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Sl No.	Name of the MoU / linkage	Name of the institution / industry with whom the MoU / linkage is made, with contact details	Year of signing MoU / linkage	Purpose of the MoU/Linkage (nternship, on-the-jobtraining, project work,student / faculty exchange and collaborative research)	Duration of MoU / linkage
1	Linkage for Joint Ph.DSupervisor	Ramkrishna Mission Vidyamandir	2021	Supervision a Ph.D.students by Dr. **Supratim Mukherjee,** Assistant Professor ofMathematics	Continuing
2	Collaborative ResearchActivity	ALIAH UNIVERSITY	2022	Research activity by**DR. Md ABUL KASIM MOLLA,** Assistant Professor of Mathematics	Continuing
3	Collaborative ResearchActivity	IIT KHRAGPUR	2022	Research activity by **DR. AJOY MANDAL,** AssistantProfessor of Physics	Continuing
4	Collaborative ResearchActivity	NIT DURGAPUR	2022	Research activity by **DR. SANJOY SATPATI,** Assistant Professor of Chemistry	Continuing
5	Collaborative ResearchActivity	JADAVPUR UNIVERSITY	2022	Research activity by **DR. SUMIT KUMAR DAS,** Assistant Professor of Physics	Continuing
6	Collaborative ResearchActivity	IIT KHRAGPUR	2023	Research activity by **DR. AJOY MANDAL & DR. SANJOY SATPATI** Assistant Professor of Physics & Chemistry	Continuing
7	Updation/Modification of People's Biodiversity Register (PBR)	West BengalBiodiversity Board	2023	Project work by OurCollege Student	15 days

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Ref.No. SVRC/MATH/GUIDE/Ph.D./2021/09 11th January, 2022

Dr. Supratim Mukherjee
Assistant Professor
Department of Mathematics
Government General Degree College
Tehatta

Respected Sir,

I am glad to inform you that you are hereby appointed Ph.D. Joint supervisor of the following research scholar.

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   1. 1st six monthly progress report submission date: 14th June, 2022.
   2. 2nd six monthly progress report submission date: 14th December, 2022.
   3. 3rd six monthly progress report submission date: 14th June, 2023.
   4. 4th six monthly progress report submission date: 14th December, 2023.
   5. 5th six monthly progress report submission date: 14th June, 2024.
   6. 6th six monthly progress report submission date: 14th December, 2024.
   7. 7th six monthly progress report submission date: 14th June, 2025.

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8. 8th six monthly progress report submission date: 14th December, 2025.
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7. Please ensure that he has at least two meetings (*to be held in virtual mode during the pandemic period*) with you every month. Please keep the date, time, and name of the concerned research scholar and the supervisor in the form which you are requested to collect from Swami Vivekananda Research Centre office. *During the pandemic, however, a soft copy of this form will be sent to you.*
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1. **Name of the Research Scholar: RATAN JANA**
2. **Registration Number: A04/PH.D./MATH/12/2021/5009**
3. **Date of Registration: 14th December, 2021**
4. **Whether a Recipient of any Fellowship or not : No (till date)**

Yours sincerely

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WAVES IN RANDOM AND COMPLEX MEDIA
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A two-temperature generalized piezo-thermoelastic problem with Eringen's non-local effect and memory-dependent derivatives under three-phase-lag heat transfer

Nasiruddin Mondal, Md Abul Kashim Molla and Sadek Hossain Mallik

Department of Mathematics & Statistics, Aliah University, Kolkata, India

ABSTRACT

This article deals with piezo-thermoelastic interactions in a homogeneous, isotropic generalized thermoelastic semi-infinite medium whose boundary is assumed to be traction free and subjected to a thermal loading. This study has been carried out in the context of two-temperature three-phase-lag generalized theory of thermoelasticity considering Eringen's non-local theory and memory-dependent derivatives. The governing equations of the problem are solved in Laplace transform domain by applying state space approach. The inversion of Laplace transform of the solutions has been done numerically. Numerical solutions obtained for different thermophysical quantities are represented in graphs to study the effects of different relevant parameters.

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KEYWORDS
Two-temperature generalized piezo-thermoelasticity; Eringen's non-local elasticity; three-phase-lag model; memory-dependent derivative; state space approach; vector–matrix differential equation

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74F05

1. Introduction

Generalized thermoelasticity, a new milestone in the theories of thermoelasticity, prevails over the vital imperfections of classical theories of thermoelasticity. Lord and Shulman [1] are the two pioneers who contributed first heavily to the coupled thermoelasticity by introducing generalized theory of thermoelasticity through alteration of the parabolic nature of the heat conduction equation to hyperbolic nature. They did this revolutionary change in the nature of the heat conduction equation by incorporating a relaxation time parameter in the Fourier's law of heat conduction and in doing so, the unrealistic phenomenon of infinite speed of thermal wave propagation was replaced by practical observation of finite speed of propagation of thermal waves. Later on a bunch of generalized thermoelastic theories viz., Green–Lindsay (G-L) theory [2], Green–Naghdi (G-N) theories [3–5], dual-phase-lag theory [6] and three-phase-lag theory [7] were introduced. To know in detail, one can go through the works of Ignaczak [8] and Chandrasekharaiah [9,10]. It is to mention that generalized thermoelastic theories are more acceptable in compared to the classical thermoelastic theories to tackle real-life oriented problems with high heat fluxes and very short interval of time, which generally occur in nuclear reactors, energy channels , LASER beams, etc.

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Research Article

Generalized Thermoelastic Interactions Using an Eigenvalue Technique in a Transversely Isotropic Unbounded Medium with Memory Having a Line Heat Source

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Stehfest method.

