



*-Ricci-Yamabe soliton on Kenmotsu manifold with torse forming potential vector field

Soumendu Roy^a, Santu Dey^b, Ali. H. Alkhalidi^c, Akram Ali^{c,*}, Arindam Bhattacharyya^d

^aDivision of Mathematics, School of Advanced Sciences, Vellore Institute of Technology, Chennai-600127, India

^bDepartment of Mathematics, Bidhan Chandra College, Asansol - 4, West Bengal-713304, India

^cDepartment of Mathematics, College of Science, King Khalid University, 61421 Abha, Saudi Arabia

^dDepartment of Mathematics, Jadaoipur University, Kolkata-700032, India

Abstract. The goal of the present paper is to deliberate *-Ricci-Yamabe soliton, whose potential vector field is torse-forming on the Kenmotsu manifold. Here, we have shown the nature of the soliton and found the scalar curvature when the manifold admitting *-Ricci-Yamabe soliton on the Kenmotsu manifold. Next, we have evolved the characterization of the vector field when the manifold satisfies *-Ricci-Yamabe soliton. Also, we have embellished some applications of a vector field as torse-forming in terms of *-Ricci-Yamabe soliton on the Kenmotsu manifold. We have developed an example of *-Ricci-Yamabe soliton on 3-dimensional Kenmotsu manifold to prove our findings.

1. Introduction

In 1972, K. Kenmotsu [20] obtained some tensor equations to characterize the manifolds of the third class. Since then the manifolds of the third class have been called Kenmotsu manifolds. In 1982, R. S. Hamilton [17] introduced the concept of Ricci flow, which is an evolution equation for metrics on a Riemannian manifold. The Ricci flow equation is given by:

$$\frac{\partial g}{\partial t} = -2S, \quad (1.1)$$

on a compact Riemannian manifold M with Riemannian metric g . A self-similar solution to the Ricci flow ([17], [32]) is called a Ricci soliton [18] if it moves only by a one-parameter family of diffeomorphism and scaling. The Ricci soliton equation is given by:

$$\mathcal{L}_V g + 2S + 2\Lambda g = 0, \quad (1.2)$$

2020 Mathematics Subject Classification. 53C15, 53C25, 53C44

Keywords. Ricci-Yamabe soliton, *-Ricci-Yamabe soliton, torse forming vector field, conformal Killing vector field, Kenmotsu manifold.

Received: 28 March 2023; Accepted: 26 July 2023

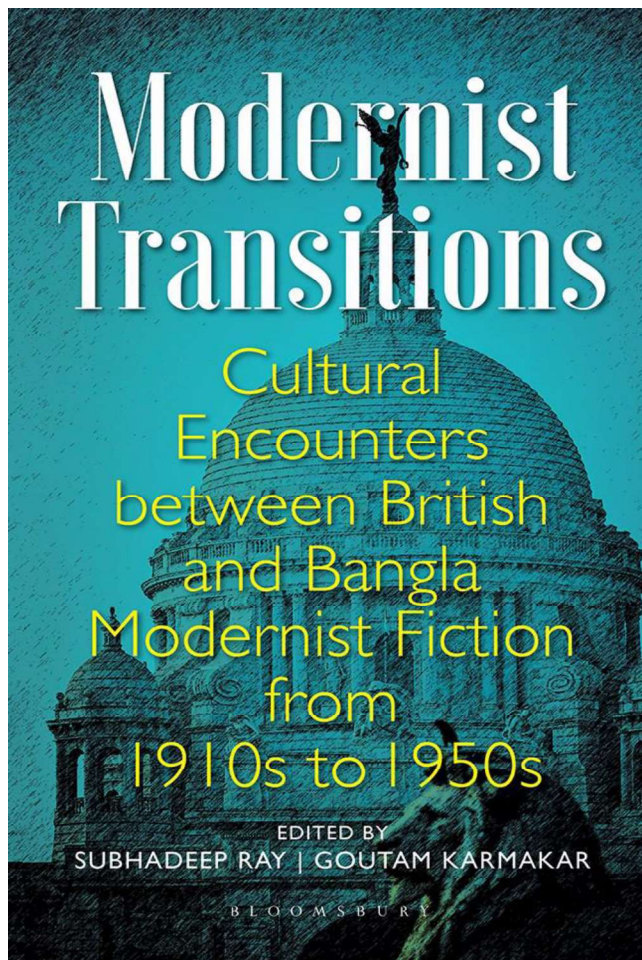
Communicated by Ljubica Velimirović

The authors would like to express their gratitude to the Deanship of Scientific Research at King Khalid University, Saudi Arabia for providing funding to research groups under the research grant R. G. P. 2/429/44.

* Corresponding author: Akram Ali

Email addresses: soumendu1103mtma@gmail.com (Soumendu Roy), santu.mathju@gmail.com (Santu Dey), ahalkhalidi@kku.edu.sa (Ali. H. Alkhalidi), akali@kku.edu.sa (Akram Ali), bhattachar1968@yahoo.co.in (Arindam Bhattacharyya)

Subhadeep Ray and Goutam Karmakar. 2024. *Modernist Transitions: Cultural Encounters between British and Bangla Modernist Fiction from 1910s and 1950s*. New Delhi: Bloomsbury India, 260 pp. ISBN: 9789356404472



Modernism has always been a contested term, and the most energetic debates about the reach of the term have recently been associated with an emerging interest in global modernism, or planetary modernism. However, horizons of multiple modernisms remain fuzzy, and conflicts and compromises between their range of practices and ideological networks mostly depend on how they were shaped by the history of imperial modernity. In this respect, Indian and British modernism of the first half of the twentieth century shared a

Certain results on gradient almost η -Ricci-Bourguignon soliton

Santu Dey

To cite this article: Santu Dey (2024) Certain results on gradient almost η -Ricci-Bourguignon soliton, Quaestiones Mathematicae, 47:2, 263-284, DOI: [10.2989/16073606.2023.2224587](https://doi.org/10.2989/16073606.2023.2224587)

To link to this article: <https://doi.org/10.2989/16073606.2023.2224587>



Published online: 13 Jul 2023.



Submit your article to this journal [↗](#)



Article views: 55



View related articles [↗](#)



View Crossmark data [↗](#)

CERTAIN RESULTS ON GRADIENT ALMOST η -RICCI-BOURGUIGNON SOLITON

SANTU DEY

Department of Mathematics, Bidhan Chandra College, Asansol-4, West Bengal-713304, India.

E-Mail santu.mathju@gmail.com santu@bccollegeasansol.ac.in

ABSTRACT. The present research article deals with the study of almost η -Ricci-Bourguignon soliton and gradient almost η -Ricci-Bourguignon soliton on almost Kenmotsu manifolds. It is shown that if the metric of a Kenmotsu manifold M^{2n+1} admits a gradient almost η -Ricci-Bourguignon soliton, then it is η -Einstein. Moreover, if the manifold is complete and ξ leaves the scalar curvature invariant, then it is locally isometric to Hyperbolic space $\mathbb{H}^{2n+1}(-1)$. Next, we demonstrate that if a (κ, μ) almost Kenmotsu manifold admits an almost η -Ricci-Bourguignon soliton, then the manifold is η -Einstein. Besides, we explore the condition for non-normal almost Kenmotsu manifolds satisfying gradient almost η -Ricci-Bourguignon soliton. In addition, we have also investigated an almost η -Ricci-Bourguignon soliton on $(\kappa, \mu)'$ -almost Kenmotsu manifold.

