3.4.2: The institution provides incentives to teachers who receive state, national and international recognitions/awards

1.Commendation and monetary incentive at a University function

Marwadi University

MARWADI EDUCATION FOUNDATION'S GROUP OF INSTITUTIONS

Rajkot Morbi Highway, At : Gauridad. Tal. & Dist : Rajkot - 360003
Email : Info@marwadieducation.edu.in

MARWADI CHANDARANA GROUP

Expense Approval Note Against Budget

Print Date : 01/06/2022

Approval ID	:	4728
Approval For	:	
Department Name	:	CHEMISTRY
SUBJECT	:	Research Incentive

Details :

Dear Sir,

I am Dr. Sabera Bijani, Working as an Assistant Professor in Department of Chemistry, Marwadi University. In this year I have published two Sci-indexed research paper in reputed journal as metioned detail below.

1. Journal Name: ACS Omega (an ACS Publication), **Impact Factor: 3.512, Title:** Novel Dihydropyrimidinone Derivatives as Potential P-Glycoprotein Modulators

2. Journal Name: Life (MDPI Journal), **Impact Factor: 3.817 Title:** Green Synthesis and Anticancer Potential of 1,4-Dihydropyridines-Based Triazole Derivatives: In Silico and In Vitro Study

With refernce to Research isentive policy of Marwadi University, I here by claim the ammount of Rs. 3000.

Research Incentive		**Allocation :- 0**
Research publication incentive		**Allocation :- 0**
Particular	**Qty.**	**Required Amount**
Incentive for Research Publication (Remarks : Research Incentive)	1	3000
TOTAL		**3000**
GRAND TOTAL		**3000**

Request to please approve the expense,

Regards,

Dr. SABERA BIJANI

CHEMISTRY

_____* Approval Authority *_____

	**1490 - Dr. SABERA BIJANI**			**1267 - Dr. VICKY JAIN**	
Creator	**RS 3000**	**01/06/2022 04:20 PM**	**Approved**	**RS 3000**	**01/06/2022 04:48 PM**

Marwadi University

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Email : Info@marwadieducation.edu.in

MARWADI CHANDARANA GROUP

Expense Approval Note Against Budget

Print Date : 02/06/2022

Approval ID	:	4726
Approval For	:	
Department Name	:	CHEMISTRY
SUBJECT	:	Incentive for research publications

Details :

Dear Sir,

During the academic year 2021-22, I have published total 4 publications - 2 in SCI index with good impact factor journals and 2 in Scopus index journals. With reference to the research incentive policy I hereby claim the amount of Rs. 5000

1. Journal of Medicinal Chemistry - Impact Factor - 7.446

2. Annals of Romanian Society for Cell Biology - Scopus Index

3. Life - Impact factor - 3.817

4. The Pharma Innovation - Scopus Index (NAAS rating - 5.23)

Regards

Dr. Vicky Jain

Research Incentive		**Allocation :- 0**
Research publication incentive		**Allocation :- 0**
Particular	**Qty.**	**Required Amount**
Incentive for research publications (Remarks :)	1	5000
TOTAL		**5000**
GRAND TOTAL		**5000**

Request to please approve the expense,

Regards,

Dr. VICKY JAIN
CHEMISTRY

*** Approval Authority ***

	**1267 - Dr. VICKY JAIN**			**104 - Dr. RAJENDRASINH JADEJA**	
Creator	**RS 5000**	**01/06/2022 10:09 AM**	**Approved**	**RS 5000**	**02/06/2022 10:42 AM**

Pre-Approval Consumed Summary Report

Pre-Approval No:	4535	**Amount:**	2000	**Budget Year:**	1920
Department:	ENVIRONMENTAL SCIENCE & ENGINEERING	**Create Date:**	28/04/2022		
Request By:	DR. NITIN KUMAR SINGH (1671)				

Particular	Qty	Main Head	Sub Head	Amount
Research Publications Incentive	1	Research Incentive	Publication Incentive	2000
			Total :	**2000**

Pre-Approval Consumed Detail

Transaction No	Purpose	Amount	Transaction Type	Date	Creator
26563	Research Publications Incentive	2000	Expense	05/05/2022	NITIN KUMAR SINGH

Total Utilised : 2000

Pre-Approval Consumed Summary Report

Pre-Approval No:	4535	**Amount:**	2000	**Budget Year:**	1920
Department:	ENVIRONMENTAL SCIENCE & ENGINEERING	**Create Date:**	28/04/2022		
Request By:	DR. NITIN KUMAR SINGH (1671)				

Particular	Qty	Main Head	Sub Head	Amount
Research Publications Incentive	1	Research Incentive	Publication Incentive	2000
			Total :	**2000**

Pre-Approval Consumed Detail

Transaction No	Purpose	Amount	Transaction Type	Date	Creator
26563	Research Publications Incentive	2000	Expense	05/05/2022	NITIN KUMAR SINGH

Total Utilised : 2000

Pre-Approval Consumed Summary Report

Pre-Approval No:	3728	**Amount:**	2000	**Budget Year:**	1920
Department:	ENVIRONMENTAL SCIENCE & ENGINEERING	**Create Date:**	01/12/2021		
Request By:	DR. NITIN KUMAR SINGH (1671)				

Particular	Qty	Main Head	Sub Head	Amount
Research Publications Incentive	1	Research Incentive	Publication Incentive	2000
			Total :	**2000**

Pre-Approval Consumed Detail

Transaction No	Purpose	Amount	Transaction Type	Date	Creator
24711	Research Publications Incentive	2000	Expense	20/12/2021	NITIN KUMAR SINGH

Total Utilised : 2000

Pre-Approval Consumed Summary Report

Pre-Approval No:	3822	**Amount:**	2000	**Budget Year:**	1920
Department:	ENVIRONMENTAL SCIENCE & ENGINEERING	**Create Date:**	20/12/2021		
Request By:	MR. ABHISHEK GUPTA (381)				

Particular	Qty	Main Head	Sub Head	Amount
research publication incentives	1	Research Incentive	Publication Incentive	2000
			Total :	**2000**

Pre-Approval Consumed Detail

Transaction No	Purpose	Amount	Transaction Type	Date	Creator
24747	Research Publication Incentive	2000	Expense	21/12/2021	ABHISHEK GUPTA
		Total Utilised : 2000			

Pre-Approval Consumed Summary Report

Pre-Approval No:	3828	**Amount:**	2000	**Budget Year:**	1920
Department:	ENVIRONMENTAL SCIENCE & ENGINEERING	**Create Date:**	21/12/2021		
Request By:	MR. ABHISHEK GUPTA (381)				

Particular	Qty	Main Head	Sub Head	Amount
research publication incentives	1	Research Incentive	Publication Incentive	2000
			Total :	**2000**

Pre-Approval Consumed Detail

Transaction No	Purpose	Amount	Transaction Type	Date	Creator
24768	Research Publication Incentive	1000	Expense	23/12/2021	ABHISHEK GUPTA
	Total Utilised :	**1000**			

Pre-Approval Consumed Summary Report

Pre-Approval No:	3967	**Amount:**	2000	**Budget Year:**	1920
Department:	ENVIRONMENTAL SCIENCE & ENGINEERING	**Create Date:**	15/01/2022		
Request By:	MR. ABHISHEK GUPTA (381)				

Particular	Qty	Main Head	Sub Head	Amount
Research Publication Incentive	1	Research Incentive	Publication Incentive	2000
			Total :	**2000**

Pre-Approval Consumed Detail

Transaction No	Purpose	Amount	Transaction Type	Date	Creator
	Total Utilised :				

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MARWADI CHANDARANA GROUP

Expense Approval Note Against Budget

Print Date : 02/08/2022

Approval ID	:	5072
Approval For	:	
Department Name	:	CHEMICAL ENGINEERING
SUBJECT	:	Research Publication Incentive

Details :

Research article/ Book Chapter Publication in a SCOPUS indexed book series

The details of the publication are as follows,

Chapter Title - An Assessment of GHG Emission Reduction by Using Renewable Energy and Energy Efficient Processes

Authors - Kosha Navnit Vaishnav & Ritesh Ramesh Palkar

- **DOI** - https://doi.org/10.1007/978-3-030-96554-9_26
- **Published on** - 12 May 2022
- **Book Chapter Online Link-** https://link.springer.com/chapter/10.1007/978-3-030-96554-9_26

Research Incentive		**Allocation :- 0**
Publication Incentive		**Allocation :- 0**
Particular	**Qty.**	**Required Amount**
Research Publication Incentive (Remarks : Book Chapter Publication in Scopus indexed book series)	1	1000
TOTAL		**1000**
GRAND TOTAL		**1000**

Request to please approve the expense,

Regards,

Dr. RITESH PALKAR

CHEMICAL ENGINEERING

_____* Approval Authority *_____

	**1444 - Dr. RITESH PALKAR**			**381 - Mr. ABHISHEK GUPTA**			**104 - Dr. RAJENDRASINH JADEJA**	
Creator	**RS 1000**	**01/08/2022 12:10 PM**	**Approved**	**RS 1000**	**02/08/2022 09:04 AM**	**Approved**	**RS 1000**	**02/08/2022 05:12 PM**