ABSTRACT

The present article looks over thermoelastic interactions in a homogeneous, linear, transversely isotropic unbounded continuum with the aid of memory-dependent derivatives in the presence of a line heat source. The exploration has been unifiedly carried out in the context of Green-Lindsay and Lord-Shulman models. A cylindrical polar coordinates system has been used to describe the problem and the eigenvalue technique has been adopted to solve the governing field equations in the transformed domain of Laplace. The solution for different thermophysical quantities is obtained in the real space-time domain using the Stehfest method for numerical Laplace inversion. The obtained numerical data for different thermophysical quantities are plotted in graphs to investigate the impacts of the time delay parameter, and the different kernel functions, and a comparison between the considered models has been accomplished. It is worth mentioning that the results of an analogous problem for isotropic material can be easily deduced from the corresponding results of this article. The adoption of generalized thermoelastic theory with memory-dependent derivative along with eigenvalue technique in analyzing the thermoelastic interactions is relatively fresh.

1. Introduction

The heat conduction equation of the classical theory of thermoelasticity does not accommodate any elastic term and it is parabolic in nature. It denies the practical observation of heat generation due to elastic changes and it also recommends boundless speed of the thermal wave propagation. The generalized theory of thermoelasticity prevails over these major imperfections of the classical theory of thermoelasticity. Towards the formulation of generalized theory of thermoelasticity, many pioneers have their valuable contributions of which we mention here some of them [1-9]. Ezzat [10] has solved a thermoelastic problem with two relaxation times in cylindrical regions. Youssef [11] has studied a thermoelastic problem in an infinite medium with a cylindrical cavity containing a moving heat source. Lotfy et al. [12, 13] have solved generalized thermoelastic problems for functionally graded and piezo-photo-thermoelastic materials respectively. Lotfy and Hassan [14] have investigated the propagation of thermoelastic waves within the purview of the Lord-Shulman two-temperature

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Diffusion-Induced Thickness Thinning of Spin-Coated Films in Crystalline Grain Boundaries: A Process of Amorphization

*Ajoy Mandal, Suman Mandal, Shiv Prakash Verma, Samik Mallik, Subhendu Sekhar Bag, and Dipak K. Goswami**

Complex molecular-level interactions of receptor molecules with semiconducting channels are often engineered to achieve higher sensitivity. However, integrating receptors in the sensor's semiconducting channel introduces deformation in crystallinity leading to poor device performance. In this work, the authors have shown how the growth of a peptide-based receptor molecule in the grain boundaries of pentacene semiconducting films can be controlled to maintain crystallinity with better integration. Pentacene has a bulk and a thin-film crystallographic phases with ≈5.8% higher lattice constant. As the receptor molecules diffuse into the grain boundaries, they systematically start impairing the thin-film crystalline phase to bulk depending on the amount of mass transport, ushering to a complete amorphization at higher doses of diffusion. A statistical analysis of rough surfaces has been conducted to study the evolution of thin-film morphology, which is connected to the diffusion of the spin-coated film. Besides, a thickness thinning of the spin-coated film is observed due to diffusion-related mass transport into grain boundaries, which has been explained with a new thickness thinning rate equation. The damage in the crystalline quality is confirmed qualitatively with residual compressive strain developed due to the diffusion of molecules into grain boundaries.

1. Introduction

Organic semiconductors (OSCs) molecules are primarily used as an active channel for fabricating organic field-effect transistors (OFETs). However, OFETs are often used to fabricate various sensors after integrating receptor molecules into conducting channels predominantly by selective surface-funcionalization techniques. Such methods are limited mostly to nanowire or 2D material-based conducting channels, leading to sensor fabrication complexity for scaling up. However, grain boundaries of semiconducting channel can be used for receptor integration to get easy access to the conducting channel using thin-film growth technique. In such cases, the performance of the OFET-based sensors depends on the growth, structure, and crystalline quality of the organic semiconducting films, as the interaction of receptor molecules with semiconductors can significantly affect charge conduction.[1,2] Besides, the crystalline quality of the conducting channel is often modified due to the diffusion of receptor molecules into grain boundaries, rendering compressive strain into films, and impairing molecular structures. Achieving a balance between better receptor integration at the cost of structural damage is paramount. In this regard, a proper understanding of the growth of receptor molecules into the semiconducting channel is very crucial in developing better OFET-based sensors. Over the last few decades, several theoretical models have been developed to correlate thin-film growth with different scaling exponents.[3–5] These scaling exponents determine surface roughness, correlation length, roughness exponent, etc. In most cases, these

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Research Article

MOF-Assimilated High-Sensitive Organic Field-Effect Transistors for Rapid Detection of a Chemical Warfare Agent

Samik Mallik, Shyam Chand Pal, Snehanjan Acharyya, Shiv Prakash Verma, Ajoy Mandal, Prasanta Kumar Guha, Madhab C. Das, and Dipak Kumar Goswami*

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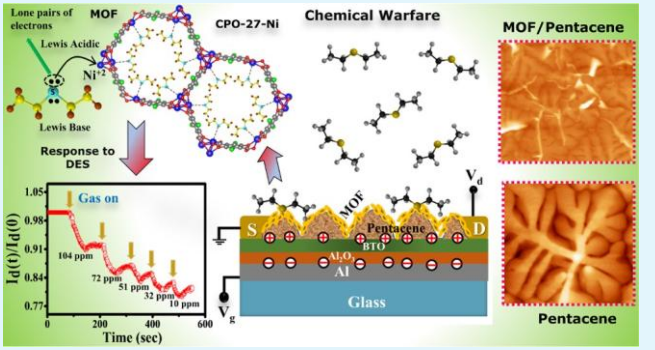
ABSTRACT: The selective and rapid detection of trace amounts of highly toxic chemical warfare agents has become imperative for efficiently using military and civilian defense. Metal−organic frameworks (MOFs) are a class of inorganic-organic hybrid porous material that could be potential next-generation toxic gas sensors. However, the growth of a MOF thin film for efficiently utilizing the material properties for fabricating electronic devices has been challenging. Herein, we report a new approach to efficiently integrate MOF as a receptor through diffusion-induced ingress into the grain boundaries of the pentacene semiconducting film in the place of the most adaptive chemical functionalization method for sensor fabrication. We used bilayer conducting channel-based organic field-effect transistors (OFETs) as a sensing platform comprising CPO-27-Ni as the sensing layer, coated on the pentacene layer, showed a strong response toward sensing of diethyl sulfide, which is one of the stimulants of bis (2-chloroethyl) sulfide, a highly toxic sulfur mustard (HD). Using OFET as a sensing platform, these sensors can be a potential candidate for trace amounts of sulfur mustard detection below 10 ppm in real time as wearable devices for onsite uses.