Mathematics Subject Classification (2020): 53C15, 53C25, 53D15.

Key words: (κ, μ) -almost Kenmotsu manifold, $(\kappa, \mu)'$ -almost Kenmotsu manifold, almost η -Ricci-Bourguignon soliton, gradient almost η -Ricci-Bourguignon soliton.

1. Introduction and motivations. The scientists and mathematicians across many disciplines have always been fascinated to study indefinite structures on manifolds. When a manifold is endowed with a geometric structure, we have more opportunities to explore its geometric properties. In 1981, a new geometric flow, named Ricci-Bourguignon flow, was introduced by Jean-Pierre Bourguignon [7], which was constructed and based on some unpublished work of Lichnerowicz and a paper of Aubin [1]. One can define the Ricci-Bourguignon flow as [24]

DEFINITION 1.1. A family of metrics $g(t)$ on an n -dimensional Riemannian manifold (M^n, g) is said to evolve by the Ricci-Bourguignon flow (RB flow for short) if $g(t)$ satisfies the following evolution equation,

$$\frac{\partial g}{\partial t} = -2(S - \vartheta rg), \tag{1.1}$$

where S is the Ricci tensor of the metric, r is the scalar curvature and $\vartheta \in \mathbb{R}$ is a constant.

From the above definition we can easily say that if $\vartheta = 0$ in (1.1), then it becomes Ricci flow. Now, from [24], we get different tensor like the Einstein tensor,

[Home](#) > [Journal of Optics](#) > [Article](#)

Design and analysis of MIMO antenna array for TeraHertz communication

| Research Article | Published: 04 April 2024

| (2024) [Cite this article](#)



[Journal of Optics](#)

[Aims and scope](#) →

[Submit manuscript](#) →

[Pia Sarkar](#) , [Arijit Saha](#), [Amit Banerjee](#) & [Vedatrayee Chakraborty](#)

 89 Accesses [Explore all metrics](#) →

Abstract

Antenna array of two dipole antennas made of copper has been designed and analyzed for 0.1 THz frequency in this work for element spacing of $d = \frac{3\lambda}{4}$ and $d = \lambda$, where λ is the wavelength.

Antenna length is $\frac{\lambda}{2}$ and width is $\frac{\lambda}{200}$. Range of azimuth angle is $[-180^\circ-180^\circ]$ and elevation angle is $[-90^\circ-90^\circ]$. Variation in correlation of power transmitted from first port to second port (S_{21}) has been analyzed changing tilt variation of second dipole, inter element spacing and frequency.

optimization of results antenna gain has been achieved as 5.41dBi and 6.35dBi for element spacing of $d = \frac{3\lambda}{4}$ and $d = \lambda$ respectively. Favorable values of diversity gain, total active reflection coefficient and mean effective gain have been achieved in this design as 10 dB, 0.5 dB and - 9.6 dB respectively.

This design gives good results of envelope correlation coefficient as 0.02 and 0.098 for element spacing of $d = \frac{3\lambda}{4}$ and $d = \lambda$ respectively. This antenna is capable of exhibiting isolation of

- 17.6702 dB and - 20.0044 dB for $d = \frac{3\lambda}{4}$ and $d = \lambda$ element spacing respectively. Antenna efficiency is of high value as 96.48% and 97.67% for element spacing of $d = \frac{3\lambda}{4}$ and $d = \lambda$ respectively.

A communication system has been studied implementing the proposed design. Encoding, precoding, orthogonal frequency division multiplexing and beam steering techniques have been applied to maintain signal quality. A compact array of small size ($1.5 \times 0.015 \text{ mm}^2$), low

Amit Banerjee ×

 [View ORCID ID profile](#)

Microsystem Design-Integration Lab, Physics Department, Bidhan Chandra College, Asansol, India

[View author publications](#)

You can also search for this author in

[PubMed](#) | [Google Scholar](#)



Dialectics of impairment: historical anxieties in late-colonial Bengali fictional narratives on disability

Subhadeep Ray

Bidhan Chandra College, Asansol, India

ABSTRACT

This article examines a body of early twentieth-century Bengali fiction foregrounding persons marked as disabled (including people experiencing physical disability, learning disability and chronic illness). A number of Bengali short stories and novels offer embodied narratives, which consider the human body as a productive site of contest between the colonial social order, the attempt to impose Western modernity and indigenous consciousness. An emergent sense of cultural agency can be found to be claimed by people, whose physical and mental states deviate from codes of 'normalcy'. These works unearth social discrimination based on the binary of 'fit' and 'unfit' under the converging rules of native feudalism and foreign colonialism. The treatment of corporeality in Bengali texts of the period from the 1930s to the 1950s cannot be fully grasped by applying the disability theories of the Global North. Rather these texts conflate multiple forms of marginalization of subject bodies to explore several socio-historical cross-sections and address the question of identity formation. This article rereads selected fiction on disability by Manik Bandyopadhyay (1908–1956) and Tarashankar Bandyopadhyay (1898–1971).

KEYWORDS

Bengali disability-fiction;
late-colonial rule; dialectical
reversal; subalternity

1. Introduction: situating the study

This article examines a body of early twentieth-century Bengali fiction that is focused on persons marked as disabled (including people experiencing physical disability, learning disability and chronic illness). This article argues that, situated within the modernist movement in Bengali literature, written during the interwar and post-war periods, a number of Bengali short stories and novels offer embodied narratives, which consider



Article

Edge-Terminated AlGa_xN/GaN/AlGa_xN Multi-Quantum Well Impact Avalanche Transit Time Sources for Terahertz Wave Generation

Monisha Ghosh ^{1,2}, Shilpi Bhattacharya Deb ³, Aritra Acharyya ⁴ , Arindam Biswas ^{2,5} , Hiroshi Inokawa ⁶ , Hiroaki Satoh ^{6,*} , Amit Banerjee ^{7,*} , Alexey Y. Seteikin ^{8,9} and Ilia G. Samusev ^{9,*}

- ¹ Department of Electronics and Communication Engineering, Supreme Knowledge Foundation Group of Institutions, Mankundu, Chandannagar 712139, India; monisha.ghosh@skf.edu.in
- ² Department of Mining Engineering, Kazi Nazrul University, Asansol 713340, India; arindam.biswas@knu.ac.in
- ³ Department of Electrical Engineering, RCC Institute of Information Technology (RCCIIT), Canal Road, Beliaghata, Kolkata 700015, India; shilpi.bhattacharya@rcciit.org.in
- ⁴ Department of Electronics and Communication Engineering, Cooch Behar Government Engineering College, Harinchawra, Ghughumari, Cooch Behar 736170, India; aritra.acharyya@cgec.org.in
- ⁵ Centre for IoT and AI Integration with Education-Industry-Agriculture, Kazi Nazrul University, Asansol 713340, India
- ⁶ Research Institute of Electronics, Shizuoka University, Hamamatsu 4328011, Japan; inokawa.hiroshi@shizuoka.ac.jp
- ⁷ Microsystem Design-Integration Lab, Physics Department, Bidhan Chandra College, Asansol 713303, India
- ⁸ Computation Biophysics Group, Amur State University, Blagoveshchensk 675027, Russia; seteikin@mail.ru
- ⁹ Research and Education Center for Fundamental and Applied Photonics & Nanophotonics, Immanuel Kant Baltic Federal University, Kaliningrad 236000, Russia
- * Correspondence: satoh.hiroaki@shizuoka.ac.jp (H.S.); amitbanerjee.nus@gmail.com (A.B.); is.cranz@gmail.com (I.G.S.)