Marwadi University

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Email : Info@marwadieducation.edu.in

MARWADI CHANDARANA GROUP

Expense Approval Note Against Budget

Print Date : 02/08/2022

Approval ID	:	5072
Approval For	:	
Department Name	:	CHEMICAL ENGINEERING
SUBJECT	:	Research Publication Incentive

Details :

Research article/ Book Chapter Publication in a SCOPUS indexed book series

The details of the publication are as follows,

Chapter Title - An Assessment of GHG Emission Reduction by Using Renewable Energy and Energy Efficient Processes

Authors - Kosha Navnit Vaishnav & Ritesh Ramesh Palkar

- **DOI** - https://doi.org/10.1007/978-3-030-96554-9_26
- **Published on** - 12 May 2022
- **Book Chapter Online Link-** https://link.springer.com/chapter/10.1007/978-3-030-96554-9_26

Research Incentive		**Allocation :- 0**
Publication Incentive		**Allocation :- 0**
Particular	**Qty.**	**Required Amount**
Research Publication Incentive (Remarks : Book Chapter Publication in Scopus indexed book series)	1	1000
TOTAL		**1000**
GRAND TOTAL		**1000**

Request to please approve the expense,

Regards,

Dr. RITESH PALKAR

CHEMICAL ENGINEERING

_____* Approval Authority *_____

	**1444 - Dr. RITESH PALKAR**			**381 - Mr. ABHISHEK GUPTA**			**104 - Dr. RAJENDRASINH JADEJA**	
Creator	**RS 1000**	**01/08/2022 12:10 PM**	**Approved**	**RS 1000**	**02/08/2022 09:04 AM**	**Approved**	**RS 1000**	**02/08/2022 05:12 PM**

Marwadi University

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Rajkot Morbi Highway, At : Gauridad. Tal. & Dist : Rajkot - 360003
Email : Info@marwadieducation.edu.in

Expense Approval Note Against Budget

Print Date : 29/01/2022

Approval ID	:	4027
Approval For	:	
Department Name	:	ENVIRONMENTAL SCIENCE & ENGINEERING
SUBJECT	:	Resarch Incentive

Details :

Title: Various Green Nanomaterials Used for Wastewater and Soil Treatment: A Mini-Review

Authors: Jayarj Nakum and Debleena Bhattacharya

Journal: Frontiers in Environmental Science

Impact Factor: 4.58

Date of Publishing: January 28, 2022

Weblink: https://doi.org/10.3389/fenvs.2021.724814

Research Incentive		**Allocation :- 0**
Publication Incentive		**Allocation :- 0**
Particular	**Qty.**	**Required Amount**
Research Incentive (Remarks : Title: Various Green Nanomaterials Used for Wastewater and Soil Treatment: A Mini-Review Authors: Jayarj Nakum and Debleena Bhattacharya Journal: Frontiers in Environmental Science Impact Factor: 4.58 Date of Publishing: January 28, 2022 Weblink: https://doi.org/10.3389/fenvs.2021.724814)	1	2000
TOTAL		**2000**
GRAND TOTAL		**2000**

Request to please approve the expense,

Regards,

Dr. DEBLEENA BHATTACHARYA

ENVIRONMENTAL SCIENCE & ENGINEERING

*** Approval Authority ***

	**1925 - Dr. DEBLEENA BHATTACHARYA**			**381 - Mr. ABHISHEK GUPTA**			**104 - Dr. RAJENDRASINH JADEJA**	
Creator	**RS 2000**	**29/01/2022 12:21 PM**	**Approved**	**RS 2000**	**29/01/2022 12:29 PM**	**Approved**	**RS 2000**	**29/01/2022 04:40 PM**

	1158 - Mr. NARESHKUMAR JADEJA	
Approved	RS 2000	29/01/2022 06:14 PM

Marwadi University

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Email : Info@marwadieducation.edu.in

MARWADI CHANDARANA GROUP

Expense Approval Note Against Budget

Print Date : 10/05/2022

Approval ID	:	4612
Approval For	:	
Department Name	:	ENVIRONMENTAL SCIENCE & ENGINEERING
SUBJECT	:	Resarch Incentive

Details :

Title: Climate Changes and Epidemiological Hotspots Authors: Debleena Bhattacharya & V K Singh Publishers: CRC Press Date of Publishing: March 22, 2022 Weblink: https://www.routledge.com/Climate-Changes-and-Epidemiological-Hotspots/Bhattacharya-Singh/p/book/9780367637682 Reference: Bhattacharya, D. and Singh, V.K., 2022. Climate Changes and Epidemiological Hotspots. CRC Press. ISBN No.: 9780367637767

Research Incentive		**Allocation :- 0**
Publication Incentive		**Allocation :- 0**
Particular	**Qty.**	**Required Amount**
Research Incentive (Remarks : Title: Climate Changes and Epidemiological Hotspots Authors: Debleena Bhattacharya & V K Singh Publishers: CRC Press Date of Publishing: March 22, 2022 Weblink: https://www.routledge.com/Climate-Changes-and-Epidemiological-Hotspots/Bhattacharya-Singh/p/book/9780367637682 Reference: Bhattacharya, D. and Singh, V.K., 2022. Climate Changes and Epidemiological Hotspots. CRC Press. ISBN No.: 9780367637767)	1	10000
TOTAL		**10000**
GRAND TOTAL		**10000**

Request to please approve the expense,

Regards,

Dr. DEBLEENA BHATTACHARYA

ENVIRONMENTAL SCIENCE & ENGINEERING

_____* Approval Authority *_____

	**1925 - Dr. DEBLEENA BHATTACHARYA**			**381 - Mr. ABHISHEK GUPTA**			**104 - Dr. RAJENDRASINH JADEJA**	
Creator	**RS 10000**	**10/05/2022 09:00 AM**	**Approved**	**RS 10000**	**10/05/2022 09:00 AM**	**Approved**	**RS 10000**	**10/05/2022 01:23 PM**

Marwadi University

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Rajkot Morbi Highway, At : Gauridad. Tal. & Dist : Rajkot - 360003
Email : Info@marwadieducation.edu.in

Expense Approval Note Against Budget

Print Date : 23/12/2021

Approval ID	:	3830
Approval For	:	
Department Name	:	ENVIRONMENTAL SCIENCE & ENGINEERING
SUBJECT	:	Incentive for Reseach publication

Details :

Titanium dioxide based nanocomposites – Current trends and emerging strategies for the photocatalytic degradation of ruinous environmental pollutants

Environmental Research
journal homepage: www.elsevier.com/locate/envres

Research Incentive		**Allocation :- 0**
Publication Incentive		**Allocation :- 0**
Particular	**Qty.**	**Required Amount**
Environmental Research journal homepage: www.elsevier.com/locate/envres (Remarks : Titanium dioxide based nanocomposites – Current trends and emerging strategies for the photocatalytic degradation of ruinous environmental pollutants Pareshkumar G. Moradeeyaa, , Archana Sharma, Madhava Anil Kumar, Shaik Basha)	1	2000
TOTAL		**2000**
GRAND TOTAL		**2000**

Request to please approve the expense,

Regards,

Dr. ARCHANA SHARMA

ENVIRONMENTAL SCIENCE & ENGINEERING

_____* Approval Authority *_____

	**1262 - Dr. ARCHANA SHARMA**		
Creator	**RS 2000**	**21/12/2021 04:56 PM**	

	**381 - Mr. ABHISHEK GUPTA**		
Approved	**RS 2000**	**22/12/2021 10:51 AM**	

	**104 - Dr. RAJENDRASINH JADEJA**		
Approved	**RS 2000**	**23/12/2021 02:29 PM**	

	**1158 - Mr. NARESHKUMAR JADEJA**		
Approved	**RS 2000**	**23/12/2021 04:23 PM**	

Marwadi University

MARWADI EDUCATION FOUNDATION'S GROUP OF INSTITUTIONS

Rajkot Morbi Highway, At : Gauridad. Tal. & Dist : Rajkot - 360003
Email : Info@marwadieducation.edu.in

Expense Approval Note Against Budget

Print Date : 24/03/2022

Approval ID	:	4310
Approval For	:	
Department Name	:	ENVIRONMENTAL SCIENCE & ENGINEERING
SUBJECT	:	Incentive for Reseach publication

Details :

Black fungus outbreak in India- a direct consequence of COVID-19 surge: A myth or reality

https://doi.org/10.1016/j.gr.2021.12.016

Research Incentive		**Allocation :- 0**
Publication Incentive		**Allocation :- 0**
Particular	**Qty.**	**Required Amount**
Incentive for Reseach publication (Remarks : Black fungus outbreak in India- a direct consequence of COVID-19 surge: A myth or reality published online on Gondwana Research, Science Direct https://doi.org/10.1016/j.gr.2021.12.016)	1	2000
TOTAL		**2000**
	GRAND TOTAL	**2000**