KEYWORDS: *organic field-effect transistors (OFETs), metal−organic frameworks (MOFs), chemical warfare agents (CWAs), recrystallization, sulfur mustard stimulants detection, Lewis acid−base interaction*

INTRODUCTION

Over the last few decades, industrial revolutions around the world have initiated a new threat to the environment by generating toxic gases. This leads to the urgency for the development of different types of gas sensors for careful and accurate monitoring.[1,2] During World War I (WWI), the chemical warfare agents (CWAs) used were highly toxic, and the exposure of a trace amount was enough to cause casualties of millions of people.[3,4] Therefore, quick detection of CWAs are crucial to deaden the persistent threat of terrorist activities to humankind. However, the issues like stability, sensitivity, and poor detection limit are hindering the realization of the sensors in real-time use. These limitations demanded some emerging materials, which lead to the discovery of crystalline hybrid materials with some structural diversity. Metal−organic frameworks (MOFs) have grown immensely over the last 20 years and are considered excellent sensing materials due to their high sensitivity in sensing various analytes, ultrahigh porosity, and large effective surface area.[5,6] During the past few years, researchers have used MOFs in the areas of catalysis,[7,8] gas storage,[9] gas separation,[10] supercapacitor,[11] gas sensors,[12−14] and optoelectronic-based sensors.[15] Besides these applications, MOFs also found applications in microelectronics industries for device fabrication as active channel materials or low-κ dielectric materials.[16,17] However, this ongoing interest in the fabrication of high-quality, homogeneous, and crystalline MOF thin film is still a challenge as there is no suitable solvent available to dissolve MOF materials properly.[18] Thus, a few methods have been used to fabricate MOF thin films such as layer-by-layer,[19] Langmuir−Blodgett (LB),[20] direct syntheses from mother solution,[21,22] seeded growth,[23] electrochemical methods,[24] spray coating,[25] and spin coating method.[26] However, the growing of uniform film under a device geometry is a challenge to exploit the material's unique properties. In this work, we have developed a new methodology to integrate MOF using a simple spin coating technique through diffusion-induced ingress into the grain boundaries of the underlying semiconducting layer and formed a well-ordered bilayer organic conducting channel for the fabrication of organic

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Experimental and theoretical investigation on the anti-corrosion characteristics of pyridine-substituted benzothiazole derivatives for mild steel in aqueous HCl†

Aditya Suhasaria,[a] Rakhi Senapati,[a] Sanjoy Satpati,[b] Subhas Ghosal,[a] Sukalpa Dey[c] and Dipankar Sukul *[a]

Three new 2-(2-pyridyl)benzothiazole derivatives, namely 2-(benzothiazol-2-yl)pyridin-3-amine (APYBT), 2-(benzothiazol-2-yl)pyridin-5-ol (HPYBT) and 2-(pyridin-2-yl)benzothiazole (PYBT), have been synthesized. Those are tested for their potentiality to impart corrosion resistance to mild steel exposed to 1 M aqueous HCl. Both electrochemical and gravimetric experiments establish the studied benzothiazole (BT) derivatives as promising corrosion inhibitors, with APYBT standing out as the most effective one exerting more than 97% inhibition efficiency at 1 mM concentration. PYBT exerts the least inhibitory performance. The electron donating property of the amine group present on the pyridine moiety in APYBT could be responsible for the superiority of APYBT as a corrosion inhibitor among the three. A potentiodynamic polarization study revealed that the inhibitors could retard both the cathodic and anodic reactions. The adsorption of the inhibitors on metal surfaces follows the Langmuir adsorption isotherm. SEM images provide visual confirmation of the protection of mild steel surfaces from corrosion in the presence of the studied benzothiazole (BT) derivatives. The interaction pattern between the mild steel and the inhibitors is explored using results derived from density functional theory (DFT) calculations. Variation of the interaction energy as obtained from molecular dynamics (MD) simulation confirms the corrosion inhibitory trend. Fukui index calculation enables the role played by the substituent group towards the relative electron donation/acceptance properties of the atoms present at the different parts of the inhibitor molecule.

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Introduction

Corrosion leads to the deterioration of a material, resulting from its chemical reaction with the environment. Metals thus adopt a more stable form, such as oxide, hydroxide, or sulphide. Corrosion leads to the degradation of various desirable properties of materials and shortens their shelf-life. However, as corrosion is thermodynamically spontaneous, only preventive measures can be employed. In addition to various other methods, like cathodic protection, the application of a corrosion inhibitor is another cost-effective and practical method. Suitable organic inhibitors by virtue of the presence of p-bonds and lone electron pairs on the heteroatoms, like N, O and S, are adsorbed on the metal surface and block the cathodic or anodic reaction sites, or both.[1–9] However, due to their environmentally harmful effects, heavy metal-based inorganic corrosion inhibitors are now under a process of gradual replacement with relatively environmentally benign organic inhibitors. A recent report showed that a mixture of rare earth metal ions, like Ce^{3+}, in conjugation with amino acids, like cysteine, provides remarkable resistivity to corrosion of Al alloys in a saline environment.[10] In recent years, there has been a tremendous surge in research employing various categories of organic corrosion inhibitors. This includes different heterocyclic bases, like thiazoles, benzothiazoles, benzotriazoles, imidazoles, benzimidazoles, benzoxazoles and many others.[11–16] The examination of corrosion protection for mild steel in acidic environments is of primary interest among the researchers in this field. Steel is the most important structural and engineering material. High compressive and tensile strength, ductility and weldability, malleability, and above all relatively low cost