Citation: Ghosh, M.; Deb, S.B.; Acharyya, A.; Biswas, A.; Inokawa, H.; Satoh, H.; Banerjee, A.; Seteikin, A.Y.; Samusev, I.G. Edge-Terminated AlGa_xN/GaN/AlGa_xN Multi-Quantum Well Impact Avalanche Transit Time Sources for Terahertz Wave Generation. *Nanomaterials* **2024**, *14*, 873. <https://doi.org/10.3390/nano14100873>

Academic Editors: Xunjun He and Ying Zhang

Received: 19 April 2024

Revised: 14 May 2024

Accepted: 14 May 2024

Published: 17 May 2024



Copyright: © 2024 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

Abstract: In our pursuit of high-power terahertz (THz) wave generation, we propose innovative edge-terminated single-drift region (SDR) multi-quantum well (MQW) impact avalanche transit time (IMPATT) structures based on the Al_xGa_{1-x}N/GaN/Al_xGa_{1-x}N material system, with a fixed aluminum mole fraction of $x = 0.3$. Two distinct MQW diode configurations, namely p^+n junction-based and Schottky barrier diode structures, were investigated for their THz potential. To enhance reverse breakdown characteristics, we propose employing mesa etching and nitrogen ion implantation for edge termination, mitigating issues related to premature and soft breakdown. The THz performance is comprehensively evaluated through steady-state and high-frequency characterizations using a self-consistent quantum drift-diffusion (SCQDD) model. Our proposed Al_{0.3}Ga_{0.7}N/GaN/Al_{0.3}Ga_{0.7}N MQW diodes, as well as GaN-based single-drift region (SDR) and 3C-SiC/Si/3C-SiC MQW-based double-drift region (DDR) IMPATT diodes, are simulated. The Schottky barrier in the proposed diodes significantly reduces device series resistance, enhancing peak continuous wave power output to approximately 300 mW and DC to THz conversion efficiency to nearly 13% at 1.0 THz. Noise performance analysis reveals that MQW structures within the avalanche zone mitigate noise and improve overall performance. Benchmarking against state-of-the-art THz sources establishes the superiority of our proposed THz sources, highlighting their potential for advancing THz technology and its applications.

Keywords: AlGa_xN; edge-termination; GaN; IMPATT; multi-quantum well; Schottky barrier; SDR; terahertz

1. Introduction

The terahertz (THz) frequency range, often referred to as the “terahertz-gap”, has become a focal point of research and innovation due to its immense potential for a wide

Estimation of the Relationship between Vegetation Pattern and Land Surface Temperature in Asansol Municipal Corporation

SOUGATA MAJI^{1,3} AND DRUHEEN CHAKRABORTTY²

¹Bankura University, Bankura, West Bengal, India

²Bankura Christian College, Bankura, West Bengal, India

³Present address: State Aided College Teacher, Bidhan Chandra College, Asansol, West Bengal, India

E-mail: majisougata14@gmail.com, druheengeobcc@gmail.com

*Corresponding author

ABSTRACT

Changing built-up area is the obvious reason for the fluctuation of land surface temperature phenomena that leads to a distressing urban environment. Urban vegetation has the potential to minimize the land surface temperature intensity. The present study investigated the relationship between land surface temperature (LST) and vegetation patterns in Asansol Municipal Corporation. Landsat 5 TM and Landsat 8 OLI satellite images for the years 1991 and 2021 were used for analysis of landscape metrics viz., class area, patch density, edge density, and mean shape index. Correlation techniques were applied to depict the association between the variables. The study concludes that vegetation configuration has no significant relationship with LST during the study period. However, the vegetation composition is slightly associated with LST which suggests that vegetation composition may play a crucial role in mitigating the LST phenomenon. However, the relationship is very complex and varies spatially and scale-wise.

Key words: Landscape Metrics, LST, Urbanization, Vegetation composition

INTRODUCTION

Urban environment research focused on the difference in air temperature between city area and their surrounding rural areas is called Urban Heat Island (UHI) phenomenon (Landsberg 1981, Weng et al. 2004). Now it has been considered one of the major environmental challenges to city planners (Taha 1997, Zhibin et al. 2014). Rapid urbanization through the extension of urban sprawl is continuously modifying the land use land cover (LULC), ecological diversity, and energy flow (Naeem et al. 2018), which sharply deteriorates environmental quality. Therefore, minimizing the Land Surface Temperature (LST) through afforestation which can reduce the temperature intensity by evaporative cooling and providing shades (Shashua-Bar and Hoffman 2000) should be promoted. Previous studies have established the relationship between LST and vegetation amount using the Normalized Difference Vegetation Index (NDVI) (Weng et al. 2004, Chen et al. 2006, Reynolds et al. 2008, Guha and Govil 2020, Maroni et al. 2021). Studies also showed how the LULC can bring an impact on LST (Barakat et al. 2019, Zhang et al. 2017, Sun et al. 2012). Zhang et al. (2009) highlighted the association between

vegetation patches and the LST phenomenon. However, very few studies have paid attention to the quantitative analysis of the influence of vegetation configuration and composition on the LST phenomenon (Li et al. 2012, Zhibin et al. 2014, Naeem et al. 2018). According to Turner (1990), landscape spatial pattern has a vital role in ecological functioning. Therefore, vegetation composition and configuration can influence the energy and material flows (Zhang et al. 2009), which has an impact on LST (Weng et al. 2007). Previous studies have shown mixed results. (Zhibin et al. 2014) and a good correlation between vegetation patterns with LST but (LI et al. (2012) and Naeem et al. (2018), have shown no significant relationship between vegetation pattern and LST. Some studies suggest the ecological process varies according to scale (Turner et al. 1989, Hess et al. 2006, Zhibin et al. 2014). Therefore, it can be expected that the determination of the relationship between the LST and the vegetation patterns is very complex and full of anomalies. The present study has been carried out in Asansol Municipal Corporation (AMC) which is being considered one of the fastest urbanizing areas to assess the relationship between changing land use land cover and LST. Generally, remote sensing data from

