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Nanostructured tetragonal crystal $NdVO_4$ for the detection of liquefied petroleum gas

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Semiconductive nanometer-sized $NdVO_4$ was synthesized by a solution combustion reaction of $Nd(NO_3)_3{\cdot}6H_2O$, $V(NO_3)_3$ and urea as a fuel. The process was a convenient, environment friendly, inexpensive and efficient preparation method for the $NdVO_4$ nanomaterial. Effects of the 800 °C calcining temperature on the phase constituents was characterized by TG-DTA, X-ray diffraction (XRD), which was used to confirm the material's structure. The as-prepared samples were further characterized by scanning electron microscopy (SEM) equipped with energy-dispersive X-ray spectroscopy (EDX), and transmission electron microscopy (TEM), to depict the crystallite microstructure. Conductance responses of the nanocrystalline $NdVO_4$ thick film were measured by exposing the film to reducing gases like acetone, ethanol, ammonia (NH_3), and liquefied petroleum gas (LPG). It was found that the sensors exhibited various sensing responses to these gases at different operating temperatures. Furthermore, the sensor exhibited a fast response and a good recovery. The results demonstrated that $NdVO_4$ can be used as a new type of gas-sensing material which has a high sensitivity and good selectivity to Liquefied petroleum gas (LPG).

Keywords: solution combustion reaction, Synthesis, $NdVO_4$ nanoparticles, gas sensor.

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1. Introduction

With the growing attention to environmental problems and the increase of standard of living, there are imperative needs for solid state gas sensors with high sensitivity and excellent selectivity, in air quality monitoring. LPG is widely used as a fuel for industrial and domestic purposes. It is one of the potentially proved hazardous gases due to explosive accidents when accidently leaked. It is therefore important to develop a good sensor for the detection of LPG. Gas sensors based on metal oxide semiconductors generally involve a catalytic reaction of the gas or vapor on the surface of sensor. Gas sensors prepared with metal oxides have been used as detectors for some combustible and toxic gases. Rare earth and transition metal oxides are very important materials for use in the advanced technologies such as solid oxide fuel cells, as catalysts, as materials for electrodes and for chemical sensors because of their functional properties. Rare earth metal oxides are very promising for monitoring the environment due to their high sensitivities and appropriate selectivity. Simple metal oxides such as SnO_2, WO_3, $ZeFe_2O_4$, $ZeCo_2O_4$, $MgFe_2O_4$, and TiO_2 are well known for their high sensitivity to changes in the surrounding gas atmosphere, as can be shown by the growing number of papers [1–7]. Gas sensors based on rare earth mixed oxides materials reported mainly focused on detecting ethanol or NO_x. For example: Aono et al. have carried out more systemic research about $SmFeO_3$ and $REFeO_3$ (Re = La, Nd, Sm, Gd, and Dy) detecting NO_2 [8, 9]. Vanadium doped tin dioxides exhibit a higher response towards SO_2 gas, because of their redox activity for SO_2 oxidation to SO_3 [10]. Catalytic additives, such as CuO [11], MoO_3 [12,13] and Fe_2O_3 [14] are known to lower sensor temperature and increase gas response. In spite of so many excellent results, experimental studies combining electrical with spectroscopic measurements to elucidate sensing mechanisms are still rather limited [15].

The mixed metal oxide materials are well known for their good stability, low cost and catalytic activity. Mixed metal oxides such as Co, Zn, and Ni, along with rare earths like La and Ce, are reported to be synthesized by sol-gel auto combustion method [16]. For these nanomaterials, the size of the particles becomes smaller as the ratio of total surface area to volume increases, which can affect many physical, chemical, mechanical, optical, and magnetic properties of these materials. Vanadates are particularly suitable hosts for luminescent applications. Among the rare earth vanadates, $NdVO_4$ belongs to zircon structure with space group $I4_1/amd$. It crystallizes in the tetragonal structure, composed of slightly distorted ${VO_4}^{3-}$ tetrahedral and rare earth ion Nd^{3+} between the neighboring tetrahedral. Each Nd^{3+} ion is surrounded by eight oxygen ions. $NdVO_4$ nanoparticles were prepared by wet chemical methods. Au et al. synthesized $NdVO_4$ particles using the citrate method, and their catalytic properties were studied by oxidative

dehydrogenation of propane. The effects of $Eu3^{+}$ doping on morphology and fluorescent properties of neodymium vanadate nanorod-arrays were studied [17,18]. Fan et al. synthesized single crystalline tetragonal nanorods of $NdVO_4$ through hydrothermal method and explained the growth mechanism [19]. The synthesis of $NdVO_4$ nanoparticles by a microwave method and the photocatalytic activity of $NdVO_4$ for degradation of methylene blue were studied [20]. The magnetic susceptibility of single crystal $NdVO_4$ was assessed at temperatures ranging from 10 mK to 300 K [21]. Magnetic properties of $NdVO_4$ particles through temperature dependence magnetic field [22]. $NdVO_4$ nanoparticles have many unique photoelectric properties which could be suggested to use extensively into the fields of X-ray imaging, biological labeling, solid state laser and displays. High ordered $NdVO_4$ nanotubes were fabricated using porous anodized aluminum oxide template (AAO) combined with sol-gel method [23].