Request to please approve the expense,

Regards,

Dr. ARCHANA SHARMA

ENVIRONMENTAL SCIENCE & ENGINEERING

_____* Approval Authority *_____

	**1262 - Dr. ARCHANA SHARMA**			**381 - Mr. ABHISHEK GUPTA**			**104 - Dr. RAJENDRASINH JADEJA**	
Creator	**RS 2000**	**24/03/2022 12:56 PM**	**Approved**	**RS 2000**	**24/03/2022 02:43 PM**	**Approved**	**RS 2000**	**24/03/2022 03:31 PM**

Marwadi University

MARWADI EDUCATION FOUNDATION'S GROUP OF INSTITUTIONS

Rajkot Morbi Highway, At : Gauridad. Tal. & Dist : Rajkot - 360003
Email : Info@marwadieducation.edu.in

Expense Approval Note Against Budget

Print Date : 24/03/2022

Approval ID	:	4311
Approval For	:	
Department Name	:	ENVIRONMENTAL SCIENCE & ENGINEERING
SUBJECT	:	Incentive for Reseach publication

Details :

Conductive polymer layered semiconductor for degradation of triclopyr acid and 2,4-dichlorophenoxyacetic acid from aqueous stream using coalesce adsorption-photocatalysis technique
Pareshkumar G. Moradeeya, Madhava Anil Kumar , Archana Sharma , Shaik Basha

Chemosphere 298 (2022) 134360

Research Incentive		**Allocation :- 0**
Publication Incentive		**Allocation :- 0**
Particular	**Qty.**	**Required Amount**
Incentive for Reseach publication (Remarks : Conductive polymer layered semiconductor for degradation of triclopyr acid and 2,4-dichlorophenoxyacetic acid from aqueous stream using coalesce adsorption-photocatalysis technique, Chemosphere 298 (2022) 134360. https://authors.elsevier.com/c/1enLwAOM9zadI)	1	2000
TOTAL		**2000**
GRAND TOTAL		**2000**

Request to please approve the expense,

Regards,

Dr. ARCHANA SHARMA

ENVIRONMENTAL SCIENCE & ENGINEERING

_____* Approval Authority *_____

	**1262 - Dr. ARCHANA SHARMA**			**381 - Mr. ABHISHEK GUPTA**			**104 - Dr. RAJENDRASINH JADEJA**	
Creator	**RS 2000**	**24/03/2022 02:17 PM**	**Approved**	**RS 2000**	**24/03/2022 02:43 PM**	**Approved**	**RS 2000**	**24/03/2022 03:31 PM**

15/11/2021

To,

HOD/Dean/Registrar,

Marwadi University.

Subject : Regarding Marwadi University Incentive Policy for Research and Publications.

Respected sir,

We Dr, Shobhit K patel (E-code:1329), Sunil Lavadiya (E-code:87) and Vishal Sorathiya (E-Code:695), working as an Professor/ assistant professor in department of ICT and CE - AI&BD engineering. We would like to request for sanction the following amount as per our MU Incentive policy for research and publication. Copy of publications is attached with this application.

Sr. No	Paper Title	Type	No of Authors from MU	Author1 (Vishal Sorathiya)	Author2 (Sunil Lavadiya)	Author3 (Shobhit patel)
1	Design and analysis of a super wideband (0.09- 30.14 THz) graphene based log periodic dipole array antenna for terahertz applications	SCI - Journal (Optik)	2	1000	1000	
2	Design and Verification of Novel Low-Profile Miniaturized Pattern and Frequency Tunable Microstrip Patch Antenna Using Two PIN Diodes	SCI - Journal (Brazillian Journal of Physics)	2	1000	1000	
3	A comparative study of broadband solar absorbers with different gold metasurfaces and MgF2 on tungsten substrates	SCI - Journal (Journal of Computational Electronics)	2	1000	1000	
4	Differential coding scheme based FSO channel for optical coherent DP-16 QAM transceiver systems	Scopus - Journal (Journal of Optical Communications)	3	666	666	666
5	CWDM communication system based inline erbium-doped fiber amplifiers with the linear geometrical polarization model	Scopus - Journal (Journal of Optical Communications)	3	666	666	666
6	Fake News Polarization for Sentiment Analysis	Book Chapter - IGI Global (Book Title: Impact and Role of Digital Technologies in Adolescent Lives)	3	666	666	
7	Terahertz Antenna: Fundamentals, Types, Fabrication, and Future Scope	Book Chapter - Springer Nature (Advances in Terahertz Technology and Its Applications)	2	1000	1000	
8	Graphene-based tunable infrared multi band absorber	Book Chapter - Springer Nature (Advances in Terahertz Technology and Its Applications)	2	1000	1000	

9	Graphene-Based Plasmonic Absorber For Biosensing Applications Using Gold Split Ring Resonator Metasurfaces	SCI - Journal (Journal of Lightwave Technology)	2	1000		
10	Broadband polarization-insensitive Jerusalem-shaped metasurface absorber based on phase-change material for the visible region	SCI – Journal (Physica B: Condensed Matter)	2			666
11	Tunable and highly sensitive graphene-based biosensor with circle/split ring resonator metasurface for sensing hemoglobin/urine biomolecules	SCI – Journal (Physica B: Condensed Matter)	1			2000
12	Comparative analysis of metasurface array-based solar absorber for visible region	SCI – Journal (Optical and Quantum Electronics)	2			1000
13	Highly sensitive and tunable refractive index biosensor based on phase change material	SCI – Journal (Physica B: Condensed Matter)	1			2000
14	Encrypted and tunable graphene-based metasurface refractive index sensor	SCI – Journal (Microwave and Optical Technology Letters)	1			2000
15	Multiband Jerusalem cross-shaped angle insensitive metasurface absorber for X-band application	SCI – Journal (Journal of Electromagnetic Waves and Applications)	3			666
16	Graphene-based tunable broadband polarizer for infrared frequency	SCI – Journal (Brazillian Journal of Physics)	2	1000		1000
Total Amount				8998	6998	10664
Maximum eligible Amount				8998	6998	10000

Looking for your support.

Thanks and Regards,

Prof. Sunil Lavadiya

Department of ICT

Prof. Vishal Sorathiya

Department of ICT

Dr. Shobhit K Patel

Department of CE-AI&BD

Prof. Jay Teraiya

Department of CE

Prof. Chandrasinh Parmar

HoD – ICT Engineering

Optik - International Journal for Light and Electron Optics 247 (2021) 167991

Contents lists available at ScienceDirect

Optik

journal homepage: www.elsevier.com/locate/ijleo

Design and analysis of a super wideband (0.09 – 30.14 THz) graphene based log periodic dipole array antenna for terahertz applications

Ch Murali Krishna [a], Sudipta Das [b,*], Soufian Lakrit [c], Sunil Lavadiya [d], Boddapati Taraka Phani Madhav [e], Vishal Sorathiya [d]

[a] Research Scholar, Department of Electronics & Communication Engineering, Indian Institute of Information Technology, Design, and Manufacturing, Jabalpur, M.P., India
[b] Department of Electronics & Communication Engineering, IMPS College of Engineering & Technology, Malda, West Bengal, India
[c] Applied Mathematics and Information Systems Laboratory, EST of Nador, Mohammed First University, Oujda, Morocco
[d] Department of Information and Communication Technology, Marwadi University, Rajkot, Gujarat 360002, India
[e] Department of Electronics and Communication Engineering, Koneru Lakshmaiah Education Foundation, Guntur, AP, India

ARTICLE INFO

Keywords:
Log periodic dipole array (LPDA)
Protrudent strip
Super wideband
Peak gain
Radiation efficiency
THz applications

ABSTRACT

A micro-scaled printed log periodic dipole array (LPDA) antenna is proposed for terahertz (THz) applications. The proposed low profile graphene conductor based LPDA antenna is designed with integrated protudent dipoles to realize super wide bandwidth and high gain characteristics. The suggested THz antenna is designed on a 10 μm thick Rogers RT / Duroid 5880 ™ substrate material of dimension 450 μm × 500 μm. The proposed antenna exhibits 2:1 VSWR operating super wide bandwidth (SWB) of 30050 GHz (0.09–30.14 THz) with a peak gain of 16.02 dBi. The designed antenna shows fractional bandwidth of 199.46% along with a huge bandwidth ratio of 334.88:1. The radiation efficiency balancing from 85% to 98.2% is maintained throughout the whole operating –10 dB SWB (0.09–30.14 THz). Design formulation of the proposed structure, structural parametric analysis, surface current distribution and characteristics parameters are discussed in detail in this paper. The proposed antenna covers the entire frequency band of the terahertz region to support a number of sub-terahertz and terahertz communication applications such as high speed short distance communication, video rate imaging, biomedical imaging, surveillance, mine detection, sensing, and security scanning.