India's Marital Rape Crisis: A Critical Study

Dr. Amrita Banerjee*

Rape, generally known as 'BALATKAR' is a petrifying word in itself. In India, it is one of the most common criminal activities. So frightening, humiliating, traumatic and terrifying the term rape is that it extinguishes the entire psychology and effects the deepest emotions of the person being raped. The term rape has been derived from Latin word 'RAPERE' which means to take away. Therefore, the literal meaning of rape could be forcibly snatching something from someone which is clearly an offence. To force means to include in an activity without the consent of another. India believes in the concept of 'MATRI DEVO BHAVA'- which means to worship women or mother. But keeping in view the number of rape cases which arise every day in India the concept of 'MATRI DEVO BHAVA' seems to dissolve. Rape is such an offence or crime that goes against the basic human rights. No single definition can define the word because of its comprehensive nature. The paper will try to focus on theoretical and practical contribution on a least research subject of crime against women in the form of marital rape and the various hurdles faced by the Indian society in categorizing it as an offence. As a responsible citizen we must raise our voice against the menace of such act, as we know that repetitively the crime rate in respect to rape within marriage or marital rape is a global problem and is growing where the lives and dignity of women are under constant threat. Although several countries have criminalized marital rapes or withdrew exemptions granted to rape within marriage, the situation has hardly changed in India, which has yet to criminalize marital rape.

India does not recognize marital rape as a felony. But there are various countries around the globe who have forbidden the offence of marital rape. In Australia, under the impact of the second wave of feminism in the seventies, marital rape was criminalized in all its jurisdiction¹. In New Zealand, the marital rape exemption was abolished in 1985 by inserting Section 128 to the Crimes Act, 1961. In Sri Lanka, recent modifications to the Penal Code recognize marital rape but only with regard to judicially separated partners, and there exists great reluctance to pass judgment on rape in the context of partners who are actually living together. The Government of Cyprus criminalized the offence of rape whether it is committed within or outside the marriage by passing laws on the Prevention of Violence in the Family and Protection of Victims, in June 1993.² In England the marital rape exemption was abolished in its entirety in 1991. These are just a few instances to project the global picture. But the issue that still disturbs us in India is that we have yet not succeeded in making marital rape a fault. Section 375 only has a limited scope to prevent marital rape as it criminalizes the act only if the victim is below 15 yrs. of age, in spite of recommendations made by the 172nd Law Commission of India or the Justice Verma Committee Report. However, Delhi High Court in a recent judgment responding

* Assistant Professor, Bidhan Chandra College, Asansol, under Kazi Nazrul University.

RESEARCH ARTICLE

Multiple Quantum Barrier Avalanche Photodiode Based on GaN/AlGa_N Heterostructures for Long Wavelength Infrared Detection

SOMRITA GHOSH¹, ARITRA ACHARYYA², ARINDAM BISWAS^{1,3}, AMIT BANERJEE⁴, HIROSHI INOKAWA⁵, (Member, IEEE), HIROAKI SATOH⁵, (Member, IEEE), ALEXEY Y. SETEIKIN^{6,7}, AND I. G. SAMUSEV⁶

¹Department of Mining Engineering, Kazi Nazrul University, Burdwan, Asansol, West Bengal 713340, India

²Department of Electronics and Communication Engineering, Cooch Behar Government Engineering College, Harinchawra, Ghughumari, Cooch Behar, West Bengal 736170, India

³Centre for IoT and AI Integration with Education-Industry-Agriculture, Kazi Nazrul University, Burdwan, Asansol, West Bengal 713340, India

⁴Microsystem Design-Integration Laboratory, Department of Physics, Bidhan Chandra College, Asansol, West Bengal 713303, India

⁵Research Institute of Electronics, Shizuoka University, Hamamatsu 4328011, Japan

⁶Research and Education Center for Laser Nanotechnology and Information Biophysics, Immanuel Kant Baltic Federal University, 236000 Kaliningrad, Russia

⁷Computation Biophysics Group, Amur State University, 675027 Blagoveshchensk, Russia

Corresponding authors: Arindam Biswas (mailarindambiswas@yahoo.co.in), Aritra Acharyya (ari_besu@yahoo.co.in), and I. G. Samusev (is.cranz@gmail.com)

This work was supported in part by the Japan–India Science Cooperative Program between Japan Society for the Promotion of Science (JSPS) and Department of Science and Technology (DST) under Grant JPJSBP120207708 (Japan) and Grant DST/INT/JNPS/P-310/2020 (India); in part by the 2023 Cooperative Research Project on Biomedical Engineering, funded by the Research Centre for Biomedical Engineering, Japan in association with Research Institute of Electronics (RIE), Shizuoka University, Japan, under Project 2055; and in part by the Device Development Programme by the Department of Science Technology, Ministry of Science and Technology, Government of India, under Grant DST/TDT/DDP-38/2021.

ABSTRACT A multiple quantum barrier (MQB) avalanche photodiode (APD) structure based on GaN/Al_xGa_{1-x}N material system has been proposed in this paper which is capable of detecting infrared (IR) signal up to 6.0 μm wavelength. A self-consistent quantum drift-diffusion (SCQDD) model developed by the authors, has been used to determine the current-voltage characteristics under dark and illuminated conditions, spectral response, excess noise properties, signal-to-noise ratio, time and frequency responses. Results show that the proposed MQB APD attains peak responsivity of 60 AW⁻¹ at 3.0 μm wavelength. Incorporation of a dedicated thin *n*-type GaN layer for avalanche multiplication in between the *p*⁺-GaN contact layer and MQB constant-field drift-layer ensures significantly low noise equivalent power under normal operating conditions at room temperature (300 K). Optical pulse response of the device reveals that special restriction over the charge multiplication able to suppress the minor peaks of the current response and consequently significantly narrow pulse response can be achieved. Narrow pulse response leads to broad bandwidth of 274.5 GHz, which is significantly broader than the existing IR photo-detectors.

INDEX TERMS Avalanche photodiodes, multiple quantum barrier, self-consistent quantum drift-diffusion model, infrared, heterojunction, responsivity, pulse response, bandwidth.