Herein, we prepared $NdVO_4$ nanopowder by this simple solution combustion reaction. One of our aims is to develop a general synthesis method and explore the gas sensing properties of the $NdVO_4$ nanopowder obtained. We found that the process is a convenient, environment friendly, inexpensive and efficient for preparation of $NdVO_4$ nanomaterial with the grain size of about 15 – 35 nm. Furthermore, the $NdVO_4$ obtained possessed excellent gas-sensing responses to reducing gas. In the present paper we report the development of thick film $NdVO_4$ LPG sensors.

2. Experimental

2.1. Sample preparation and characterization

In this study polycrystalline $NdVO_4$ powder was prepared via the combustion route using urea as the fuel. The materials used as precursors were $Nd(NO_3)_3{\cdot}6H_2O$, $V(NO_3)_3{\cdot}6H_2O$ and urea (Nuclear band). Urea possesses a high heat of combustion. It is an organic fuel and provides a platform for redox reactions during the course of combustion. Initially the Neodymium Nitrate, Vanadium Nitrate and urea are combined in a 1:1:4 stoichiometric ratio and dissolved in a 250 ml beaker then slowly stirred using a glass rod, providing a clear solution. Solution formed was evaporated on hot plate in temperature range 70 to 80 °C gives thick gel. The gel was kept on a hot plate for auto combustion and heated in the temperature range 180 to 190 °C. The nanocrystalline $NdVO_4$ powder was formed within 40 – 50 minute. And then sintered at about 800 °C for about 4 hours then we obtain a yellow shining powder of nanocrystalline $NdVO_4$.

Neodymium Vanadate oxide powder was ground in an agate mortar and pestle to ensure sufficiently fine particle size. The fine powder was calcined at 800 °C for 24 h in air and re-ground. The thixotropic paste [24, 25] was formulated by mixing the resulting $NdVO_4$ fine powder with a solution of ethyl cellulose (a temporary binder) in a mixture of organic solvents such as butyl carbitol acetate, and turpineol. The ratio of inorganic and organic path was kept as 75:25 in formulating the paste. The paste was then used to prepare thick films. The thixotropic paste was screen printed on a glass substrate in desired patterns. The films prepared were fired at 500 °C for 24 h.

2.2. Characterization techniques

The synthesized $NdVO_4$ nanoparticles are characterized using Thermogravimetric Differential Thermal Analyzer (TG-DTA, PERKIN ELMER, USA, and Diamond TG/DTA). The crystallinity and crystal phase were characterized by X-ray diffraction (XRD, Bruker, D8 – advanced diffractometer) pattern measured with Cu-Kα Radiation ($\lambda = 1.5406$ Å) in the range of 20 – 60 °. The morphology and composition of the synthesized $NdVO_4$ nanoparticles were examined by scanning electron microscopy (SEM, JEOL, JSM-6360), SEM coupled energy dispersive X-ray spectroscopy (EDX, Bruker, XFlash 6130). The exact morphological structure and size of $NdVO_4$ nanoparticles were examined by Transmission Electron Microscopy (TEM) with Selected Area Electron Diffraction (SEAD) by using a Philips, CM 200 with an accelerating voltage of 200 kV. The Fourier Transform Infrared (FT-IR) spectrum was recorded by JASCO 4100 in the range of 4000 – 400 cm^{-1}. The optical properties were measured by UV-Visible Spectrophotometer (JASCO-Spectrophotometer, V-770) and DRS is obtained at the scanning range of 200 – 800 nm.

2.3. Fabrication and analysis of gas sensors

The sensing performance of the sensors was examined using a static gas-sensing system. There were electrical feeds through the base plate. The heating was constant on the base plate to heat the sample under test up to required operating temperatures. The current passing through the heating element was monitored using a relay with adjustable ON/OFF time intervals. A Cr–Al thermocouple was used to sense the operating temperature of the sensors. The output of the thermocouple was connected to digital temperature indicators. A gas inlet valve was fitted at one port of the base plate. The required gas concentration inside the static system was achieved by injecting a known volume of test gas using a gas-injecting syringe. A constant voltage was applied to the sensors, and current was measured by a digital Pico-ammeter. Air was allowed to pass into the glass dome after every gases exposure cycle in shown Fig. 1.