1. Introduction

In the current era, the ever-increasing demand for faster data rates has brought a revolutionary change in the domain of wireless communication technology. The modern miniaturized multifunctional gadgets require a higher communication data rate to ensure ultra high speed communication links. In the coming future, the utilization of mm-wave spectrum will not be sufficient to meet the requirements of next generation communication applications. The next generation's commercial and civilian applications will seek gigantic data rates in terabits/sec (Tbs) and enormous channel capacity. The terahertz wireless communication can be considered as a potential option to satisfy the requirements of next generation advanced communication applications by exploring its massive

* Corresponding author.
E-mail address: sudipta.das1985@gmail.com (S. Das).

https://doi.org/10.1016/j.ijleo.2021.167991
Received 26 August 2021; Accepted 13 September 2021
Available online 20 September 2021

Brazilian Journal of Physics
https://doi.org/10.1007/s13538-021-00951-2

GENERAL AND APPLIED PHYSICS

Design and Verification of Novel Low-Profile Miniaturized Pattern and Frequency Tunable Microstrip Patch Antenna Using Two PIN Diodes

Sunil P. Lavadiya[1] · Vishal Sorathiya[1] · Sunny Kanzariya[2] · Bhavik Chavda[2] · Osama S. Faragallah[3] · Mahmoud M. A. Eid[4] · Ahmed Nabih Zaki Rashed[5]

Received: 19 March 2021 / Accepted: 22 June 2021

Abstract
The presented manuscript represents a miniaturized microstrip patch antenna with frequency and pattern reconfigurability. Three modes are analyzed based upon switching actions of two PIN diodes to achieve tunability. Low profile material FR-4 is used for the fabrication. The analysis is carried out in terms of tunability, reflectance response, resonance frequency, electric field, and bandwidth. The proposed structure provides tunability for the two bands. The proposed design provides the maximum tunability of 340 MHz, the bandwidth of 700 MHz, reflectance response of − 40.38 dB, an electric field of 4234.9 V/m, and beam tilting capability of 30°, − 40°, + 35°, − 90°, and 120°. Simulation and fabrication are carried out for the verification. The optimization of design is carried out by varying the dimensions of the three parameters. The comparison is also carried with previously published work. The proposed design can be used for multiband applications in the S and C bands.

Keywords Patch antenna · Reconfigurable · Bandwidth · Tunability · PIN diode

1 Introduction

To configure multiple wireless communication applications, it is desired to achieve tunable characteristics. The antenna must be reconfigurable to accomplish the new design specification [1]. New wireless communication systems have many standards. Hence, they require the new systems with the reconfigurable concept because it provides outstanding antenna performance. It provides multifunctionality using a single design with low cost and good compact size. A single reconfigurable antenna can operate multiple antennas [2]. Nowadays, in wireless systems, flexible antennas are highly in demand, and they should be reconfigurable. Reconfigurability can be accomplished by varying the radiation pattern, frequency, and polarization [3]. This antenna improves security and saves energy by improving signal directions and filtering applications [4, 5].

While designing the reconfigurable antenna, antenna designers have so many important factors in their minds. The factors such as good impedance, the antenna should have decent gain, and steady radiation pattern [6]. Based on an antenna's different properties, four reconfiguration techniques are available: electric, optical, machine-driven, and substantial change [7]. The electrically reconfigurable antenna can be achieved by inserting solid-state elements such as varactor diode. This method gives smooth frequency tunneling by changing the capacitance value or PIN diode or adding a microelectromechanical system (RF-MEMS) [8]. Reconfiguration using PIN diode provides more dynamic reconfiguration as compared to RF-MEMS. Varactor diodes and PIN diodes have a higher switching speed compared to RF-MEMS switches and are within the

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A comparative study of broadband solar absorbers with different gold metasurfaces and MgF_2 on tungsten substrates

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Abstract

A comparative study of different highly efficient broadband solar absorbers based on gold resonators is presented. We compare the absorption parameters for cylindrical, hollow cylindrical, pyramid, and sawtooth-shaped gold resonator structures over a wide input incident range at solar frequencies from 100 to 1200 THz (250 to 3000 nm). The performance of the structures is quantified in terms of the absorption, reflectance, and transmittance. We also numerically calculate the behavior of the structures when varying geometric parameters including the overall dimensions, the substrate size, and the resonator thickness. The proposed absorber structures can trap > 98% of the input incident light over a wide range of the terahertz (THz) spectrum. The performance of the absorber structures is compared based on their response to AM1.5 spectral irradiance to confirm their wide absorption behavior across the solar range. The proposed absorber structures offer higher absorption efficiency over a wide range of the solar spectrum. The effect of the height and other physical dimensions on the absorption is also presented. These results will help to choose the operating band for wide-angle and short-angle applications. This article also provides suggestions for the design of selective band absorption by changing the dimensions of such structures. The proposed absorber structures could be applied to design highly efficient solar cells with stable wide-angle behavior across input incident waves.

Keywords Solar absorber · Wideband · Metasurface · Perturbation

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Differential coding scheme based FSO channel for optical coherent DP-16 QAM transceiver systems

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Abstract: This article has indicated optical coherent differential polarization (DP) 16 quadrature amplitude modulation (QAM) transceiver systems with free-space optical (FSO) channel in the presence of differential coding scheme. The optical coherent DP 16-QAM receiver executes the reverse process conversion of the optical signal into an electrical one that is detected to the users. The proposed optical coherent DP-16 QAM transceiver systems based FSO channel model with differential coding has been presented and compared with the previous model. However, the simulation results have confidence realization about the superiority of the proposed simulation model. Hence the proposed optical coherent DP-16 QAM transceiver systems simulation model with differential coding is verified and validated the enhancement performance based on simulation performance parameters.

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Keywords: coherent DP-16 QAM; differential coding; FSO; transceiver system.

1 Introduction

The need for the development of an economical and reliable transmission medium with enormous bandwidth capable of handling such a huge amount of information and connecting all computers (including cell phones) over the worldwide network has been a crucial motivation in modern telecommunications [1–16]. Optical fiber systems with their inherent potential of infinite bandwidth play an effective role in the development of telecommunication systems. The optical fiber is a hair-thin, flexible, transparent acting as a transmission medium [17–29], light waveguide, or light pipe, to guide or propagate light between the two fiber ends from the transmitter to the receiver [30–52]. The optical fibers used in optical communications allow higher data rate transmission for ultra-longer distances than other kinds of communications. Optical fibers are now used instead of metallic wires due to their low loss and their numerous advantages [53–70].

They can work reliably even in hostile surrounding environments which may be because of electromagnetic interference, electrostatic discharges, and corrosive atmosphere. Additionally, there is an absence of an unauthorized tapping of data from cables [71–92]. The fiber cable diameter may vary from 1 to 20 mm. The optical cable is formed of single or multiple waveguides which are sheathed in the protective jacket material. This coating or jacketing is also a multilayer of polymer [93–120]. The protective covering shield is made to add mechanical strength and safety for the optical fibers from the mechanical damage. It protects the waveguides from the surrounding circumstances and environmental effects like shocks that affect the optical and physical characteristics of the fiber and even lead to fiber damage [121–130]. The optical fiber mainly contains two concentric layers of highly pure silica glass; the central core and the cladding which are surrounded by the protective sheath [131–136]. It is generally composed of core, cladding, buffer, and jacket. The buffer layer is put on the top of the cladding before the plastic jacket [137–153].

Mahmoud M. A. Eid, Vishal Sorathiya, Sunil Lavadiya, Juveriya Parmar, Shobhit K. Patel, Shaimaa Ahmed Ali and Ahmed Nabih Zaki Rashed*

CWDM communication system based inline erbium-doped fiber amplifiers with the linear geometrical polarization model

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Abstract: Optical fiber coarse wavelength division multiplexing (CWDM) with erbium-doped fiber inline-amplifiers for the linear polarization geometrical model is studied in this paper for fiber system optimization by using the Optisystem simulation software. Signal gain (SG), noise figure (NF), and signal/noise are measured against CWDM optical fiber variations. The erbium-doped fiber amplifier (EDFA) is based on the Giles model which solves the steady-state rate equations for SG and signal absorption parameters with the cross-section area of the amplifier itself. The signal is optimized at EDFA length of 6 m, 10 Gb/s data rates (DRs) transmission and 10 km CWDM fiber optic length (FOL). Max. Q factor is degraded and min. BER is upgraded with both CWDM optical FLs and higher DRs transmission increase.

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Keywords: EDFA preamplifier; linear polarization; optical fiber CWDM; power dependent.