I. INTRODUCTION

Avalanche photodiodes (APDs) are most suitable optical detector for the optical receivers in long-haul optical communication systems [1]. The APDs are preferred as optical signal detector over other photo-detectors in both free space

The associate editor coordinating the review of this manuscript and approving it for publication was Shuo Sun.

and fibre-optic communication systems, except the applications in which the signal-to-noise ratio (SNR)-budget is low. In those cases, low noise *p-i-n* detector, in combination with the trans-impedance amplifier are preferred. However, high internal gain mechanism of APDs eliminates the burden of trans-impedance amplifiers in case of the applications where SNR-budget is not a major concern. Moreover, high sensitivity and ultra-high speed of APD are

- [Abstract](#)
- [Introduction](#)
- [Materials and Methods](#)
- [Results and Discussion](#)
- [Conclusions](#)
- [Author Contributions](#)
- [Funding](#)
- [Data Availability Statement](#)
- [Acknowledgments](#)
- [Conflicts of Interest](#)
- [References](#)

K

[Order Article Reprints \(/2079-4991/14/2/225/reprints\)](#)

Open Access Article

On-Chip Modification of Titanium Electrothermal Characteristics by Joule Heating: Application to Terahertz Microbolometer

by **Durgadevi Elamaran** ^{1,*} (<mailto:durgaelamaran@gmail.com>), **Ko Akiba** ² (<mailto:akiba.ko.17@shizuoka.ac.jp>), **Hiroaki Satoh** ^{2,3} (<mailto:satoh.hiroaki@shizuoka.ac.jp>) (<https://orcid.org/0000-0002-5868-0219>), **Amit Banerjee** ^{3,*} (<mailto:amitbanerjee.nus@gmail.com>) (<https://orcid.org/0000-0001-9612-4523>), **Norihisa Hiromoto** ^{1,2} (<mailto:hiromoto.norihisa@shizuoka.ac.jp>) and **Hiroshi Inokawa** ^{1,2,3,*} (<mailto:inokawa.hiroshi@shizuoka.ac.jp>) (<https://orcid.org/0000-0002-8647-3524>)

¹ Graduate School of Science and Technology, Shizuoka University, Hamamatsu 432-8011, Japan

² Graduate School of Integrated Science and Technology, Shizuoka University, Hamamatsu 432-8561, Japan

³ Research Institute of Electronics, Shizuoka University, Hamamatsu 432-8011, Japan

* Authors to whom correspondence should be addressed.

† Current address: Graduate School of Arts and Science, The University of Tokyo, Komaba, Tokyo 153-8902, Japan.

‡ Current address: Microsystem Design-Integration Lab, Physics Department, Bidhan Chandra College, Asansol 713303, India.

Nanomaterials **2024**, *14*(2), 225; <https://doi.org/10.3390/nano14020225> (<https://doi.org/10.3390/nano14020225>)

Submission received: 11 December 2023 / Revised: 15 January 2024 / Accepted: 17 January 2024 / Published: 19 January 2024

(This article belongs to the Section **Nanoelectronics, Nanosensors and Devices** (/journal/nanomaterials/sections/nanoelectronics_nanosensors_devices))

(https://pub.mdpi-res.com/nanomaterials/nanomaterials-14-00225/article_deploy/html/images/nanomaterials-14-00225-g001.png?1706090537) (https://pub.mdpi-res.com/nanomaterials/nanomaterials-14-00225/article_deploy/html/images/nanomaterials-14-00225-g002.png?1706090538) (https://pub.mdpi-res.com/nanomaterials/nanomaterials-14-00225/article_deploy/html/images/nanomaterials-14-00225-g003.png?1706090539) (https://pub.mdpi-res.com/nanomaterials/nanomaterials-14-00225/article_deploy/html/images/nanomaterials-14-00225-g004.png?1706090539) (https://pub.mdpi-res.com/nanomaterials/nanomaterials-14-00225/article_deploy/html/images/nanomaterials-14-00225-g005.png?1706090542) (https://pub.mdpi-res.com/nanomaterials/nanomaterials-14-00225/article_deploy/html/images/nanomaterials-14-00225-g006.png?1706090543) (https://pub.mdpi-res.com/nanomaterials/nanomaterials-14-00225/article_deploy/html/images/nanomaterials-14-00225-g007.png?1706090545) (https://pub.mdpi-res.com/nanomaterials/nanomaterials-14-00225/article_deploy/html/images/nanomaterials-14-00225-g008.png?1706090548) (https://pub.mdpi-res.com/nanomaterials/nanomaterials-14-00225/article_deploy/html/images/nanomaterials-14-00225-g009.png?1706090551)

Share

Help

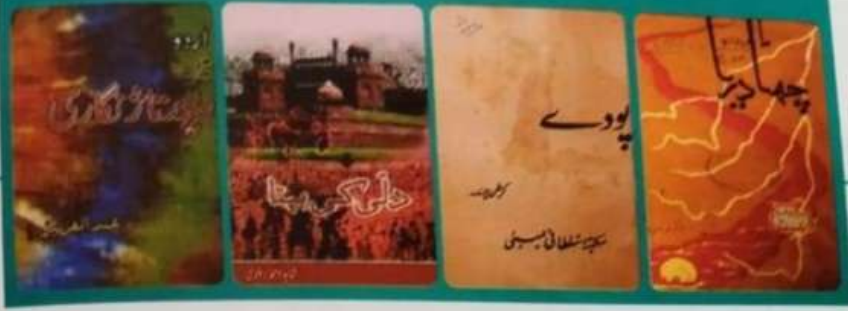
Cite

Discuss in SciProfiles

[https://groups/utmsou](https://groups.utmsou)

Endorse

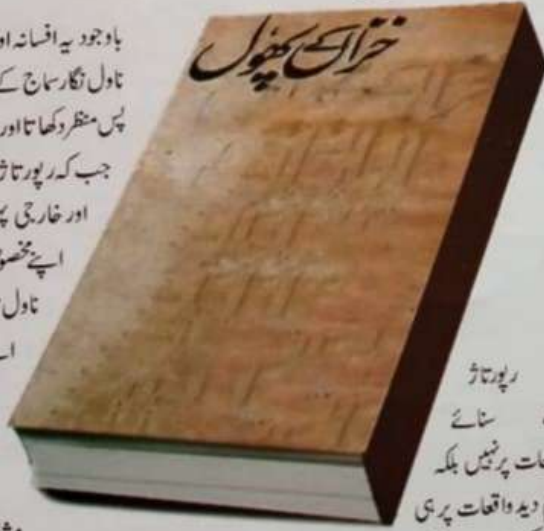
Comment



رپورتاژ: فن اور روایت

● صبا پروین

باوجود یہ افسانہ اور ناول سے قطعی مختلف ہے۔ افسانہ اور ناول نگار سماج کے کچھ مخصوص پہلوؤں سے متعلق حقائق کا پس منظر دکھاتا اور بالواسطہ اپنی بات قاری تک پہنچاتا ہے جب کہ رپورتاژ لکھنے والا ادیب سماجی حقیقت کے داخلی اور خارجی پہلوؤں کو پیش کرتا ہے اور براہ راست اپنے مخصوص نظریے کو بیان کرتا ہے۔ افسانہ اور ناول نگار کے مقابلے ایک رپورتاژ کا ادیب اپنے کرداروں کو بہتر طور پر پیش کر پاتا ہے کیونکہ وہ اپنے کرداروں کے ساتھ جیتا ہے اور ان کے احساسات و تخیلات اور حرکات و سکنات کا



رپورتاژ

سنے

واقعات پر نہیں بلکہ

چشم دید واقعات پر ہی

لکھ سکتے ہیں۔ اس حقیقت

مشاہدہ موجودہ حالات میں بہت ہی قریب سے کرتا ہے۔ چونکہ رپورتاژ خاص کر کسی کانفرنس کی روداد ہوتی ہے لہذا ادیب کے دوست و احباب کی بھی شرکت ہوتی ہے، جن کو ادیب بہت قریب سے جانتا ہے۔ ڈاکٹر فرمان فتح پوری اپنی کتاب ”اردو نثر کا فن ارتقا“ میں رقم طراز ہیں:

”سماجی اور معاشرتی تصورات سے قطع نظر کر کے اگر ہم افسانہ اور ناول کے وسیع کیڑوں کو دیکھیں تو اس میں قطعی فرضی بے بنیاد، ناقابل تصدق، غیر ممکن، قطعی تخیلی اور یہاں تک کہ (Fantastic) قصوں، کہانیوں اور نہ صرف بالکل فرضی بلکہ غیر انسانی کرداروں کی بھی گنجائش ہوتی ہے۔ ظاہر ہے کہ رپورتاژ میں ان سب کے لیے کوئی جگہ نہیں ہے۔“

(شمیم احمد: رپورتاژ اور اس کا موضوع؛ بحوالہ: اردو نثر کا فن ارتقا، فرمان فتح پوری، ص: ۳۰۷)

ایک اچھے رپورتاژ کے لیے ایک یا کئی واقعات کا انتخاب کیا جاتا ہے۔ چونکہ رپورتاژ کا تعلق کسی تاریخی

سے انکار کی گنجائش نہیں کہ داخلی کیفیات اپنی تمام تر شدت کے ساتھ اسی وقت پیدا کی جاسکتی ہیں، جب کہ مصنف نے واقعات کا بذات خود مشاہدہ کیا ہو۔ سُنے ہوئے واقعات داخلی کیفیات کو مجروح کرتے ہوئے واقعات کی حقیقت کو بھی ٹھیس پہنچا سکتے ہیں اور سُنے ہوئے واقعات کو ترتیب دینے سے تخلیق میں خارجی اثرات کا غلبہ ہو جانے کا خدشہ بھی لاحق رہتا ہے۔ جب کوئی ادیب کسی واقعہ یا حادثے کو دیکھنے کے بعد رپورتاژ لکھتا ہے تو اس میں داخلی عناصر کی تصویر کشی بھی دلآویزی کے ساتھ کرتا ہے۔ چنانچہ ایک اچھے رپورتاژ کی تخلیق کے لیے واقعات کی صداقت اور اسی کے ساتھ جذبات و تاثرات کی گہرائی اور خلوص کا ہونا لازمی ہے۔ یہی وجہ ہے کہ ادیب کا واقعات کا بذات خود مشاہدہ کرنا ناگزیر ہے۔

رپورتاژ میں کسی فرضی قصے کا بیان نہیں کیا جاسکتا ہے۔ یہی وجہ ہے کہ اسے ڈرامائی انداز میں بیان کیے جانے کے

رپورتاژ ایک جدید صنف ہے۔ یہ فرانسیسی زبان کا لفظ ہے جسے رومن رسم الخط میں Reportage لکھا جاتا ہے اور انگریزی زبان کے لفظ Report کے معنی میں ہی استعمال کیا جاتا ہے۔ رپورتاژ کے لغوی معنی روداد یا خبر کے ہیں۔ اسی نسبت سے رپورتاژ کی تعریف ہم یوں کر سکتے ہیں کہ ”کسی واقعہ کی خبر یا رپورتاژ اس طرح تیار کی جائے کہ اس میں افسانے کا انداز پیدا ہو جائے یا اس میں مصنف کی شخصیت کی جھلک دکھائی دے تو اسے رپورتاژ کہتے ہیں۔“

ایک صنف کی حیثیت سے اردو ادب میں رپورتاژ کا وجود ترقی پسند تحریک کی دین ہے۔ اسی تحریک کے دور میں اس صنف کا عروج دیکھنے کو ملتا ہے اور یہی وہ عہد ہے جس کے درمیان رپورتاژ اردو ادب میں اپنی ایک مستحکم جگہ بنا لیتا ہے۔ رپورتاژ کا تعلق گرچہ صحافت ہی سے ہے، مگر اس صنف میں داخلی اور خارجی دونوں ہی تاثرات کی کارفرمائی ہوتی ہے۔ یہ ایک ایسی صنف ہے جس میں داخلیت اور خارجیت کا ایک حسین امتزاج ہوتا ہے۔ رپورتاژ میں کسی تقریب یا کانفرنس یا جلسے کی کارروائی کی روداد بیان کی جاتی ہے۔ رپورتاژ کا مقصد صرف اطلاع فراہم کرنا نہیں ہوتا، رپورتاژ نگار کے لیے ضروری ہے کہ وہ تخلیقی مزاج کا حامل ہو اور اگر وہ صحافی ہے تو اس میں خبر کو افسانہ بنانے کی اہلیت ہو۔ رپورتاژ میں اسلوب بیان کی خاص اہمیت ہوتی ہے کیونکہ بیان کا جادو ہی کسی تحریر کو پراثر بناتا ہے اور تحریر کو اس قابل بنا دیتا ہے کہ پڑھنے والے کے ذہن پر پورے پورے اثر چھوڑ جاتا ہے۔

جلد نمبر: ۳۷

شمارہ: ۵

ستمبر ۲۰۲۳ء

زیر سالانہ سادہ ڈاک سے: ۱۵۰ روپے

رجسٹرڈ ڈاک سے: ۵۸۲ روپے

فی شمارہ پندرہ روپے

مدیر

محمد احسن عابد
سکرٹری

خط و کتابت اور ترسیل زر کا پتہ

سکرٹری، اردو اکادمی، دہلی

سی۔ پی۔ او۔ بلڈنگ، کشمیری گیٹ، دہلی۔ ۱۱۰۰۰۶

ISSN: 2321-2888

فون نمبر: 011-23863697, 23863858
23863566

سوالے متعلق شکایات دیگر معلومات کے لیے رابطہ کریں:

011- 23863729

ای میل کا پتہ:

aiwaneurduumangdelhi@gmail.com

ترجمین و سرورق: سلام الدین خان

”ایوان اردو“ میں شائع ہونے والی تحریروں میں ظاہر کی گئی آراء سے ادارے کا متفق ہونا ضروری نہیں۔ تمام افسانوں میں نام، مقالات اور واقعات میں مطابقت کو اتفاقیہ سمجھا جائے گا۔ تنازع امور پر کارروائی صرف دہلی کی عدالتوں میں ہی کی جاسکتی ہے۔

اپنی بات ————— اداریہ ————— 4

مضامین

- داستان کی تکنیک (تاریخ کے اوراق سے) ————— پروفیسر کلیم الدین احمد ————— 5
- میر کا جبر و قدر ————— پروفیسر عبدالحق ————— 9
- غزل، تغزل: حدود و امکانات ————— پروفیسر قدوس جاوید ————— 13
- ریاست ٹوٹک میں ترویج شاعری ————— ڈاکٹر راشد میاں ————— 24
- صالحہ عابد حسین کا سفر نامہ امریکہ: وطن پرستی کا نگار خانہ ————— ڈاکٹر محمد یونس شوگر ————— 30
- اردو ناول کے فروغ میں علی گڑھ کا حصہ: ایک اجمالی جائزہ ————— ڈاکٹر حامد رضا صدیقی ————— 35
- ترقی پسند نظم گو شاعر کا احتجاجی رویہ ————— ڈاکٹر جمشید احمد ————— 44
- شہیم خنی کا مطالعہ اقبال ————— طاہر حسین ————— 49
- انشاء اللہ خاں انشاء اور ان کی دو فارسی تصانیف ————— محمد رضا ظہری ————— 52

