

EDITORIAL

Welcome to Science of Optics and Photonics

Dear Readers, Authors, Reviewers, and Colleagues,

It is a pleasure to welcome you to the inaugural issue of Science of Optics and Photonics, a journal dedicated to advancing scientific understanding and technological innovation in optics, photonics, optical materials, optoelectronics, optical sensing, and light-based energy technologies. The growing importance of light in modern science and engineering has created exciting opportunities for research at the intersection of physics, materials science, electronics, energy conversion, and computational modelling. From nanoscale antennas capable of concentrating electromagnetic energy to advanced optical sensors, next-generation photovoltaic devices, and materials with tailored linear and nonlinear optical properties, photonics continues to open new pathways for scientific discovery and practical applications. The development of efficient optical and photonic devices requires more than the identification of promising materials. It also demands a detailed understanding of electromagnetic interactions, material interfaces, charge transport, optical absorption, and the influence of structural parameters on device performance. Computational methods, including finite-element analysis, transfer matrix modelling, semiconductor device simulation, and density functional theory, have become valuable tools for exploring these relationships. By enabling researchers to investigate complex systems and optimize their designs before experimental implementation, these approaches can help guide materials development and accelerate the exploration of emerging technologies. The inaugural issue brings together six contributions addressing complementary aspects of this broad research landscape. The articles investigate a silver bowtie nanoantenna for optical rectenna energy harvesting, a multilayer lossy mode resonance sensor, hole-transport-layer engineering in tin-based perovskite solar cells, the optimization of CdTe thin-film photovoltaics, the optical properties of the quaternary chalcogenide $\text{Ag}_2\text{SrTiSe}_4$, and a hybrid bismuth silicate–Franckeite surface plasmon resonance biosensor. Although the studies differ in their materials, methods, and intended applications, they share a common objective: to understand how material selection, structural design, optical interactions, and computational optimization can improve the performance of light-based devices. The first contribution, “Visible–Near-Infrared (350–1050 THz) Silver Bowtie Nanoantenna for Optical Rectenna

Energy Harvesting: A Gap-Dependent Full-Wave Study,” by Saurav Mishra et al., examines a nanoscale antenna structure intended for optical rectenna applications. Optical rectennas combine antennas with ultrafast rectifying elements to convert electromagnetic radiation into direct-current electrical power. Their potential for solar energy harvesting has motivated considerable interest in antenna designs that provide broad impedance bandwidth while concentrating electromagnetic fields near the location of the rectifier. In this study, the authors design a silver bowtie nanoantenna with an arm length of 150 nm and a flare angle of 90° , positioned on a 10 nm silicon dioxide (SiO_2) layer. The electromagnetic response is investigated through full-wave finite-element simulations using COMSOL Multiphysics 6.2 with the RF Module. Particular attention is given to the influence of the feed-gap width, with 20 nm and 30 nm configurations compared in terms of reflection coefficient, input impedance, near-field distribution, radiation pattern, and realised gain. The reported results indicate that both configurations resonate at approximately 650 THz, corresponding to a wavelength of about 461 nm. The minimum reflection coefficients are -24.2 dB for the 20 nm gap and -24.6 dB for the 30 nm gap. The reported -10 dB impedance bandwidth extends from approximately 480 to 875 THz, corresponding to a bandwidth of about 390 THz and a fractional bandwidth of approximately 57%. The realised gain increases from around 0.2 dBi at 350 THz to approximately 3.25–3.28 dBi at 750 THz. A dipole-like radiation pattern is maintained up to approximately 850 THz, beyond which higher-order modes begin to distort the pattern. An important finding concerns the relationship between the feed-gap geometry and the antenna’s electromagnetic response. Below approximately 850 THz, changing the gap width from 20 nm to 30 nm produces only minor changes in the minimum reflection coefficient and realised gain. The authors report variations of less than 0.5 dB in the minimum S_{11} and less than 0.05 dB in gain. This suggests that the overall antenna response may be relatively tolerant of the gap variations associated with electron-beam lithography. At the same time, the narrower gap produces an approximately 50% increase in peak gap-field intensity, highlighting the importance of nanoscale geometry for local electromagnetic-field enhancement. The concentration

of the strongest near fields at the feed gap identifies this region as a potential location for integrating a metal–insulator–metal tunnelling diode. Nevertheless, the authors recognize that realizing a complete optical rectenna requires further consideration of rectifier cut-off frequency, antenna–diode impedance matching, polarization, and the partial coherence of sunlight. By examining both antenna-level performance and the limitations of practical integration, this study contributes to the computational design of nanoscale structures for optical energy harvesting.