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† Electronic supplementary information (ESI) available: NMR, FTIR, mass spectra, EIS spectra, adsorption isotherms, Arrhenius plots, and Fukui indices. See DOI: https://doi.org/10.1039/d3cp01392h

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Interaction of newly synthesized dipeptide Schiff bases with mild steel surface in aqueous HCl: Experimental and theoretical study on thermodynamics, adsorption and anti-corrosion characteristics

Sanjoy Satpati [a b], Aditya Suhasaria [a], Subhas Ghosal [a], Sukalpa Dey [c], Dipankar Sukul [a]

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Highlights

- Dipeptide Schiff bases act as cathodic inhibitors for mild steel in aqueous HCl.
- The aromatic ring in the dipeptide backbone provides best inhibitory effect.
- DFT study interconnects electronic properties with inhibitory performance.
- Planar orientation of Schiff bases on metal surface is predicted by MD simulation and DFTB+calculation.
- Inhibitor to metal change transfer is proposed comparing PDOS curves for bonded and non-bonded inhibitor.

Abstract

Adsorption behavior and anti-corrosion propensity of three newly synthesized dipeptide Schiff bases are investigated using mild steel submerged in aqueous 1 M HCl. Electrochemical techniques (potentiodynamic polarization and electrochemical impedance spectroscopy) as well as gravimetric method are employed to ascertain the effect of concentration, temperature and immersion time on corrosion inhibition performance of the inhibitors. It is revealed that the Schiff base condensed between glycyl-L-tyrosine and indole-3-carboxaldehyde (GTI) imparts better inhibitory effect (greater than 98% inhibition efficiency) than those condensed between the same aldehyde and glycyl glycine

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Effect of the Heterocyclic Groups on the Anti-corrosion Performance of Heterocyclic Schiff Bases of Benzothiazole for Mild Steel in 1 M Aqueous HCl

Aditya Suhasaria[1] · Sanjoy Satpati[1,2] · Subhas Ghosal[1] · Sukalpa Dey[3] · Dipankar Sukul[1]

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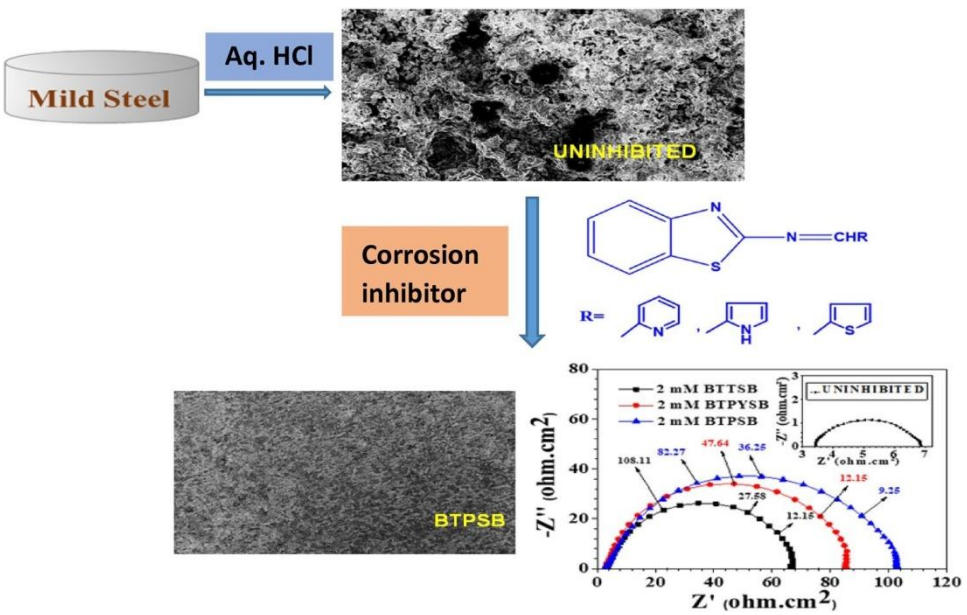
Abstract

Three different heterocyclic Schiff bases of benzothiazole were prepared through condensation of 2-amino benzothiazole with pyrrole-2-carboxaldehyde, pyridine-2-carboxaldehyde, and thiophene-2-carboxaldehyde, separately (abbreviated as BTPSB, BTPYSB and BTTSB, receptively). Their anti-corrosive propensity towards mild steel in 1 M aqueous HCl were tested using both electrochemical and gravimetric estimations. Effects of temperature and immersion time were also evaluated. BTPSB is found to be superior inhibitor among the three resulting in more than 97% of inhibition efficiency of mild steel when exposed for 48 h in aqueous HCl at 30 °C. This is corroborated in terms of interaction energy as obtained from molecular dynamics (MD) simulation study. Benzothiazole (BT) Schiff bases act as mixed type inhibitor and their adsorption on mild steel surface are governed by different interactions, like van der Waals, electrostatic (physisorption) as well as charge transfer or sharing (chemisorption). From density functional theory (DFT) calculation and Fukui indices values of atoms, mode of interaction between the inhibitor molecules and Fe metal surface was ascertained.

Graphical Abstract



Keywords Mild steel · Benzothiazole Schiff base · Heterocyclic group · Corrosion inhibition · Density functional theory · Molecular dynamics simulation

Extended author information available on the last page of the article

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This is to certify that college has no objection in permitting **DR. SUMIT KUMAR DAS, ASSISTANT PROFESSOR OF PHYSICS** to continue his research/academic linkage/activities with the **DEPARTMENT OF PHYSICS, JADAVPUR UNIVERSITY** started in **2022** without hampering the normal duties of college.