افسانے

- فرض شناس ————— پروفیسر حمید سہروردی ————— 56
- میں پن کا شیطان ————— سلیم خان ————— 57
- سفید نور کا راز ————— ڈاکٹر ریاض توحیدتی ————— 58
- دعا ————— سیدہ ایمن عبدالستار ————— 60

شاعری

- شہیم طارق، پروفیسر ہار شریف ————— 12
- ڈاکٹر ظفر مراد آبادی، ڈاکٹر اشہد کریم الفت ————— 23
- مدھوش بنگرامی، فردوس گیادی ————— 29
- مختار حسینی، ساحت نصرت ————— 34
- دفا عظمیٰ، سعدیہ صرف ————— 43
- نیاز جیر اچھوری، ڈاکٹر مخدوم کاکوروی ————— 48

تیسرے و تعارف: راشد جمال فاروقی، ڈاکٹر نوید احمد خاں، انور آفاق، نسیم محمود، وثیق الرحمن، امتیاز احمد ————— 67

گرامر اس خاصے: ————— 73

محمد احسن عابد سکرٹری، اردو اکادمی، دہلی (پرنٹر، پبلشر) نے ایس ڈی ایم پرنٹری اینڈ بکری، پی۔ ۲۱۵، سیکٹر۔ ۳، بلاک ۱۱، انڈسٹریل ایریا، دہلی۔ ۱۱۰۰۳۹ سے چھپوا کر دفتر اردو اکادمی، دہلی سی۔ پی۔ او۔ بلڈنگ، ہزر در سیمیا، کشمیری گیٹ، دہلی ۱۱۰۰۰۶ سے شائع کیا۔



ادب ہر بڑے اور بنیادی انقلاب کا نقیب ہوتا ہے۔ چونکہ ادب ایک آلہ ہے نئے توازن کی جستجو کا، اس لیے تبدیلیوں کی حمایت ادب کے لیے ناگزیر ہے۔

ترقی پسند حکم گو شعرا کا احتجاجی رویہ

ڈاکٹر جمشید احمد

گئے رزم ناموں کی بات کی جائے یا شمالی ہند کے شہر آشوب کی۔ ہمیں ان میں احتجاج کا رنگ صاف طور پر نظر آتا ہے۔ اسی طرح شمالی ہند میں احتجاج کے حوالے سے جعفر زئی کا نام بڑا نمایاں ہے۔ جعفر زئی کے یہاں اس دور کے سماجی و سیاسی حالات کے خلاف واضح طور پر احتجاج نظر آتا ہے۔ جعفر زئی کے علاوہ اس دور کے دیگر شعرا کے یہاں بھی شہر آشوب کی شکل میں احتجاجی عناصر موجود ہیں۔ پروفیسر ابوالکلام قاسمی اردو ادب کی احتجاجی شاعری کے تعلق سے لکھتے ہیں:

”اس حقیقت سے انکار مشکل ہے کہ ہر زمانے کی بلند پایہ شاعری میں ایک نوع کی اقدار پسندی کی نشاندہی ضرور کی جاسکتی ہے اور یہ اقدار پسندی ظالم کے خلاف مظلوم اور کہنہ روایت کے برخلاف نئے نظام یا شاعر کے خوش آئند خواہوں کی نمائندگی کرتی ہے۔ اس بات کو یوں بھی کہا جاسکتا ہے کہ شاعری میں آدرش پسندی کی زیریں لہریں ہی اسے مستقبل کے قاری کے لیے بامعنی بناتی ہیں۔ اردو کی کلاسیک شاعری میں مذہبی انتہا پسندی کے بجائے صوفیانہ رواداری، رسمیت کے برخلاف اعلیٰ انسانی اور اخلاقی اقدار اور ناپسندیدہ معاصر صورت حال کے مقابلے میں خواب و خیال کی دنیا میں پناہ لینے پر اصرار دراصل آدرش پسندی ہی کی مختلف صورتیں ہیں۔“

(دیباچہ۔ ابوالکلام قاسمی بحوالہ اردو نظموں کا احتجاجی

احتجاج کے لغوی معنی اعتراض یا انکار کے ہیں۔ ادب میں احتجاج دراصل ناموافق حالات سے کسی شاعر یا ادیب کی برہمی یا بے اطمینانی کا اظہار ہے۔ اردو ادب میں احتجاجی شاعری کا آغاز کسی نہ کسی طور پر ابتدا سے ہی ہو جاتا ہے۔ چاہے دکن میں لکھے

رنگ، شہزاد انجم برہانی، ص: ۱۸-۱۷) بلاشبہ ادب بنیادی طور پر احتجاج اور مزاحمت کا ایک عمل ہے۔ لہذا ہر زمانے کے شعرو ادب میں اس کی زیریں لہریں موجود رہتی ہیں۔ اس سلسلے میں محمد حسن عسکری نے بڑی اہم بات کی طرف اشارہ کیا ہے:

”بنیادی تبدیلیوں کی ضرورت کا احساس سب سے پہلے ادب ہی دلاتا ہے۔ اپنے آپ کو انقلابی کہے بغیر ادب ہر بڑے اور بنیادی انقلاب کا نقیب ہوتا ہے۔ چونکہ ادب ایک آلہ ہے نئے توازن کی جستجو کا، اس لیے تبدیلیوں کی حمایت ادب کے لیے ناگزیر ہے۔“

(بحوالہ اردو نظموں کا احتجاجی آئینگ، شہزاد انجم برہانی، ص: ۲۷)



Spiral organization of *quasi-periodic* shrimp-shaped domains in a discrete predator–prey system

Cite as: Chaos 34, 083126 (2024); doi: 10.1063/5.0208457

Submitted: 15 March 2024 · Accepted: 10 July 2024 ·

Published Online: 20 August 2024



N. C. Pati^{a)} 

AFFILIATIONS

Department of Mathematics, Bidhan Chandra College, Asansol 713304, Paschim Burdwan, West Bengal, India

^{a)}Author to whom correspondence should be addressed: naresh@bccollegeasansol.ac.in and ncpati.math@gmail.com

ABSTRACT

In this paper, we report the discovery of some novel dynamical scenarios for quasi-periodic shrimp-shaped structures embedded within chaotic phases in bi-parameter space of a discrete predator–prey system. By constructing high-resolution, two-dimensional stability diagrams based on Lyapunov exponents, we observe the abundance of both periodic and quasi-periodic shrimp-shaped organized domains in a certain parameter space of the system. A comprehensive comparative analysis is conducted to elucidate the similarities and differences between these two types of shrimps. Our analysis reveals that, unlike periodic shrimp, quasi-periodic shrimp induces (i) torus bubbling transition to chaos and (ii) multistability with multi-tori, torus-chaotic, and multi-chaotic coexisting attractors, resulting from the crossing of its two inner antennae. The basin sets of the coexisting attractors are analyzed, and we observe the presence of intriguing basin boundaries. We also verify that, akin to periodic shrimp structures, quasi-periodic shrimps also maintain the three-times self-similarity scaling. Furthermore, we encounter the occurrence of spiral organization for the self-distribution of quasi-periodic shrimps within a large chaotic domain. We believe that these novel findings will significantly enhance our understanding of shrimp-shaped structures and the intricate dynamics exhibited by their distribution in chaotic regimes.