1 Introduction

The optical communication systems fulfill the requirements of good communication system [1–11]. The benefits of optical fiber transmission are low loss transmission medium per unit length offering less signal attenuation which is required especially for long transmission distances (0.2 dB/km). This verifies almost lossless transmission (error-free reliable transmission) over long haul networks [12–31]. Longer repeater span and therefore decreased number of repeaters required considerably and increased transmission distance for signal propagation due to its lower cable losses. This will minimize the overall system cost and complexity [32–41]. Very high data speed transmission for multiple signals like audio, video, and data (broadband services delivered to the home) [42–57]. Extremely wide bandwidth means huge data rates and increased (bit rate – distance) product to support high speed communications [58–67]. Fiber is smaller diameter thus smaller size and less space for storage. Fiber is more flexible and lightweight cables because they are fabricated from glass or plastic which is lighter than other metallic cables (aluminum or copper). It is very useful for aircraft, satellites and ships where small and lightweight fibers are beneficial. These flexible cables are required in mechanical and medical imaging systems [68–82].

Fiber is more compact and least weight components (transmitters and receivers). Fiber has more immunity to irradiative and conductive interferences because fibers are dielectric waveguides; nonconductors (electrical insulator made of glass or plastic). Thus, no shock hazards, electrical current, nor voltage is associated with them. Optical fibers are not affected by stray interference pickup which occurred with coaxial cables [83–102]. Fiber is high immunity to noise and thus no cross talk generated from magnetic induction; so ideal for areas of power-carrying lines, utility lines, high lightning strike incidence, and railroad tracks. They are resistant to nuclear radiations, so they are used in the nuclear reactors. Fiber is high signal security compared with other

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Chapter 19
Fake News Polarization for Sentiment Analysis

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ABSTRACT

The popularity of the internet has increased the use of e-commerce websites and news channels. Fake news has been around for many years, and with the arrival of social media and modern-day news at its peak, easy access to e-platform and exponential growth of the knowledge available on social media networks has made it intricate to differentiate between right and wrong information, which has caused large effects on the offline society already. A crucial goal in improving the trustworthiness of data in online social networks is to spot fake news so the detection of spam news becomes important. For sentiment mining, the authors specialise in leveraging Facebook, Twitter, and Whatsapp, the most prominent microblogging platforms. They illustrate how to assemble a corpus automatically for sentiment analysis and opinion mining. They create a sentiment classifier using the corpus that can classify between fake, real, and neutral opinions in a document.

INTRODUCTION

Knowledge sharing has been an important aspect in this 21st century and this has become more effective with the usage of the common platform we all know the Internet. Internet users use many communication tools and the most widely used is microblogging platforms are Facebook, Twitter, and WhatsApp. which contains arbitrarily large text posts (Zhang, Dong, and Yu 2018). This Corpus can be in form of

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Terahertz Antenna: Fundamentals, Types, Fabrication, and Future Scope

Sunil Lavadiya and Vishal Sorathiya

Abstract Terahertz technology has grown in popularity in recent years due to the rapid development of wireless communication applications. To begin, the evolution of Terahertz antennas is briefly studied, and the fundamental concepts of THz antennas are employed. THz antennas are then classified as dielectric antennas, metallic antennas, recent novel material antennas. Following that, the most recent scientific advances in THz horn antennas, photoconductive antennas, on-chip antenna, microstrip antennas, lens antennas, on-chip antenna, graphene sheet-based THz antenna will be discussed. The technological challenges like the smaller size and relatively high loss for the developing THz antennas are addressed, along with promising methods. This chapter also discusses THz antenna designing technology and the critical problems and potential study directions for THz antennas. THz technologies open the new door for the application like radio astronomy, radar imaging, remote sensing, graphene-based plasmonic resonator, broadband communication, high data rate, high switching RF components, and fast-pulse optical time-domain spectroscopic techniques.

Keywords Terahertz antennas · Quantum cascade laser · Photoconductive antenna · Technological challenges · Graphene

1 Introduction

The popularity of wireless communication gadgets and the huge data traffic have reached a new era of accelerated growth [1]. A vast number of systems are now moving from PCs to cellular devices like mobiles, which are easier to bring and run in real-time, however, these conditions often results in a quick rise in data usage

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Polarization of THz Signals Using Graphene-Based Metamaterial Structure

Vishal Sorathiya and Sunil Lavadiya

Abstract Graphene-based Terahertz devices have attracted huge attention because of their ultrathin design and tunable property. The graphene-based polarizer can be formed using a single or multilayer of graphene sheet over the dielectric substrate. The different shapes and size of the engraved graphene geometry make possible to design different band and different mode of the polarizer which was ultrathin in design. The graphene-assisted polarizer also has the tunable by various physical parameters such as chemical potential, frequency, scattering rate. The graphene-based polarizer also provided unusual material properties like negative refractive index which makes the overall polarizer structure a metamaterial device. The proposed book chapter provides the fundamentals of graphene-based polarization devices. The chapter includes the mathematical modeling of the graphene-based polarizers devices and numerical investigation techniques used to identify the performance of the graphene-based polarizer structure. The chapter also includes a detailed comparative analysis of the previously published and available polarization devices in the market.

Keywords Graphene · Polarizer · Terahertz · Tunability

1 Introduction

Metamaterials (MMs), a modern form of the artificial substance that was recently investigated in terms of their non-traditional electromagnetic properties. These features are used to achieve numerous results such as negative refractive index [1], perfect lensing [2], bolometer [3], etc. On the other way, Graphene owns exceptional optical, electrical, and mechanical properties, such as large young modules, high

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Graphene-Based Plasmonic Absorber for Biosensing Applications Using Gold Split Ring Resonator Metasurfaces

Shobhit K. Patel, Juveriya Parmar, Vishal Sorathiya, Rozalina Binti Zakaria, Truong Khang Nguyen, and Vigneswaran Dhasarathan

***Abstract*—We propose a novel graphene-based metasurface plasmonic biosensor. The gold split-ring resonator is used as a metasurface element in the biosensor. Split Ring Resonator structures are used to localize and increase electromagnetic field incidents. Two types of split-ring resonator based metasurface (Single split-ring resonator and Double split-ring resonator) designs are analyzed to observe its effect on biosensing. The proposed biosensor is used to sense hemoglobin and urine biomolecules for their different concentrations. The design results in the form of absorption, electric field, and magnetic field are presented. The sensitivity for hemoglobin biomolecules and urine biomolecules are calculated from their absorption peak difference and refractive index difference. The sensitivity results are compared with previously published designs. The proposed single split ring resonator metasurface design has the highest sensitivity for hemoglobin-urine concentrations. The proposed biosensor can become a building block for future medical biosensing devices.**

***Index Terms*—Sensor, graphene, metasurface, peak wavelength, sensitivity.**

I. Introduction

PRODUCT prototypes for biosensor devices have mostly included either the tissue implantation of appliance electrodes or the mechanical alignment of components on the body using adhesive tapes, clamps, or braces. The advancement in the current nanotechnology has created notable interest among the researcher to develop the small-sized, cost-effective nanosensor devices for biomedical applications. The current nanomaterials such as nanowire, graphene, and carbon nanotube (CNT) offer the rapid development of the nanosize biosensor which does not require complex mechanical alignment.

Biosensors are used to sense the biomolecules which are used to apply in medical applications, environment applications, industrial applications, etc. [1]–[3] The various types of biosensors available like optical biosensors [4]–[5], electrochemical biosensor [6] and physical biosensors [7]. The main purpose to use an optical biosensor because of its compact size, less cost, and use of novel nanomaterials that are easy for nanofabrication. Optical biosensors are classified into two main categories direct detection optical biosensors and labeled detection biosensors [8]. Direct detection biosensors are cost-effective compared to labeled detection biosensors. One of the important direct detection biosensors is surface plasmon resonance (SPR) based detection [9].

SPR biosensor is widely used nowadays because of its wide range of applications. SPR biosensor is used for detecting biomolecules like hemoglobin, urea, proteins, etc [10]–[12]. A fiber-optic SPR biosensor for detecting protein biomolecules is presented. This fiber optic SPR biosensor is used for different concentrations of protein biomolecules. The results in the form of reflected light are observed in label-free detection of biomolecules [10]. Cancer cells can be detected using an SPR biosensor. Different concentrations of prostate-specific antigen solutions are used in this SPR biosensor detection [11]. A graphene-based SPR refractive index biosensor is presented for detecting hemoglobin biomolecules. The absorption response for different concentrations of hemoglobin biomolecules is observed [12]. Photonic crystal fiber biosensor made with polymer is observed for different biomolecule concentrations. The confinement loss is observed and increased sensitivity is obtained [13]. Silica and its composites can be use in biosensing applications because of its superior strong and stable fluorescence optical property for biosensing application [14]. Similarly, Gold nanoparticles are used in biosensor applications in the category of noble metal nanoparticles because of their biocompatibility, optical and electronic properties, and relatively simple manufacturing and alteration. [15]. Recently researchers have also

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Broadband polarization-insensitive Jerusalem-shaped metasurface absorber based on phase-change material for the visible region

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ABSTRACT

In this paper, a broadband metasurface absorber using phase change material covering the visible region (500 THz to 740 THz) is numerically investigated. The top metallic layer comprises an array of Jerusalem shaped structures periodic in the x-y direction placed above the $Ge_2Sb_2Te_5$ (GST) layer. The GST layer is followed by a thick metallic layer and silicon dioxide (SiO_2). The intermediate dielectric layer in between two metallic layers is made of phase change material. The tri-layer structure is placed above the SiO_2 with average absorption is achieved with an efficiency of 92.86% using the amorphous GST (a-GST) phase in the dielectric layer. The average absorption of a-GST is more in the crystalline GST (c-GST) phase in the proposed absorber. The change in the absorption peaks are observed using GST material in the terahertz region. The proposed broadband Jerusalem-shaped metasurface absorber is polarization insensitive due to its symmetrical structure.