Synthesis of endophytic actinomycetal Cu oxide nanoparticles and their antagonistic activity against common gram positive and gram negative pathogens.

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Abstract

Two endophytic actinomycetes were used for the production of nanoparticles, these species were belongs with Streptomyces. These species were identified with 16SrRNA gene sequence. Two species were confirmed as Streptomyces noursei (A-1) and Streptomyces fradiae (A-2). The biomass extract of these species were used for the production of Cu oxide nanoparticles using the Cu SO_4 $5H_2O$. The prepared nanoparticles were tested for characterization with UV visible spectroscopy, FTIR Spectroscopy, X ray Diffraction and Transmission electron microscopy (TEM) The bio synthesis of Cu oxide nanoparticles showed surface plamon resonance (SPR) absorption band in the range 410 to 450 nm. These the bio synthesis of Cu oxide nanoparticles were spherical shaped and crystalline in nature. The size of bio synthesis of Cu oxide nanoparticles lies in between 50 to 100 nm. XRD analysis shown that both A-1 and A-2 biosynthesized actinomycetal CuO nanaoparticles were crystalline nature. FTIR spectra attributed that presence no. of different bonds and were major C-O and N-H bonds.

Bio synthesized Cu oxide nanoparticles were tested by evaluation and results were recorded. The results were positive for therapeutic application, It was effective against pathogenic microorganisms. Bio synthesized Cu oxide nanoparticles were showing antagonistic activity against pathogenic microorganisms as like human prokaryotic and eukaryotic microorganisms. In pathogenic bacteria bio synthesized Cu oxide nanoparticles were tested against gram positive and gram negative bacterial cells. Competitively out of both gram negative bacteria are more sensitive to bio synthesized Cu oxide nanoparticles than the gram positive. The bio synthesized Cu oxide nanoparticles were effective and showing their antagonism against human pathogenic fungi also as an example Candida rugosa

Key words: *Triticum vulgare,* ***Actinomycetes,*** *Cu SO_4 $5H_2O$ and Pathogens*

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Research Article

GREEN SYNTHESIS OF MAGNESIUM NANOPARTICLES FROM *ACTINOMYCETES* AND THEIR THERAPEUTIC APPLICATIONS

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ABSTRACT

Nanoparticles are becoming popular and taken the charge of novel research that will provide the significant role in resolving the problem easily. Different nanoparticles have been synthesized by number of various methods. Simultaneously microbial viz. actinomycetal nanoparticles were synthesized by using *Streptomyces* and magnesium nitrate hexa hydrate, $Mg(NO_3)_2 \cdot 6H_2O$ termed as Actinomycetal Mg NPS. These were microbially synthesized nanoparticles while antagonistic action of these nanoparticles was tested using pathogenic microorganisms present in water as one gram-negative and other gram positive microorganisms'. The results indicated that microbially synthesized actinomycetal Mg NPs were effective nanoparticles against water-borne pathogens. XRD patterns of prepared nanoparticles were characterized and XRD pattern revealed the formation of manganese nanoparticles. Mg nanoparticles were subjected to UV-Visible spectrum showed absorption peak which was lies in between 300 to 430 nm. TEM suggested that the particle size lies in the range of 100 to 125 nm.

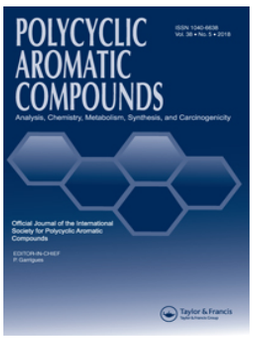
Keywords: *Actinomycetes*, Mg NPs, Pathogen, Antagonism.

1. INTRODUCTION

The nanoparticles are innovation and very applicable in most of the fields. These are way synthesized chemically and recently it has been viewed as a way to synthesize by using microorganisms, including bacteria and fungus. Nowadays actinomycetes are in current use for the biosynthesis of nanoparticles and actinomycetal nanaoparticles are showing the verity of application in each field of technology where the term used as biological application. The actinomycetal nanoparticles are ecofriendly, do not cause any type of pollution or side effects and easy to handle. It is not hazardous for human being because the main source is biological rather than the other ways like chemical. Actinomycetes are the group of microorganisms. Nanoparticles synthesized by microorganisms in which actinomycetes were used for the synthesis of nanoparticles have a great importance and these nanoparticles are important to showing highly toxic against bacterial cells.