Govt. Gen. Degree College Tehatta * Estd-2014 * Govt of West Bengal *

Dr. Sibsankar Pal
Officer-in-charge
Govt. Gen. Degree College, Tehatta
Nadia-741160

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Sinha R, Das SK, Ghosh M and Chowdhury J (2022), Fabrication of gold nanoparticles tethered in heat-cooled calf thymus-deoxyribonucleic acid Langmuir-Blodgett film as effective surface-enhanced Raman scattering sensing platform.
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Fabrication of gold nanoparticles tethered in heat-cooled calf thymus-deoxyribonucleic acid Langmuir-Blodgett film as effective surface-enhanced Raman scattering sensing platform

Rajdeep Sinha[1†], Sumit Kumar Das[2†], Manash Ghosh[3] and Joydeep Chowdhury[1*]

[1]Department of Physics, Jadavpur University, Kolkata, India, [2]Department of Physics, Government General Degree College, Tehatta, India, [3]Department of Spectroscopy, Indian Association for the Cultivation of Science, Kolkata, India

SERS active substrate fabricated through self-assembly of Gold nanoparticles on the disjointed networks of Heat-cooled Calf Thymus DNA (HC-Ct DNA) Langmuir-Blodgett (LB) film has been reported. Adsorption kinetics of HC-Ct DNA molecules at the air-water interface has been studied explicitly. The UV-Vis electronic absorption spectra in conjunction with the FESEM images collectively suggest the presence of H- type aggregated domains most likely owing to plane-to-plane self-association of the HC-Ct DNA molecules aligned vertically on the surface of the LB film. Elemental composition and the morphological features of the as-prepared substrate (APS) are explored from XPS analysis and the FESEM, AFM images respectively. The SERS efficacy of the APS has been tested with trace concentrations of 4-Mercaptopyridine molecule. Finally, this SERS active substrate has also been used for the detection of malathion at ultrasensitive concentrations.

KEYWORDS

calf thymus DNA, Langmuir-Blodgett film, gold nanoparticles, SERS, malathion detection

1 Introduction

Surface-enhanced Raman scattering (SERS) spectroscopy has now emerged as a fascinating analytical tool for the detection of molecules at trace concentrations in the limit of single molecule regime (Nordlander et al., 2004; Kneipp et al., 2008; Hernandez-Sanchez et al., 2018; Tian et al., 2022). The reason behind the colossal enhancements of Raman bands is now been attributed to the collective response from the electromagnetic (EM) and charge transfer (CT) mechanisms, of which the former

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Self-assembled gold nanoparticles on the serpentine networks of Calf Thymus-DNA Langmuir-Blodgett films as efficient SERS sensing platform: Fabrication and its application in thiram detection

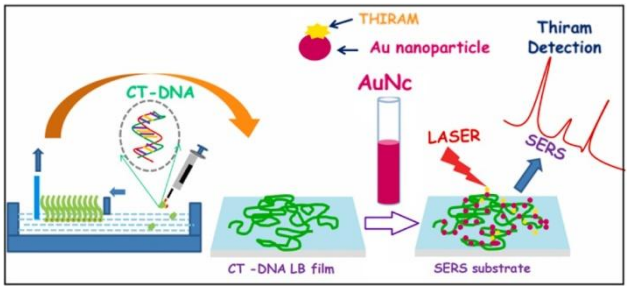
Rajdeep Sinha [a,1], Sumit Kumar Das [b,1], Manash Ghosh [c], Joydeep Chowdhury [a,*]

[a] Department of Physics, Jadavpur University, Kolkata, 700032, India
[b] Department of Physics, Government General Degree College, Tehatta, Nadia, 741160, India
[c] Department of Spectroscopy, Indian Association for the Cultivation of Science, Jadavpur, Kolkata, 700032, India

HIGHLIGHTS

- Fabrication of SERS active substrate from the Langmuir-Blodgett film of CT-DNA.
- Relaxation kinetics of CT-DNA molecules at the air-water interface studied.
- FESEM images of CT-DNA film exhibit complex pattern of serpentine networks.
- SERS active substrate used for thiram detection at ultrasensitive concentration.

GRAPHICAL ABSTRACT



ARTICLE INFO

Keywords:
Langmuir-Blodgett film
SERS
Calf thymus-DNA
Thiram detection

ABSTRACT

Fabrication of efficient SERS active substrates from the Langmuir-Blodgett (LB) films of Calf Thymus-DNA (CT-DNA) molecule after incubation into gold nanocolloid for 24 h has been presented. Relaxation kinetics of CT-DNA molecules at the air-water interface has been explicitly studied. The experimental observations from UV–Vis electronic absorption spectra together with the FESEM and AFM images of CT-DNA molecule organized in LB film collectively suggest the presence of H-type aggregated domains due to plane-to-plane self-association of the CT-DNA molecules on the surface of the LB film. XPS spectrum of the as prepared substrate has been unveiled to identify its chemical compositions while their morphological features are explored from the FESEM and AFM images. The SERS efficacy of the substrate has been tested with the 4-Mercaptopyridine (4-MPy) molecule at trace concentration. SERS enhancement factors ranging from 10^6–10^7 orders of magnitude have been evaluated for the characteristic bands of the 4-MPy molecule. The substrate not only exhibits appreciable spectral reproducibility, but it also confirms its stability and uniformity. The as prepared SERS active substrate has also been used for thiram detection at ultrasensitive concentration.

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[1] have equal contributions.

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GOVERNMENT GENERAL DEGREE COLLEGE, TEHATTA

Tehatta, Nadia, Pin-741160

This is to certify that college has no objection in permitting **DR. AJOY MANDAL, ASSISTANT PROFESSOR OF PHYSICS & DR. SANJOY SATPATI, ASSISTANT PROFESSOR OF CHEMISTRY** to continue his research/academic linkage/activities with the **IIT KHARAGPUR** under **INUP I2I PROGRAMME** started in **2023** without hampering the normal duties of college.