1. Introduction

The perfect absorption of electromagnetic waves is used for many applications like solar absorbers [1], photonics imaging sensors [2], Bio-sensor [3], thermal emitter [4] and optical modulators [5]. The absorber with metamaterial have properties of negative refractive index and these properties can be developed by arranging the components on the sub-wavelength scale. The properties with negative refractive index are not easily available in nature. The periodically arrangement of unit cells with size less than wavelength of electromagnetic wave makes artificial metamaterials. The electromagnetic properties such as reverse Doppler effect, negative refraction, clocking, etc are depends upon the geometrical structure of proposed design. The advancement of the research toward developing the metamaterial based optical sensor leads to development of components based on metamaterial to detect the material and circumstance. The four parameters such as operating frequency, measurable readout signals, linearity against quality factor and sensitivity to be considered while designing different type of sensors [6–9]. The designed metamaterial absorber with such electromagnetic properties which are used to design perfect absorption [10]. The designed metamaterial structure is not easy to fabricate due to its complex structure and also because of its extensive ohmic losses. Recently, the metasurface-based electromagnetic absorber attracted much attention due to its characteristics such as the two-dimensional planar surface, high absorptivity, lower ohmic loss, and also ultra-thin thickness [11]. The perfect electromagnetic absorber with the electric and magnetic response is experimentally proposed by placing two resonators on the top and bottom sides of the substrate. The structures of metasurface are tailored in such a way that the permittivity and permeability of metamaterial help to match the impedance of the metasurface absorber structure with the impedance of the free space. The matching of the impedance results in suppression of the reflectivity and finally realized the perfect absorption at certain frequencies in the terahertz region [12–14]. Since then, the metasurface absorber are extended in the terahertz regions such as infrared [15], visible [16], and ultraviolet region [17].

The structure of metasurface perfect absorbers are consists of a three-layer called metal, insulator, and metal (MIM). The bottom layer results in zero transmissivity and the tailored structure of the top layer results in less reflectivity and thus intermediate insulator layer absorb the incoming electromagnetic waves at certain frequencies [18]. The perfect absorption occurs at a specific resonance due to its resonance effect. To

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Tunable and highly sensitive graphene-based biosensor with circle/split ring resonator metasurface for sensing hemoglobin/urine biomolecules

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ABSTRACT

We propose a graphene-based biosensor for achieving a good sensitivity to detect hemoglobin and urine biomolecules of different concentrations. Graphene-based design results are analyzed in the form of absorption, sensitivity, and electric field. Metasurface in the form of a circle and split ring resonator is analyzed for detecting urine and hemoglobin biomolecules. The design results are also analyzed for different metasurface sizes. The thickness of different physical layers is varied to check its effect on absorption. The absorption response is reconfigured by changing the chemical potential of graphene material. The absorption response is tuned by changing the metasurface shape and size. The electric field intensity results are also matching with the obtained absorption response at a particular wavelength. The proposed design results are also compared with previously published similar designs. The high sensitivity obtained through this graphene-based biosensor can be applicable in medical applications for detecting hemoglobin and urine biomolecules.

1. Introduction

Sensing different biomolecules with higher sensitivity is the need for today's biosensors as we are facing many serious diseases which require higher and effective sensing of biomolecules. The sensor is the link between the physical and electrical world. Among the sensors such as pressure sensor, temperature sensor, infrared sensor commonly used are biosensors, absorber, etc [1,2]. Sensors based on Surface-Enhanced Raman Scattering, Fano Resonance, etc are used in clinical applications, defence, food quality control, etc [3,4]. Fabricating the devices for sensors needs research in the field of physics, biology, chemistry, and engineering [5,6]. Plasmons are excitation of electrons that plays important role in sensing biomolecules. Graphene-based plasmonics is used nowadays to sense the biomolecules more effectively [7,8].

Graphene is one of the promising materials for practical applications. It is basic of sp^2 carbon materials. Graphene works very well in designing surface plasmon resonance biosensors. Graphene material is also used as a good reflector and filter when it is grated with silicon material [9–11]. Graphene-based metasurface biosensor with different refractive index is useful in increasing the sensitivity used in medical biosensing devices and photovoltaic devices [12,13].The results are obtained in the form of transmission, absorption and reflection can be derived by considering their optical constants such as n and k of the noble metals. They are generally used for designing sensors, absorbers, etc [14,15]. Graphene plasmonics has created many opportunities as graphene can handle the plasmonic waves created which leads to perfect confinement, good tunability, in the infrared, terahertz region. They are effective in designing sensors and detectors [16–18].

The metamaterial-based absorber can be used for achieving a good bandwidth response in terms of absorption, reflection, and transmittance [19]. Among metamaterial absorbers, tunable metamaterial absorber rectangular-shape geometry having two splits and a varactor diode placed at the right split is designed for checking the applications such as temperature, humidity, and density [20]. Cancer cells are detected at nanometer size level by designing a metamaterial-based structure that contains an array of resonators placed on the dielectric substrate [21]. The result of getting the response of toroidal dipole and good tenability can be achieved by designing the toroidal metamaterial building artificially periodically arranged arrays. They are used in plasmonic and nanophotonic devices. This type of design can be used in the narrowband filter in wireless THz communication systems and sensing applications. Gold material plays an important role as resonating materials in designing sensors [22,23].

The two important factors for designing the sensor are tunable

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Comparative analysis of metasurface array-based solar absorber for visible region

Jaymit Surve[1] · Juveriya Parmar[2,4] · Shobhit K. Patel[3,4] · Rajendrasinh Jadeja[1]

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Abstract
We have proposed a graphene-based metasurface solar absorber for broadband visible wavelength range. The absorption analysis for four different designs is represented. We have explored the Four C-shape array metasurface absorber design, Five circle array metasurface absorber design, Five C-shape array metasurface absorber design, and the Four circle array metasurface absorber design for ultraviolet, visible, and infrared regions with the wavelength ranging from 0.2 to 0.8 μm. The highest average absorption is achieved for the four C-shape array metasurface absorber design. Furthermore, the absorptance response is also explored for various parameter variations such as substrate thickness, resonator thickness, and graphene chemical potential. The substrate height and resonator height have a marginal effect on absorptance. We have also analysed the design by placing graphene material spacer between gold layer and SiO_2 substrate layer. While the effect of graphene chemical potential on absorptance is negligible for 0.1–0.7 eV, but for graphene chemical potential of 0.9 eV, the absorptance plot shows a sudden decrease at around 0.69 μm wavelength. The proposed metasurface solar absorber can be applied for photovoltaic applications and solar energy harvesting applications.

Keywords Solar absorber · Metasurface · Graphene · Efficient

1 Introduction

Optical metamaterials are attracting a lot of attention due to their potential applications in photonics. The metamaterials can be engineered to obtain the expected optical characteristics by characterizing the electromagnetic properties of the material. The extensive function of optical metamaterials (MMs) has pushed research in the area of electromagnetic

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Highly sensitive and tunable refractive index biosensor based on phase change material

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ARTICLE INFO

Index Terms:
Optical sensor
GST
Metasurface
Tunable
Absorber

ABSTRACT

Sensitivity is very important while designing any biosensor. We present a tunable and highly sensitive absorbing metasurface for sensing hemoglobin biomolecules. The metasurface is based on phase change material made using different alloy combinations of $Ge_2Sb_2Te_5$ (GST). Hemoglobin biomolecules are sensed using the perfect absorbing metasurfaces. Three metasurfaces made up of C-shape split-ring resonator and thin wire are investigated. The biosensor is investigated for different phases of GST material and tuning is observed for amorphous GST (aGST) and crystalline GST (cGST). The results are presented in the form of absorption, electric field, and magnetic field. The absorption results for different angles show that the metasurface is angle sensitive. The results are also observed for different geometrical parameters like GST material thickness and gold metasurface thickness. The proposed perfect absorbing sensitive metasurface based on phase-changing material can be used for sensing hemoglobin in biomedical applications.

1. Introduction

Metasurfaces are widely used nowadays due to their tremendous electromagnetic properties and negative refractive index. These properties can be used to achieve perfect absorption in optical structures. This perfect absorption for infrared, visible, and ultraviolet regions can be applied for sensing applications and solar energy harvesting applications. The metasurfaces fulfill the desire for optical properties in terms of absorption, reflection, and transmission. They offer a platform for achieving broad and narrow bands that can be obtained for absorbing energy. Metasurface absorption can also be used for sensing applications [1–3]. Optical metasurfaces are designed artificially and have properties that cannot be found in natural materials. This material has a high efficiency which is required for sensing biomolecules [4,5].