Compared to the chemically prepared nanoparticle, the microbially synthesized nanoparticles are effective and showing valuable results. Among them, nanoparticles prepared using actinomycetes are becoming more important as a concern with their applications. Different types of microbial cells and various metals are used for the preparation of microbially synthesized nanoparticles. Metal oxides are generally and mostly used for such type of synthesis and easy to synthesize by any route. The particles that fall in the range of 0.1 to 100 nm have shown the range of ideal properties such as identical strength as its resistant to crushing, having discrete energy levels, active surfaces which have important catalytic efficiency. As far concern with the size and shape of the nanoparticles it is simplified in the term of morphology which is important for their function in each field of their application.

The properties of nanoparticles are important for their functions, for example, smaller particles are more effective than larger nanoparticles. As they became smaller, it increases the capacity of influence to do their action. The microbially synthesized silver nanoparticles using actinomycetes were found to be highly toxic to bacteria and it was found that smaller silver nanoparticles synthesized by microbial route had a greater antibacterial activity when compared to their chemical priorities. In some cases some bacterial cells might be silver resistant, these bacterial cells can resist the action of silver, even these bacterial cells were accumulated the silver



Polycyclic Aromatic Compounds

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Reusable $ZnCr_2O_4$ Nano Catalyzed One Pot Three-Component Cycloaddition Reaction for Synthesis of Azetidine Derivatives under Ultrasound Irradiation

Sachin Bangale, Valmik Jondhale, Dattatraya Pansare & Pravin Chavan

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Reusable $ZnCr_2O_4$ Nano Catalyzed One Pot Three-Component Cycloaddition Reaction for Synthesis of Azetidine Derivatives under Ultrasound Irradiation

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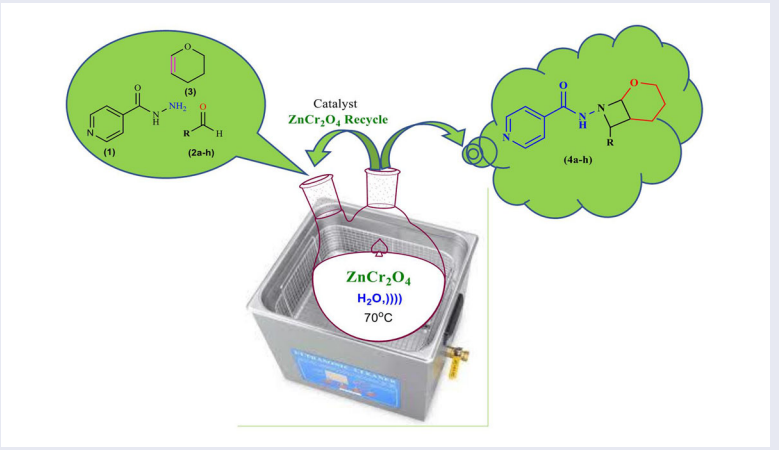
ABSTRACT

A versatile and effectual, three-component one pot ($2\pi + 2\pi$) cycloaddition reaction to the synthesis of substituted azetidines in the excellent yields is described. The reaction of isonicotinic acid hydrazide (**1**) as starting materials. Design and preparation of N-(7-R)-2-oxa-8-azabicyclo[4.2.0]octan-8-yl)isonicotinamide derivatives (**4a-h**) was carried out by condensation of isoniazid (**1**) with aromatic aldehyde (**2a-h**), $ZnCr_2O_4$ nano catalyzed one-pot cycloaddition of isoniazid Schiff base with pyran (**3**) under ultrasonic irradiation. Moreover, the Prepared $ZnCr_2O_4$ nanoparticles were easily recovered by corresponding solvent and reused for next synthesis of derivatives without significant loss of their catalytic activity. Prepared $ZnCr_2O_4$ nanoparticles were confirmed by XRD, EDX, TEM, HRTEM, TGA-DTA and all substituted azetidines were characterized by ^{1}H NMR, ^{13}C NMR, FT-IR, mass and elemental analysis.