Govt. Gen. Degree College Tehatta * Estd-2014 * Govt of West Bengal *

Dr. Sibsankar Pal
Officer-in-charge
Govt. Gen. Degree College, Tehatta
Nadia-741160

DECLARATION

I/We hereby declare that I/we do not have any funding from our parent organization/government/private funding agencies to support my/our research activities.

This is also to declare that my/our student/staff implementing the project is/are not availing any fellowship or financial assistance.

INUP project details

Title of the project: Surface & Structural analysis of Turmeric & Mxene films using AFM & XRD.

Principal Investigator's name & address:

Dr. AJOY MANDAL
DEPARTMENT OF PHYSICS
GOVT. GENERAL DEGREE COLLEGE, TEHATTA, 741160, W.B.

Co-Principal Investigator's name & address:

Dr. SANJOY SATPATI
DEPT. OF CHEMISTRY
GOVT. GENERAL DEGREE COLLEGE, TEHATTA
NADIA - 741160 (W.B).

Student's name & registered degree program:

Ajoy Mandal

Name & Signature

Principal Investigator

Sanjoy Satpati.

Name & Signature

Co-Principal Investigator

17/7/23

Signature & Seal of the Head of the Institute

Dr. Sibsankar Pal
Officer-in-charge
Govt. Gen. Degree College, Tehatta
Nadia-741160

Date:

Govt. Gen. Degree College at Tehatta
Estd.-2014
Govt. of West Bengal

Gmail ajoy mandal <ajoymandal989@gmail.com>

Fwd: Item shared with you: "Service_1_week - ajoy mandal.pdf"

3 messages

snigdha gupta <guptasnigdha646@gmail.com> Wed, Aug 23, 2023 at 12:43 PM
To: ajoy mandal <ajoymandal989@gmail.com>

---------- Forwarded message ---------
From: **snigdha gupta** <guptasnigdha646@gmail.com>
Date: Wed, Aug 2, 2023 at 10:59AM
Subject: Re: Item shared with you: "Service_1_week - ajoy mandal.pdf"
To: <ajoymandal989@gamil.com>, <tehattagovtcollege@gmail.com>
Cc: INUP IITKGP <inup.iitkgp@gmail.com>, Dipak Goswami <dipak@phy.iitkgp.ac.in>, INUP - i2i <inup@iitkgp.ac.in>, Atul Sharma <ats14795@gmail.com>

Dear researchers,

Your short-term research proposal, entitled "Surface and structural analysis of turmeric and MXene films using AFM and XRD" is approved under the INUP programme at IIT Kharagpur. Please contact Prof. Dipak K Goswami(dipak@phy.iitkgp.ac.in) for further details on your research work.

Please copy the communication email to the INUP Team (inup@iitkgp.ac.in).

With regards
INUP-Team
IIT Kharagpur

On Mon, Jul 31, 2023 at 11:32AM INUP IITKGP (via Google Drive) <drive-shares-dm-noreply@google.com> wrote:

> INUP IITKGP shared an item
>
> INUP IITKGP (inup.iitkgp@gmail.com) has shared the following item:
>
> Service_1_week - ajoy mandal.pdf
>
> Open
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snigdha gupta <guptasnigdha646@gmail.com> Wed, Aug 23, 2023 at 12:45 PM
To: ajoymandal989@gmail.com

[Quoted text hidden]

---

ajoy mandal <ajoymandal989@gmail.com> Fri, Aug 25, 2023 at 12:10 PM
To: "Dr. Dipak Kumar Goswami" <dipak@phy.iitkgp.ac.in>

Dear Sir,

I have applied for XRD and AFM measurements of some thin films under INUP program. These measurements has been accepted. Please confirm my accommodation from 31st August to 2nd September.

[Quoted text hidden]

Ministry of Electronics
& Information Technology
Government of India

Indian Nanoelectronics Users' Programme - Idea to Innovation

Certificate of Participation

This is to certify that **Sanjoy Satpati** from **Government General Degree College, Tehatta** has participated in the INUP Users' Meet, held at IIT Bombay on August 10, 2024.

Ashwin A. Tulapurkar

Dr. Ashwin Tulapurkar,
Professor, Dept. of Electrical Engineering,
Indian Institute of Technology, Bombay

INUP-i2i

Sunita Verma

Smt. Sunita Verma,
Senior Director, GC R&D -
Electronics & IT,

Ministry of Electronics
& Information Technology
Government of India

Indian Nanoelectronics Users' Programme - Idea to Innovation

Certificate of Participation

This is to certify that **Ajoy Mandal** from **Government General Degree College, Tehatta** has participated in the INUP Users' Meet, held at IIT Bombay on August 10, 2024.

Dr. Ashwin Tulapurkar,
Professor, Dept. of Electrical Engineering,
Indian Institute of Technology, Bombay

INUP - i2i

Smt. Sunita Verma,
Senior Director, GC R&D -
Electronics & IT,

T Bombay

MeitY
Government of India

Diabetic Foot Ulcer

Navanika C

dian Institute of Technology, Kharagpur

Peripheral neuropathy

Peripheral vascular disease

Nerve Damage

Reduced blood flow

Loss of Sensation

Altered Biomechanics

Poor Blood Circulation

Foot Deformation

Delayed Wound Healing

Fig 1: Development of Diabetic F

MeitY
Government of India

INUP Users' Meet
August 10, 2024

INUP-i2i

Turmeric Film Based Nanogenerator and its Potential Application in Energy Harvesting Device

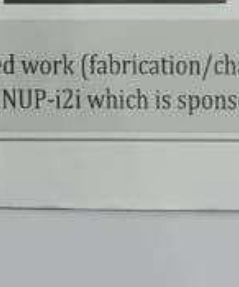
Ajoy Mandal[1]* & Sanjoy Satpati[2]

