of goods displayed in a supermarket will lead the customers to bye more. These observations have attracted many marketing researchers and practioners to investigate the modeling aspects of this phenomenon. To minimize the cost with the assumption that stock- dependent consumption rate is a function of the initial stock level Gupta and Vrat (1986)[8] first developed a model for consumption environment. Silver and Meal (1973),[24] Datta and Pal (1988)[4] has progressed the model where demand rate is not required to be constant.

Covert and Philip (1973),[3] Giri et al. (2003),[6] Ghosh and Chaudhari (2004),[5] Sana et. al. (2004)[21] are developed lot size models for deteriorating items. Mishra and Tripathy (2010),[26] Kawale and Bansode (2012), etc., considered model saving deterioration rate proportional to time. A Price and ramp-type demand which also depends on time has been developed by Wang, Chuanxu, Huang, Rongbing (2014).[27] Patro et. al. (2017) & (2018)[14,15] developed Economic Order Quantity (EOQ) models without deterioration and with deterioration using allowable proportionate discount under learning effects respectively. A more practical and realistic EOQ model is the one considering items to be imperfect. Porteus (1986),[17] Rosenblatt and Lee (1987),[11] Raouf,

Corresponding Author: M. R Mishra,
Department of Mathematics, O P Jindal University, Raigarh, Chhattisgarh
Tel: 9109977034
Email: mail_to_mrmishra@yahoo.co.in

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