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Catalysis

Reusable Nano Catalysed Synthesis of Heterocycles: An Overview

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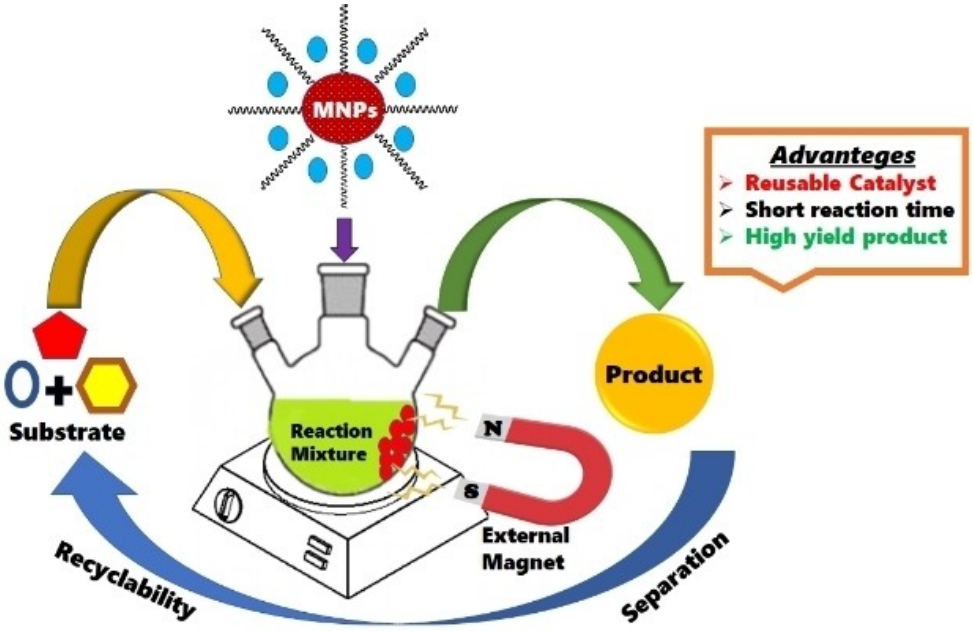

The field of reusable nano-catalysts has grown rapidly over the last decade. Recently, transition metal catalysed organic reactions have attracted considerable interest from the pharmaceutical and organic chemistry fields. Synthetic procedures based on such heterogeneous nanocatalysts are easier, less expensive, non-toxic, and eco-friendly, producing only the most desirable products in higher yields and allowing for easy catalyst separation. Heterogeneous nano-catalysts were highly preferred over homogeneous catalysts for the synthesis of heterocyclic compounds due to their effective separation processes for both products and catalysts. According to recent studies, nanoparticles (NPs) are commonly used as a heterogeneous catalyst in the production of heterocyclic compounds. Heterogeneous catalysts are widely used in a variety of organic reactions due to their high surface-to-volume ratio. Most importantly, after the reaction is complete, easy magnetic separation of the catalyst minimises the requirement for catalyst filtration. Additionally, magnetic NPs, particularly supported magnetic nanocatalysts, have garnered considerable interest in both academic and industrial research due to their effectiveness as alternatives to traditional materials, their ease of separation via an external magnet, and their high degree of chemical stability in a variety of organic and inorganic solvents. To reach its depth, this review is focused on the most recent examples, their preparation, synthetic strategies and recycling studies of highly excited catalytic systems used for the synthesis of heterocyclic compounds.

1. Introduction

Over The new era of chemistry is moving towards inventive techniques that are primarily concerned with environmental issues. Without influencing the reaction yield or quality, each component of the reaction is examined by using eco-friendly concept such as the use of a non-hazardous solvent (water) or solvent-free synthesis, as well as a low-cost catalyst. Due to the broad range of pharmacological properties, the synthesis of heterocyclic cores is notable segment of organic synthesis. Various synthesis methods have been used, including catalysts, ultrasound irradiation, and microwave irradiation. Using these methods has some disadvantages, such as expensive instruments, non-recyclability and non-selectivity etc. To tackle these issues, reusable heterogeneous nanocatalysts are being deployed. Quite recently, the critical role of Prussian blue (PB) (Fe^{3+} 4 $[Fe^{2+}(CN)_6]_3$) and its PB analogous (PBA) ($A_2T[M(CN)_6]$, A = Li, K, Na; T = Fe, Co, Ni, Mn, Cu, etc.; M = Fe, Mn, Co, etc.) were reviewed by Nayebi et al.[1] However, significant works have concluded that adding a third metal to bimetallic catalysts improves catalytic performance tremendously. In yet another recent review, the metallic NPs accumulating in the environment may have a detrimental effect on the ecology were discussed.[2] So, recycling and reusing metal NPs can help to reduce their accumulation and thus mitigate their adverse consequences. By increasing recycling rates, individual companies, industries can move towards a circular economy and thereby reduce their reliance on element production whilst also generating little, or ideally no, waste (Figure 1).