Tunable behavior is essential for metasurfaces to be applicable in sensing biomolecules. The absorber is designed by using gold resonators and their results are obtained in terms of reflectance, transmittance, and absorption which show increased efficiency [6]. Mechanical tunability is achieved by applying strain on metamaterials cells in the Terahertz region [7]. By changing the parameters of geometry structure in the design, the frequency can be easily tuned in a metamaterial-based perfect absorber [8]. Surface plasmon resonance is excited using a metamaterial absorber which results in broadband absorption [9,10]. In metamaterials, subwavelength resonant metal particles are designed in the desired shape that is not possible of naturally occurring materials [11]. Perfect metamaterial absorber is polarized insensitive and omnidirectional. They are designed to overcome the challenges that are faced in the thickness of the material of some devices which will make them miniature, cost-effective, etc [12] [[,]] [13]. Metasurface resonators achieve maximum absorption and their characteristics are measured by the finite difference time domain (FDTD) method. The band is obtained in the terahertz and infrared region [14]. Broadband can be easily tuned by making changes in some parameters from low to high frequency that is useful in designing optoelectronic devices, energy harvesting devices, etc [15]. Solar absorber designed using gold metasurface resonators with the MgF_2 substrate increases the absorption rate that is shown in terms of their optical properties [16]. Thermophotovoltaic cells are an important source for a renewable source of energy. They are useful in capturing solar cell radiation as it consists of high temperature. To increase the efficiency of the absorber, metamaterials used with nanophotonics help in making it cost-effective and increases efficiency [17]. It also helps in increasing the resonance factor from the fundamental

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WILEY

RESEARCH ARTICLE

Encrypted and tunable graphene-based metasurface refractive index sensor

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Abstract

Encryption is a very essential part to secure data communication in today's world where there is a threat of stealing data. We have proposed a graphene-based metasurface biosensor for sensing and encryption applications. The biosensor is designed to sense the hemoglobin (HT) biomolecules with high sensitivity. The results are analyzed in the form of transmittance and electric field of the proposed graphene-based metasurface biosensor. The graphene layer's chemical potential is varied to achieve the coding of '0' and '1'. This creates one-digit coding. The array of this proposed structure with this coding can be used for encryption applications. The biosensor design is analyzed for four HT concentrations and their sensitivity is compared. Different geometrical parameters are analyzed and their effect is observed for tunability. The response from the design can be useful in future biomedical and data encryption applications.

KEYWORDS

encryption, graphene, metasurface, sensor, tunable

1 | INTRODUCTION

Sensing and encryption applications are very important nowadays to improve data communication. Biosensors are used not only for sensing biomolecules but they are also used in encryption applications.[1,2] Biosensors are used for sensing hemoglobin (HT) and urine biomolecules.[3,4] They are also used for sensing glucose and other proteins, which is applicable in diagnostic applications.[5] Pathogenic microorganisms are detected using optical biosensors. This sensing helps to observe the level of infection in the body.[6] The main two types of biosensors are label-free biosensors and labeled biosensors.[7] The label-free biosensors are widely used because of their selectivity and affinity features. Label-free biosensors are used to sense HT biomolecules from blood.[8] The latest development in carbon nanotubes and graphene material has improved the sensing of label-free biosensors[9] and because of this reason graphene material is widely used in biosensing now a days.[10]

The biosensor is very rapid, fast, and accurate in the detection of viral and bacterial diseases.[11–13] A grating sensor can be used to achieve higher sensitivity in detecting these viruses and bacteria.[14] Graphene biosensors are useful in applications such as photovoltaic devices, defense, and clinical applications.[15] The graphene-based biosensor can also be designed using metasurface that reduces fabrication cost and gives good stability, and good sensitivity.[16,17] A metamaterial is artificially designed periodically structures that consist of properties such as negative permeability and permittivity.[18] Graphene-based metamaterial sensor has good control in infrared and terahertz regions. They can be easily nanofabricated by electron beam lithography technique, which makes them cost-effective.[19] Optical properties such as transmittance, absorption, and reflection help in increasing overall sensitivity and efficiency in these metasurface-based graphene structures.[20] Graphene sensors can be used for encoding and decoding which gives the flexibility for applying in encryption applications.[21]

Encryption and tuning are very important and thus we present an encrypted biosensor for sensing HT biomolecules and encrypted with coding '0' and '1' digits. The encryption is achieved by changing graphene's chemical potential. Four different HT biomolecules are used for achieving higher sensitivity. The different geometrical parameters are varied to check their effect on transmittance response. The graphene biosensor design with circle metasurface is presented in Section 2. The encryption and high-sensitivity results are presented in Section 3. Section 4 is giving the concluding remarks about the proposed design and its results.

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Multiband Jerusalem cross-shaped angle insensitive metasurface absorber for X-band application

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ABSTRACT

In this paper, a multiband symmetrical Jerusalem cross-shaped metasurface absorber is designed, fabricated, and measured. The upper layer consists of Jerusalem cross metasurface placed over FR-4 substrate to achieve perfect absorption. The unit cell of the proposed absorber is symmetrical and periodic in the horizontal and vertical axis. The Jerusalem cross absorber gives good impedance response at five different frequencies in the X-band region. The proposed absorber gives absorptivity of 97.3%, 97%, 96.1%, 98.8%, and 97.4% at 8.82 GHz, 9 GHz, 9.25 GHz, 9.43 GHz, and 10.1 GHz. In transverse electric and magnetic field response, the absorptivity is angle insensitive up to 600. The change in absorption spectra for the proposed absorber with a change in different physical parameters, electric field distribution is presented. The measured results of the fabricated absorber are similar to the numerically investigated results. The proposed absorber can be applicable in X-band satellite and radar applications.

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KEYWORDS
Metasurface; absorber; mutiband; gigahertz; X-band

Introduction

The metamaterial is three-dimensional artificially engineered electromagnetic structure. The structure is periodic and has distinctive electromagnetic properties, which are not readily available in nature [1]. The measuring parameters depend upon the size and shape of resonators rather than the material used in the design. The unique electromagnetic properties such as negative refractive index and shift in phase of incoming electromagnetic make metamaterial structure for designing controllable smart surface [2]. The structure of metamaterial has a complex design and it's difficult to fabricate. The two-dimensional metasurface design is used in place of the metamaterial due to its easy structure and simple fabrication process [3–5]. The electromagnetic properties of producing nearly arbitrary wavefront and phase shift of incoming electromagnetic waves have achieved great attention for the researcher [6]. Due to its extraordinary electromagnetics properties, it have a potential application in optical and microwave regions such as reconfigurable microwave

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Your Submission BJPH-D-21-00689R1 - [EMID:d1eb123fbce06ed4]

2 messages

Brazilian Journal of Physics <em@editorialmanager.com> Tue, Nov 9, 2021 at 12:14 AM
Reply-To: Brazilian Journal of Physics <jade.santos@springer.com>
To: Vishal Sorathiya <vishal.sorathiya9@gmail.com>

Dear Mr Sorathiya,

We are pleased to inform you that your manuscript, "Graphene-based tunable broadband polarizer for infrared frequency", has been accepted for publication in Brazilian Journal of Physics.

You will be contacted by Springer Author Services in due course with a link to complete the grant of rights. Please note that you will receive your proofs after the publishing agreement has been received through the online system.

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With best regards,

Antonio Martins Figueiredo Neto
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Graphene-based tunable broadband polarizer for infrared frequency

Vishal Sorathiya[1,3,#], Shobhit K Patel[2]

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Abstract

This paper proposes the tunable graphene-assisted polarizer structure which is working on the infrared frequency range. The tunable polarizer has been designed by a three-layered structure of silica, graphene, and gold. The polarizer behavior of the structure is analyzed for the frequency range of 3 to 12 THz. The tunability of the structure is analyzed for the different values of fermi energy which is tunable parameter of single-layer graphene sheet. Polarizer response is derived in terms of different performance parameters such as reflectance, phase variation, phase difference, polarization conversion rate, and effective refractive indices. Graphene-based polarizer structure is investigated for the co-polarization and cross-polarization input incident conditions to check linear to circular polarization conversion. It also shows an effective refractive index response to check the metasurface behavior of the polarizer for 3 to 12 THz range. We have observed that the polarization amplitude becomes stronger for the higher Fermi energy value of the graphene sheet. The reflection amplitude is achieved up to 90%. Results of the proposed polarizer structure can be used to design the various electro-optical structure which operates in the lower THz range.

Keywords:

Polarizer, Tunability, Infrared, Metasurface, Graphene, Ultrathin, Terahertz

1. INTRODUCTION

Metamaterials are materials that are arterially fabricated. Dimension-reduced metasurfaces have attracted a lot of interest due to their practical implementation and extremely excellent light

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Expense Approval Note Against Budget

Print Date : 23/11/2021

Approval ID	:	3651
Approval For	:	CHAIRMAN
Department Name	:	ELECTRONICS & COMMUNICATION
SUBJECT	:	Regarding Marwadi University Incentive Policy for Research and Publications.