Published under an exclusive license by AIP Publishing. <https://doi.org/10.1063/5.0208457>

The shrimp-like structure is a typical island of stable (periodic/quasi-periodic) regular oscillations within a chaotic background, often observed in bi-parameter bifurcation analyses of non-linear dynamical systems. Typically, this stable structure is characterized by a central head with four narrow antennae, and it emerges as a consequence of the intersection of two superstable cycles. Since the late nineties, extensive research has been dedicated to exploring the emergence of periodic shrimp-shaped islands, corresponding to periodic attractors, and their self-organization within aperiodic regimes. Popovych *et al.*¹ have identified the existence of quasi-periodic shrimp. Inspired by this work, our current study focuses on uncovering several novel dynamical scenarios associated with quasi-periodic shrimps and their clustering in the parameter space of a discrete-time predator–prey system. Our investigation has unveiled the occurrence of quasi-periodic shrimp induced torus bubbling transition to chaos and multistability with three types of coexisting attractors, viz., multi-quasiperiodic, quasiperiodic-chaotic, and multi-chaotic. The similarities and differences between periodic and


quasi-periodic shrimps are extensively analyzed. Additionally, we revealed, for the first time, the emergence of spiral organization among quasi-periodic shrimps. The spiral organization for periodic shrimps was reported in Refs. 2–4.

I. INTRODUCTION

Bifurcation diagrams, phase portraits, and time series plots are some common and frequently used tools for investigating asymptotic behaviors of a nonlinear dynamical system with respect to a control parameter. However, recent decades have witnessed a notable shift in focus toward exploring nonlinear systems in bi-parameter space, wherein two control parameters of the underlying system are varied simultaneously. This approach not only provides a comparatively more intricate perspective of the dynamics but also unveils novel dynamical features and transitional patterns that cannot be obtained in single-parameter space with only one varying control parameter.^{5,6}

Article

Terahertz Radiation from High Electron Mobility Avalanche Transit Time Sources Prospective for Biomedical Spectroscopy

Sahanowaj Khan ¹, Aritra Acharyya ² , Hiroshi Inokawa ³ , Hiroaki Satoh ³ , Arindam Biswas ^{4,*} , Rudra Sankar Dhar ¹ , Amit Banerjee ⁵  and Alexey Y. Seteikin ^{6,7,*} 

- ¹ Department of Electronics & Communication Engineering, National Institute of Technology Mizoram, Chaltlang, Aizawl 796012, Mizoram, India; khannowda@yahoo.co.in (S.K.); rudra.ece@nitmz.ac.in (R.S.D.)
² Department of Electronics and Communication Engineering, Cooch Behar Government Engineering College, Harinchawra, Ghughumari, Cooch Behar 736170, West Bengal, India; ari_besu@yahoo.co.in
³ Research Institute of Electronics, Shizuoka University, Hamamatsu 4328011, Japan; inokawa.hiroshi@shizuoka.ac.jp (H.I.); satoh.hiroaki@shizuoka.ac.jp (H.S.)
⁴ Centre for IoT and AI Integration with Education-Industry-Agriculture, Department of Mining Engineering, Kazi Nazrul University, Asansol 713340, West Bengal, India
⁵ Microsystem Design-Integration Lab, Physics Department, Bidhan Chandra College, Asansol 713303, West Bengal, India; amitbanerjee.nus@gmail.com
⁶ Immanuel Kant Baltic Federal University, 236000 Kaliningrad, Russia
⁷ Amur State University, 675027 Blagoveshchensk, Russia
* Correspondence: mailarindambiswas@yahoo.co.in (A.B.); seteikin@mail.ru (A.Y.S.)

Abstract: A Schottky barrier high-electron-mobility avalanche transit time (HEM-ATT) structure is proposed for terahertz (THz) wave generation. The structure is laterally oriented and based on AlGa_N/Ga_N two-dimensional electron gas (2-DEG). Trenches are introduced at different positions of the top AlGa_N barrier layer for realizing different sheet carrier density profiles at the 2-DEG channel; the resulting devices are equivalent to high–low, low–high and low-high–low quasi-Read structures. The DC, large-signal and noise simulations of the HEM-ATTs were carried out using the Silvaco ATLAS platform, non-sinusoidal-voltage-excited large-signal and double-iterative field-maximum small-signal simulation models, respectively. The breakdown voltages of the devices estimated via simulation were validated by using experimental measurements; they were found to be around 17–18 V. Under large-signal conditions, the series resistance of the device is estimated to be around 20 Ω. The large-signal simulation shows that the HEM-ATT source is capable of delivering nearly 300 mW of continuous-wave peak power with 11% conversion efficiency at 1.0 THz, which is a significant improvement over the achievable THz power output and efficiency from the conventional vertical Ga_N double-drift region (DDR) IMPATT THz source. The noise performance of the THz source was found to be significantly improved by using the quasi-Read HEM-ATT structures compared to the conventional vertical Schottky barrier IMPATT structure. These devices are compatible with the state-of-the-art medium-scale semiconductor device fabrication processes, with scope for further miniaturization, and may have significant potential for application in compact biomedical spectroscopy systems as THz solid-state sources.

Keywords: avalanche transit time; high electron mobility; 2-DEG; monolithic integration; noise measure; noise spectral density; terahertz biomedical



Citation: Khan, S.; Acharyya, A.; Inokawa, H.; Satoh, H.; Biswas, A.; Dhar, R.S.; Banerjee, A.; Seteikin, A.Y. Terahertz Radiation from High Electron Mobility Avalanche Transit Time Sources Prospective for Biomedical Spectroscopy. *Photonics* **2023**, *10*, 800. <https://doi.org/10.3390/photonics10070800>

Received: 29 May 2023
Revised: 27 June 2023
Accepted: 6 July 2023
Published: 10 July 2023



Copyright: © 2023 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

1. Introduction

Recently, the frequency gap between the millimeter-wave and infrared bands, known as the terahertz gap (THz-gap), is drawing the attention of researchers due to its enormous possible applications in the fields of imaging, astronomy and spectroscopy; the quality inspection of industrial, medical and pharmaceutical products; in bio-sensing; etc. [1–8]. Some solid-state devices such as high-electron-mobility transistors (HEMTs), heterojunction