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Heterogeneous nanocatalysts are very important in many aspects: (a) Green chemistry: The reaction proceeds without the use of any non-hazardous solvent in the presence of reusable catalyst; (b) Simple separation: The catalyst can be easily separated using magnetic forces and recycled multiple times without losing significant catalytic activity were reviewed.[3] Heterocycles play a significant role in many biochemical processes, so they are often found as substructures in several pharmaceutical products. Many researchers are interested in the bioactive heterocyclic compounds and methods for synthesising them because of their high pharmacological activity. The use of heterogeneous catalysts to improve the efficiency of a wide range of organic synthesis is one of the most fascinating methods of synthesis for researchers. These heterogeneous systems have a faster reaction time and significantly larger acceleration than homogeneous catalysis, a higher turn-over number, greater resistance to deterioration, relatively easy separation of products from catalysts, quick and easy purification protocols, relatively low synthesis costs, and the ability to scale up, which is a promising factor for industrial applications. According to Mohammadreza Shokouhimehr, magnetic catalysts have the advantages of easy recovery and reuse after the end of the reactions, as well as eco-friendly chemical

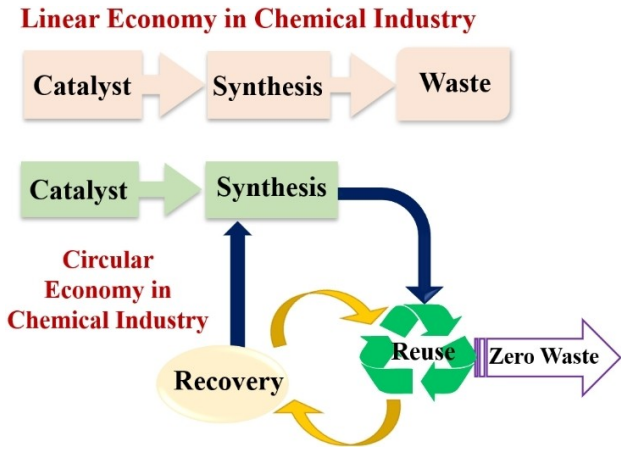

Figure 1. Illustration to highlight a reusable metallic nano catalyst flow cycle.

processes.[4] Magnetic NPs have garnered significant attention in recent years due to their intriguing biological uses, including drug delivery, magnetic resonance imaging, bio separation, biomolecular sensors, and magneto-thermal therapy. Furthermore, Behnam Nayebi et al. reported on a recyclable and effective heterogeneous catalyst including boron nitride and Pd NPs in water, which was used to reduce nitrobenzene derivatives under mild reaction conditions.[5] Kaiqiang Zhang et al. also reported a simple and green approach for producing a reproducible heterogeneous catalyst comprising graphene oxide (GO)-supported Pd NPs. In aqueous sodium borohydride, the GO-supported Pd NPs (Pd/GO nanocatalyst) showed good catalytic activity for the reduction of nitroaromatics to amino aromatics.[6] In 2005, Yoon-Sik Lee and coworkers reported that when the Heck reaction of aryliodides with n-butylacrylate was catalysed by a polymer-supported N-heterocyclic carbene-palladium complex, moderate to good yields were obtained.[7] Rai et al. reviewed the catalytic performance of various carbon-based materials, including carbon nanotubes, graphitic carbon nitride, and N-doped graphene, which have all been widely used to synthesise various heterocycles.[8] This manuscript extensively discusses the catalysis of NPs using magnetite, functionalized magnetite NPs, transition metal oxide NPs, alkaline earth metal oxide NPs, and other miscellaneous systems utilised in the synthesis of heterocycles. In this work, we will look at some recent instances of NPs that have been used in organic transformation, such as quinoxaline, pyrazole, tetrazole, triazole, isoquinolinones, quinoline, acridine, and pyridine. (Figure 2).

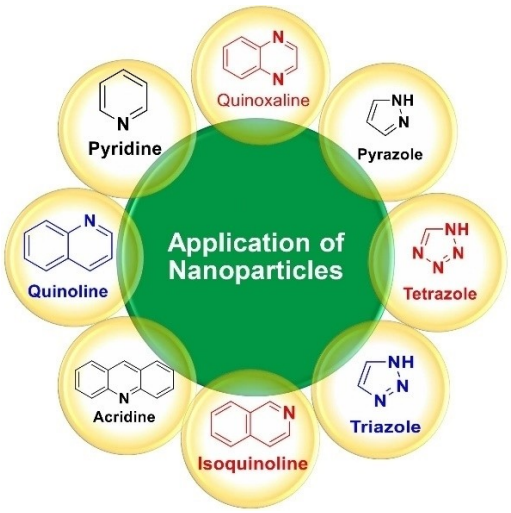

Figure 2. Application of NPs in organic synthesis

2. Synthesis of Heterocyclic Compounds

For a long period of time, molecules containing nitrogen, sulphur, and oxygen occupied a prominent position in the area of medicinal chemistry. Heterocyclic compounds with a nitrogen ring are commonly employed in medicine and agriculture and require effective synthesis routes.