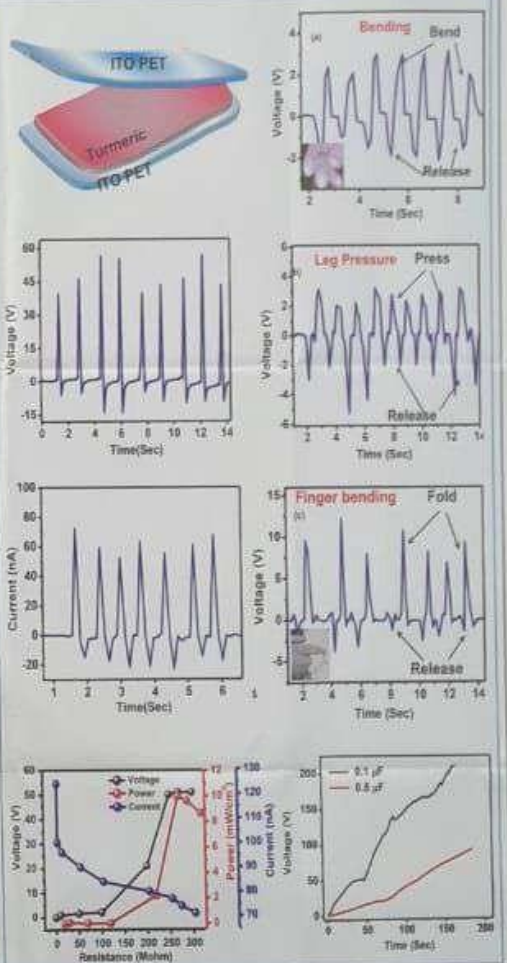
[1]Department of Physics, Government General Degree College, Tehatta, 741160, West Bengal, India.

[2]Department of Chemistry, Government General Degree College, Tehatta, 741160, West Bengal, India.

Abstract

Bio-piezo/ferroelectric materials with built-in electric signal capacity have gained attention to use in electrotherapy treatment, energy harvesting devices, and disease diagnosis with biocompatibility and biodegradability properties. The risk of secondary surgery and the leakage risk of the battery content in traditional implantable therapeutic devices can be reduced by using Bio-piezo/ferroelectric materials. In this study, turmeric film was investigated as a novel piezo/ferroelectric material, and the result revealed that it has spontaneous polarization, which increases its polarization density and facilitates its use in wearable, flexible electronics. The ferroelectric properties of turmeric film were investigated by piezoelectric force microscopy (PFM), and its switchable polarization and piezoelectric force spectroscopy were systematically checked using varying external electric fields. The measured value of turmeric's piezoelectric coefficient (d_{33}) can reach up to 37.5 pm/V. Finally, we have extended its piezoelectric properties by fabricating a biopiezoelectric nanogenerator (Bio-PENG). The fabricated turmeric-based Bio-PENG provides an open circuit voltage of 46 V and a short circuit current of 60 nA. The fabricated device also delivered an output power of 10 μW/cm² across 200 MΩ resistance. The Bio-PENG can light up four commercial LEDs without storing the energy and harvesting energy from different human body motions. Hence, turmeric-based PENG can be readily used to drive wearable and portable electronics, bio-implantable devices, and healthcare monitoring devices.





A part of the reported work (fabrication/characterization) was carried out at IIT Kharagpur Nanocentre under INUP-i2i which is sponsored by MeitY, Government of India.

MeitY
Government of India

INUP Users' Meet
August 10, 2024

INUP-i2i

Turmeric Film Based Nanogenerator and its Potential Application in Energy Harvesting Device

Ajoy Mandal[1]* & Sanjoy Satpati[2]

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[2]Department of Chemistry, Government General Degree College, Tehatta, 741160, West Bengal, India.

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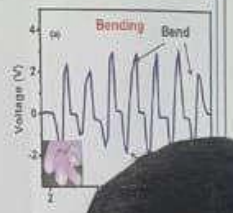

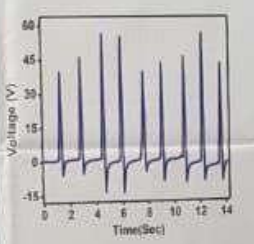

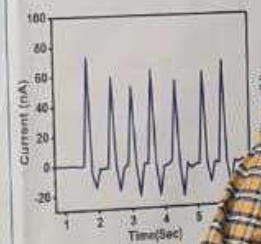

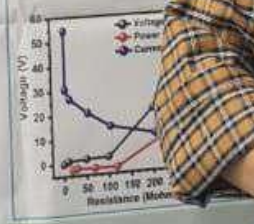

A part of the reported work (fabrication/characterization) was ca
Nanocentre under INUP-i2i which is sponsored by MeitY, Gover

WEST BENGAL BIODIVERSITY BOARD
(Department of Environment, Government of West Bengal)

Memo No. : 419 /1R(Bio)-2/2022 Date: 15 /05/2023

To

The Principal
Tehatta Govt. College
Tehatta,Nadia, West Bengal 741160

Sub: Updation / modification of People's Biodiversity Register (PBR) … regarding.

Madam/Sir

The Biodiversity Management Committees (BMC) at all the local bodies of West Bengal have been constituted as per Biological Diversity Act 2002 for effective implementation of the said Act. The BMC plays a crucial role in conservation of biodiversity, promotion of livelihood generation through sustainable utilization of bio-resources etc.

For fulfilment of these objectives, the first and prime function of the Committee is to prepare People's Biodiversity Register (PBR) in consultation with local people. The PBR is considered as a statutory technical document that captures all the details of biological resources and their associated knowledge available in the jurisdiction of the local body. All the BMCs have already completed their PBRs.