Details :

Respeecrted Sir,

I Sunil Lavadiya (E-code:87) working as an assistant professor in department of ICT engineering. I would like to request for sanction the following amount as per our MU Incentive policy for research and publication. Copy of publications is attached with this application.

Research Incentive		**Allocation :- 0**
research publications		**Allocation :- 0**
Particular	**Qty.**	**Required Amount**
Incentive Policy for Research and Publications. (Remarks : Copy of publications is attached with this application along with the summary of incentive amount per paper.)	1	6998
TOTAL		**6998**
GRAND TOTAL		**6998**

Request to please approve the expense,

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24/11/21

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Approval For	:	
Department Name	:	INFORMATION & COMMUNICATION TECHNOLOGY
SUBJECT	:	Regarding Marwadi University Incentive Policy for Research and Publications.

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Incentive Policy for Research and Publications.

Research Incentive		**Allocation :- 0**
research publications		**Allocation :- 0**
Particular	**Qty.**	**Required Amount**
Incentive Policy for Research and Publications. (Remarks : Copy of publications is attached with this application along with the summary of incentive amount per paper.)	1	3000
TOTAL		**3000**
GRAND TOTAL		**3000**

Request to please approve the expense,

Regards,

Mr. SUNIL LAVADIYA

INFORMATION & COMMUNICATION TECHNOLOGY

_____* Approval Authority *_____

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Approved	**RS 3000**	**09/03/2022 09:35 AM**

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Approved	**RS 3000**	**09/03/2022 02:47 PM**

	**1158 - Mr. NARESHKUMAR JADEJA**	
Approved	**RS 3000**	**10/03/2022 12:09 PM**

15/02/2022

To,

HOD/Dean/Registrar,

Marwadi University.

Subject: Regarding Marwadi University Incentive Policy for Research and Publications.

Respected sir,

I Sunil Lavadiya (E-code:87) working as an assistant professor in the department of ICT. I would like to request for sanction the following amount as per our MU Incentive policy for research and publication. Copy of publications is attached with this application.

Sr. No	Paper Title	Type	No of the Authors from MU	Author1 (Vishal Sorathiya)	Author2 (Sunil Lavadiya)
1	Graphene-based tunable short band absorber for infrared wavelength	SCI – Journal (Applied Physics B)	2	1000	1000
2	Infrared graphene assisted multi-band tunable absorber	SCI - Journal (Optical and Quantum Electronics)	2	Not Eligible	1000
3	Tunable squared patch-based graphene metasurface infrared polarizer	SCI – Journal (Applied Physics B)	2	Not Eligible	1000
Total Amount				**1000**	**3000**
Maximum eligible Amount				**10000**	**10000**
Already claimed amount				**9000**	**7000**

Looking for your support.

Thanks and Regards,

Prof. Sunil Lavadiya

Department of ICT

Prof. Vishal Sorathiya

Department of ICT

Prof. Chandrasinh Parmar

HoD – ICT Engineering

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Applied Physics B
Lasers and Optics

Graphene-based tunable short band absorber for infrared wavelength

Vishal Sorathiya[1] · Sunil Lavadiya[1] · Leena Thomas[2] · Mohammed Abd-Elnaby[3] · Ahmed Nabih Zaki Rashed[4] · Mahmoud M. A. Eid[5]

Received: 29 April 2021 / Accepted: 20 December 2021

Abstract

The tunable graphene-based short band absorber has been numerically examined in this article. The absorption response of the proposed design has been analyzed with the variations of chemical potential, the radius of the resonator, width of the resonator, height of silver (Ag) resonator and the height of silica substrate. The proposed structure provides narrow band absorption and wideband response over an infrared wavelength of 1.5–1.6 μm. It has been reported that abortion amplitude was up to 99%. Metamaterial behavior was analyzed by the calculation of permittivity, permeability and refractive index. We have also investigated the absorption and reflectance response of 2×2 and 3×3 array-based structures. Comparative analysis with the previously published article is also represented. Thanks to its tunability, efficiency, and self-alignment, the proposed absorber can find application as a compact high-contrast filter in infrared optical systems. This research work can also apply to the different research filed of designing sensors, polarisers, modulators, and many more.

1 Introduction

The research in the metamaterials field has grown extremely wide in a short period. It was back in the year 1898, an introduction of artificial materials for microwave applications was experimented with by Jagadis Chunder Bose which is now commonly known as chiral characteristics [1]. Since then there was a wide range of experiments performed like in the year 1914–1948 [2, 3], scientists procured a wide dimension of study regarding customizing the external properties of the material by fabricating artificially structures of various shapes and sizes. This new aspect of changing properties or creating material with non-existing properties generated a wide range of research into the field of metamaterials. It offers some unrealistic exotic properties like negative permeability and permittivity [4]. Also, properties like negative refraction [5–7] perfect lensing [8] or superlens [9], and invisibility cloaking [10–12] are also created with the help of this kind of material.

On the contrary, another material which is researched widely in recent years is a 2D lattice structure named graphene [13]. Despite being monolayered, it outcastes some of the unique properties like flexibility, optical transparency [14], conductivity [15], and high electron mobility [16]. Also, ultra-wideband tunability can be achieved through an electrostatic field, magnetic field, or chemical doping by graphene [17, 18]. It depends on the different values such

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Infrared graphene assisted multi-band tunable absorber

Sunil Lavadiya[1] · Vishal Sorathiya[1] · Osama S. Faragallah[2] · Hala S. El-Sayed[3] · Mahmoud M. A. Eid[4] · Ahmed Nabih Zaki Rashed[5]

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Abstract
The proposed manuscript represents the easy and analytical approach for designing a tunable multi-band Graphene-based absorber. The crossed-shaped resonators are used in the presented manuscript in near-infrared wavelengths over the wavelength of 1400 nm to 1700 nm. Four modes are included based upon the position of resonators for the reflectance and transmittance behavior analysis. It has enumerated more than 98% of absorption response in all the design structures. The proposed absorber structure is numerically investigated using FEM computational techniques. The absorption behavior of the proposed design is represented for the different chemical potential values, varying dimensions of the centered resonator(g_p), the varying height of resonators (h_{Ag}), the varying height of substrate (h_{si}), and for multiple layers of a substrate (Si) with Graphene sheets. The presented paper includes a very simple design, equation, and corresponding RLC circuit model of the multi-band absorber. The RLC model of the equivalent absorber structure is presented in the manuscript for identifying the impedance matching condition to create perfect absorption. The proposed absorber shows the possibilities of designing short-band and wide-band tunable behavior of perfect absorption using graphene silver geometries. The resonance wavelength and absorption bandwidth can be regulated by different physical parameters. The proposed design was also compared with the previously reported work. This design opens new opportunities in solar absorption, optical communication, and bio-sensor-based applications.

Keywords Tunable · Graphene · Circuit model · Terahertz absorber

1 Introduction

Terahertz and infrared wave technology has drawn enormous interest from the engineering community in recent decades owing to its interesting position in a variety of precious applications such as waveguides, detectors, sources, indoor communications, medical, biosensing, imaging, and defense applications (Tonouchi 2007; Chen et al. 2005). The infrared frequency range has benefits such as higher operating frequency, reduced dimension, nonionizing, and low photon energy properties (Russell et al. 2016). To advance the

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Extended author information available on the last page of the article

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Applied Physics B
Lasers and Optics

Tunable squared patch-based graphene metasurface infrared polarizer

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Abstract

In this manuscript, patch-shaped graphene metasurface polarizer has been numerically investigated for the far-infrared frequency spectrum. We have identified the resonance response of the proposed polarizer by changing the physical dimensions of the proposed polarizer. The proposed polarizer structure has been investigated for the 1–20 THz of the frequency range. The different physical parameters such as phase variation, polarization conversion rate, reflectance, and transmittance have been investigated for the proposed polarizer structure. Graphene-based polarizer structures are formed with the squared patched geometry, and its complementary condition has been investigated to identify the polarization effect's behavior. The proposed polarizer device is tunable by various values of graphene chemical potential. The calculated polarization conversion rate (PCR) is >0.9 for the resonating point, showing the linear to circular polarization conversion. The proposed structure works as a tunable polarizer device where the graphene sheet properties can be controlled from external sources. A resonating band of the polarization effect has been identified from the numerical results of polarization conversion rate and cross-polarization behavior. The phase variation is observed between $-180°$ and $180°$ in the graphene patch-based polarizer structure. In contrast, the polarizer structure's complementary geometry generates the phase variation between $100°$ and $180°$. The proposed polarizer can be easily fabricated using conventional methods as it does not require a complex structure to engrave the graphene sheet. Ultrathin design and tunable properties of the polarizer structure can be used in many photonics and optoelectronics applications.

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