Five and six-membered heterocyclic molecules containing nitrogen, sulphur, and oxygen have played a significant role in medical chemistry for decades. Due to their high pharmaco-

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A THEORETICAL AND EXPERIMENTAL STUDY OF TEMPERATURE DEPENDENT THERMAL CONDUCTIVITY ENHANCEMENT OF FUNCTIONALIZED NANOFLUIDS

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Abstract:
A theoretical study of effective thermal conductivity (ETC) of Nanofluids (NFs) is carried out. The Carbon Nanotube (CNT) based Nanofluid (NF) has been synthesized by two-step synthesis method. ZnO/Silver based NFs were synthesized by single step wet chemical method. Hot wire transient method was used to measure the thermal conductivity of NFs. The various models of ETC in the current literature were discussed and are applied to our experimental data. New model have been compared to experimental data, which explains the anomalous behaviour in the thermal conductivity of NFs.
Keywords: Effective medium theory, Brownian motion, Carbon nanotubes, Nanofluids, Thermal Conductivity.

Introduction:
Recent work suggests that NFs, dispersions of nanometer-sized particles, CNTs in fluid, have the ability to increase the amount of thermal transport beyond what most conventional coolants can see today [1-3]. Since carbon nanotubes exhibit the highest thermal conductivity of any material known to man, the addition of them to conventional heat transfer fluids should, in turn, increase the fluid's thermal conductivity and effusivity [3-6]. Results indicate that through the uses of ionic surfactants, chemical functionalization, and the use of ultrasonication stable dispersions, on the order of months, can be obtained in water and ethylene glycol with loadings of carbon nanotubes as low as 0.001 wt%. [7]. Tests on the thermal conductivity and effusivity of the prepared samples reveal increases of nearly 85-90% [8]. Further tests on the viscosity and electrical conductivity of the added nanoparticles/CNTs reveals that charge interactions implemented by surfactants play an important role in the stability and subsequent increase in transport properties of the fluids [9]. The large thermal conductivity enhancements reported by experiment led to excitement but also to controversy [10]. The origin of the excitement was that the measured thermal conductivity was often much larger than that predicted by well- established effective medium theories under the assumption of well-dispersed particles. [11].
Most of the NFs fall naturally in to the two classes: those NFs in which one component is a metal/metal oxide NPs and surfactant and those in which the former is replaced with CNTs. Many NFs in both classes have been studied, but, because of the macroscopic scale for colloids and composites description now changed to nanoscale with different physics, the Effective Medium Theory (EMT) of Maxwell and Brugemann is not appropriate to predict their transport properties [12]. Instead, the differential EMT developed by Gao and his coworkers for rod like inclusions and modified by us for CNT NFs, has been applied in conjunction with Brownian motion theory developed by Choi et al [1, 13]. Unfortunately, in spite of its wide application to NFs, the validity of this approach is still open to some questions [13]. In this formulation, for example, a CNT approximated as rod for calculation of ETC. Temperature dependence was explained in dynamic Brownian motion part but not in EMT part and two phase system is assumed in spite of NFs which are now mostly hybrid ones. The model discussed in this study consist of the Static mode and Brownian motion induced nanoconvection mode with the inclusion of effective dispersion term for volume fraction.

Experimental
Dispersing CNTs/Nanoparticles
The solvable properties of nanoparticles/CNTs in water show a behaviour, which is intermediate between that of homogeneous solution (complete dispersion) and that of incomplete dispersion [14]. Consider for instance the case of CNTs in water without surfactant; its sedimentation properties will be different from those dispersions, which contain various moieties, which make them partially water-soluble. To break the CNTs bundle in water it requires high power of ultrasonication as compared to time of ultrasonication. Increase in the power of ultrasonication increase the defragmentation of CNTs [15]. A CNT is chemically extremely stable because the valence of all its carbon atoms are saturated, which makes difficulties in electrostatic charge generation on them through various surfactants.
Synthesis of NFs
The existing methods of NF synthesis are divided into the single-step and two-step processes. In the single step, NF can be produced during one process cycle. The advantage is reflected by the fact that produced nanoparticles are usually small (2-30 nm), agglomeration is minimized, and the produced NFs are the stable ones. Silver NF was obtained by reduction of silver nitrate with PVP in ethanol under the effect of microwave radiation [16]. In the two-step methods, the nanoparticles are firstly produced and then incorporated into base the fluid. In comparison with the single step methods, the two-step method is preferable for the particles of oxides because of their lower tendency to agglomeration. Zinc oxide NFs are synthesized by this route with acetylacetone as a dispersant [17]. CNT based NFs are synthesized with the help of ultrasonication of CNTs in water containing various surfactants [18]. Figure 1 shows the SEM micrographs of nanoparticles/CNTs used in this study. Silver nanoparticles are trapped in PVP matrix

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SECOND WAVE OF COVID-19 PANDEMIC IN MAHARASHTRA: NEED OF A COMPREHENSIVE RESUMPTION AND IMPLEMENTATION OF T3 PROTOCOLS

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Abstract
The Covid-19 timeline data of the Maharashtra state is used to analyse current pandemic situation. The datasets are obtained from the website of Indian Statistical Institute, Bangalore Centre and analysed with python graphics libraries. Covid-19 data for the Raigad district was obtained from the webpage of district collector office. Strongly correlated variables like total deaths, total cases, population, GDP (Gross Domestic Product) etc. has been studied.