The Ministry of Environment Forest and Climate Change has taken a nationwide initiative of PBR updation-cum-verification from 23rd May to 4th June, 2023. As per the guidelines of the exercise, students of Graduate/ Post Graduate (Zoology/ Botany / Biological science) are to be involved in this programme. The students will be trained to have an understanding of this activity. After that, they will visit the concerned Gram Panchayats (GPs.) /Block for updation / modification of PBRs in consultation with local people and other stakeholders and finalise the updated PBR in prescribed format. The local administration / BMC will provide support to them. This nation-wide action has to be completed by 3rd June and the documents along with photographs will have to be uploaded on the website, to be hosted specifically for this purpose, by 4th June, 2023.

The students will be provided their conveyance/ tiffin cost and a certificate of participation on completion of this activity.

Prani Sampad Bhawan (5th Floor), Block: LB-2, Sector: III, Salt Lake City, Kolkata- 700 106, West Bengal, India
Phone: 033 2335 2731/ 5954 Telefax: 033 2335 2763 Email: biodiversity.wbbb@gmail.com, biodiversity.wbbb@rediffmail.com
Website: www.wbbb.gov.in

In this context, you are hereby requested to be associated with this endeavour and send names of your 22 students for participating in the updation / modification process of Tehatta I Block PBR comprising 11 GPs. Smt. Saswati Roy Reevs, District Coordinator of Nadia district (Mob. - +919674624094) will be in touch with you to facilitate the programme.

Member Secretary

No.: /1R(Bio)-1/2022 Date: /05/2023

Copy for information to:

1. The Chairman, Tehatta I Block Biodiversity Management Committee, Tehatta I dev. Block, West Bengal 741160.
2. The DNO, Sanitation & District Youth Officer Nadia Nadia, & DNO on Biodiversity Matter, District Magistrate and District Collector, Krishnanagar, West Bengal 741101

Member Secretary

List of our students participated in updation / modification process of Tehatta I Block PBR

Sl. No.	Name of the students	Email Id
1.	Dipam Dutta	dipamdutta92001@gmail.com
2.	Tanmayee Ghatak	tanmayeeghatak@gmail.com
3.	Sahin Shahriar Mondal	sahinshahriarmondal@gmail.com
4.	Subrata Biswas	subratabiswas03032002@gmail.com
5.	Jisan Shaikh	Shaikhjisan143@gmail.com
6.	Rubel Sekh	rubelsekh2412@gmail.com
7.	Rakib Sekh	rakibsekh2002@gmail.com
8.	Shova Khatun	shovacharakpota@gmail.com
9.	Rizwan Mondal	rizwanmondal186@gmail.com
10.	Shubhra Laha	shubhralaha3k@gmail.com
11.	Asish Sarkar	asish2776@gmail.com
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16.	Dipen Mandal	dipenmandal741155@gmail.com

(Dr. Sibsankar Pal)
Officer-In-Charge
Govt. Gen. Degree College, Tehatta

Officer-in-charge
Govt.Gen.Degree College, Tehatta
Nadia-741160

Govt. Gen. Degree College at Tehatta
Estd.-2014
Govt. of West Bengal

\

Ministry of Environment, Forest and Climate Change Government of India

WBBB

CERTIFICATE OF APPRECIATION

THIS CERTIFICATE IS PRESENTED TO

Dipam Dutta

of Govt. Gen. Degree College, Tehatta, Nadia

for his/her active participation in the National Campaign on Updating Cum Verification of People's Biodiversity Registers (PBRs) organized by Ministry of Environment, Forest & Climate Change, National Biodiversity Authority and West Bengal Biodiversity Board from 23rd May to 4th June 2023.

Smt. Tripti Sah, IFS
Member Secretary
West Bengal Biodiversity Board

Azadi Ka Amrit Mahotsav

LiFE Lifestyle for Environment

Dr. B. Balaji, IFS
Secretary,
National Biodiversity Authority

G20

Government of West Bengal
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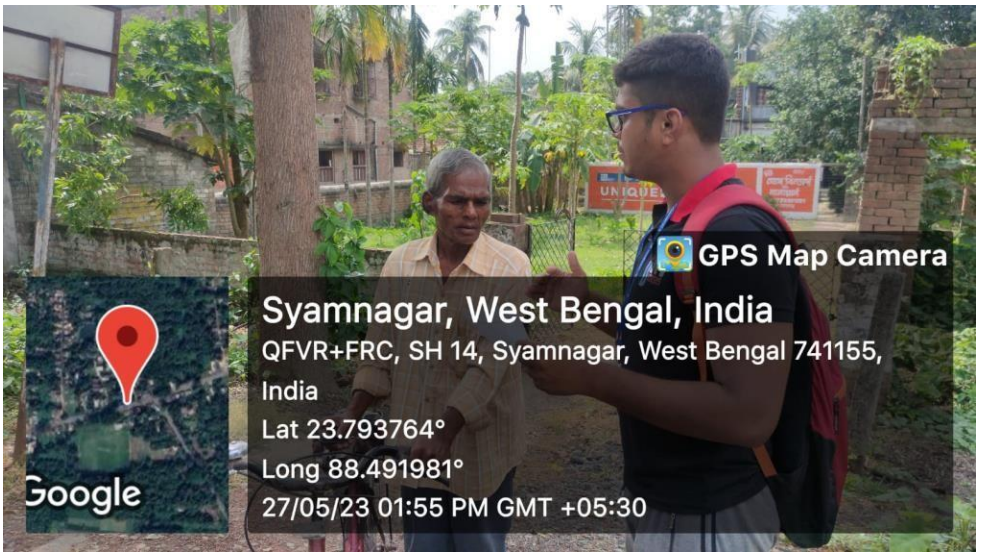
Tehatta, Nadia, Pin-741160



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Estd-2014
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Dr. Sibsankar Pal
Officer-in-charge
Govt. Gen. Degree College, Tehatta
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