Keywords: COVID-19, GDP per capita, total deaths, age, states.

Introduction
The traditional test, treat and track protocol (T3 protocol) although effective at first place in India is no longer implemented at its full capacity in second wave of Covid-19 [1-2]. The mentioned T3 protocol has been deployed effectively last year in most of the districts of Maharashtra [3]. The efforts put in increasing testing, setting up quarantine facilities, COVID-19 treatment facilities, contact tracing through Aarogya Setu application are fell short when it came to suppressing the pandemic [4-5]. Asha workers will play an effective role in the contact tracing and making awareness about this pandemic in villages [6]. The health infrastructure is not equivalent between rural and urban India. 65 percent of our population resides in rural area but same percentage of beds available for the patients which are located in urban area [7]. Many people done research on this subject in various ways such as biological, economical etc. [8]. In recent times, there in huge increment in variants of mutated versions of Covid-19 corona virus, which are, more and more deadly than the very first version found in china [9-11]. Covid-19 patients are also suffering through various diseases/issues that came along with Covid-19. Such as skin problems, psychological issues [12], as well as one of the most important is economic issues [8]. Many people lost their jobs. Many countries lost lot of their capital and GDP's of many countries gone down [13]. In this study, we used Covid-19 data for the state of Maharashtra to predict the various possibilities responsible for the rising number of active cases in second wave.

Materials and Methods
The data for the Covid-19 analysis for Maharashtra has been downloaded from the webpage of Indian Statistical Institute, Bangalore centre. The data was released by Ministry of Health and Family Welfare for States and Union territories. The data comprises updated file in csv file format with 70 district profiles of Covid-19 [14]. Every profile includes two sections:

1. Cases: new cases are being confirmed each day and number of cases have been confirmed since the pandemic started.
2. Deaths: number of deaths from COVID-19

This data file is analysed with python *libraries* including NumPy, Pandas, Matplotlib, *Seaborn,* and Plotly. The data is analysed from 12 April 2021 to 12 July 2021. The data for the Raigad district was collected from the webpage of the district collector office [15].

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On a new species of the Genus Spinicauda, Travassos (1920) (Nematoda: Heterakidae) in *Duttaphrynus melanostictus* (Anura: Bufonidae) from Industrial area of Aurangabad (Maharashtra) India

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ABSTRACT

Spinicauda anurae sp. nov. from the intestine of *Duttaphrynus melanostictus* [21] collected from industrial area of Aurangabad (M.S.) India. The specimens under investigation show the resemblance in their various body characters with *S. cophotis* Baylis, [7]. Morphologically the most closely related species is *S. voltaensis* [2] in *Bufo sp*. from Burkina Faso, but it differs in smooth cuticle and is less sclerotized.

Keywords : Spinicauda, intestine, *Duttaphrynus melanostictus,* investigation, Aurangabad.

I. INTRODUCTION

Nematode parasites of different species of amphibians of Maharashtra were studied in past years by many workers. One new species of the genus *Subcularis* from *Rana tigrina* have reported by P.G. Deshmukh and A.C. Choudhari [12]. Spinicauda was created by Travassos [16] during revision of Heterakidae, in which *Spinicaudinae* was established to contain the previously described *Strongyluris*, *Africana* and *Spinicauda*.

The species of the genus *Spinicauda* belongs to the family Heterakidae [19] and are parasites of reptiles and amphibians from tropical and subtropical regions: South America (Brazil), Africa (Madagascar, Egypt, Algeria, and Burkina Fasto), Australia, New Guinea, Taiwan, Indonesia and India. *Spinicauda anurae sp. nov.* is morphologically the most closely related species is *S. voltaensis* [2] in *Bufo sp*. from Burkina Faso, but it differs in smooth cuticle and is less sclerotized.

Present investigation reported as a first nematode species from Maharashtra. It was previously reported from Kolkata (W.B.) in amphibian host. Although record of this genus either from reptiles or from amphibian in India. Hence *Bufo melanostictus* and *Rana tigrina* forms the new host record from Study area.

II. METHODS AND MATERIAL

Toad *Duttaphrynus melanostictus* [21] were collected in different seasons throughout the year from industrial areas namely Waluj, Chikalthana, Shendra and Ranjangaon of Aurangabad. One annual cycle 2018-19 were considered for the collection of nematodes.