The second article, “MATLAB Simulation Based Study of a Lossy Mode Resonance Sensor Design with Improved Detection Accuracy,” by Arun Uniyal et al., focuses on optical refractive-index sensing using a multilayer lossy mode resonance (LMR) configuration. Optical sensors based on resonance phenomena can detect changes in their surrounding medium through changes in the optical response of a carefully designed sensing structure. Their performance depends on the interaction between the incident electromagnetic field, the optical properties of the constituent layers, and the refractive index of the analyte. The authors propose a prism-coupled multilayer structure consisting of a prism, Cytop, indium tin oxide (ITO), titanium dioxide (TiO_2), and a sensing medium. The transfer matrix method (TMM) is implemented in MATLAB to simulate the reflectance response under angular interrogation. ITO serves as the lossy mode resonance supporting layer, while Cytop and TiO_2 are introduced to influence optical coupling, modal confinement, and resonance characteristics. The investigation considers the effects of transverse-electric (TE) and transverse-magnetic (TM) polarization, as well as variations in Cytop, ITO, and TiO_2 layer thicknesses. The sensor is evaluated for refractive indices ranging from 1.33 to 1.41 at a wavelength of 633 nm. According to the abstract, the TE polarization mode produces a narrower resonance peak and a smaller minimum in the reflection spectrum than the TM mode, with the TE configuration also exhibiting better detection accuracy in the simulated design. The thickness of the TiO_2 layer emerges as another important design parameter. The authors identify a thickness of 5 nm as providing the strongest and most clearly defined LMR response and select it as the preferred configuration. These observations illustrate how polarization selection and multilayer thickness optimization can be used to tailor the resonance characteristics of an optical sensing platform. The significance of this contribution lies in its systematic examination of the relationships between multilayer architecture, polarization, and reflectance response. Such modelling can help researchers identify promising sensor configurations and understand the parameters that influence resonance definition and detection performance. Further experimental investigation would be valuable to assess the practical response of the proposed structure under real sensing conditions, including fabrication tolerances and variations in material properties. The third contribution, “Unlocking the Potential of Tin-Based

Perovskite Solar Cells through Hole Transport Layer Engineering,” by Shatrughan Mishra et al., addresses an important challenge in photovoltaic research: the development of efficient alternatives to lead-based perovskite solar cells. Tin-based perovskites, including $\text{CH}_3\text{NH}_3\text{SnI}_3$, are of interest in the search for photovoltaic materials that can reduce reliance on lead while retaining attractive optoelectronic properties. Their device performance, however, depends on several interacting factors, including the properties of charge-transport layers and the losses that occur during charge generation and collection. The authors use SCAPS-1D simulations to compare organic and inorganic hole-transporting layers (HTLs) in tin-based perovskite solar cells. Their analysis focuses on the influence of HTL selection on photovoltaic performance and spectral response, with particular attention to the identification of a transport material that can support efficient charge extraction and reduce recombination losses. Among the materials considered, TAPC—identified in the supplied abstract as 1,1-Bis[(di-4-alkylamino)phenyl]cyclohexane—emerges as the preferred HTL candidate. For the reported bulk-material thickness of 0.3 μm , the simulated device achieves a power conversion efficiency of approximately 31.82%, an open-circuit voltage of about 1.19 V, a short-circuit current density of approximately 32.20 mA cm^{-2} , and a fill factor of around 82.73%. The abstract also reports a quantum efficiency of approximately 90% across the wavelength range of 400–800 nm. These results point to the potential importance of HTL engineering in controlling the performance of tin-based perovskite devices. The reported spectral response suggests that the selected configuration can make effective use of a broad portion of the visible spectrum, while the simulated photovoltaic parameters indicate a promising combination of voltage, current density, and fill factor. By comparing transport-layer candidates within a common simulation framework, the study provides a basis for further investigation of the relationships between material selection, charge transport, and photovoltaic output. The findings should be understood within the scope of numerical device modelling. High simulated efficiencies are valuable indicators of a promising design, but they do not by themselves establish the efficiency, operational stability, or manufacturability of a fabricated device. Experimental validation, including assessment of material stability and device reproducibility, will be necessary to determine whether the predicted performance can be achieved in practice. This contribution nevertheless highlights the value of computational screening in the continuing development of lead-free photovoltaic technologies. The fourth article, “Novel combined Strategy to obtain more efficiency in the CdTe – thin film solar cell using SCAPS-1D,” by Bishal Hazarika et al., investigates the numerical optimization of cadmium telluride (CdTe)-based thin-film solar cells. CdTe is an established absorber material of

interest for thin-film photovoltaics, and its device performance depends not only on the absorber itself but also on the properties of adjacent layers, defect populations, and electrical contacts. In this work, the authors model a CdTe-based solar cell incorporating indium gallium zinc oxide (IGZO) as the electron-transport layer (ETL) and copper(I) oxide (Cu_2O) as the hole-transport layer (HTL). SCAPS-1D simulation software is used to examine the effects of absorber thickness, defect densities in the transport layers, and the selection of front and rear contact materials. The authors evaluate these parameters in relation to power conversion efficiency, open-circuit voltage, short-circuit current density, and fill factor. The abstract identifies absorber defect density as the most influential factor in improving efficiency, followed by the selection of appropriate contact materials. The simulations demonstrate that variations in the investigated structural and material parameters can substantially influence the predicted photovoltaic response. Under AM1.5G illumination, the optimized configuration is reported to achieve a power conversion efficiency of 23.01%, a short-circuit current density of 18.84 mA cm^{-2} , an open-circuit voltage of 1.35 V, and a fill factor of 90.46%. These results emphasize the importance of defect control and contact engineering in thin-film solar-cell design. Defect populations can influence charge-carrier recombination, while contact selection and band alignment affect the collection and transport of photogenerated carriers. Examining these factors together allows the authors to consider a more integrated optimization strategy rather than treating each component as an isolated design variable. The study demonstrates how semiconductor device simulations can help identify parameters that merit particular attention during device development. The reported values provide a numerical target for subsequent investigations, although experimental fabrication and characterization will be required to verify the predictions and evaluate the influence of real material interfaces, processing conditions, and device imperfections. The work therefore offers a computational contribution to the broader effort to improve thin-film photovoltaic performance through coordinated absorber, transport-layer, and contact optimization. The fifth article, "Unveiling the Linear and Nonlinear Optical Potential of $\text{Ag}_2\text{SrTiSe}_4$: A First-Principles Pathway towards Next Generation Photonic and Optoelectronic Devices" by Kunjal Singh et al., details the optical properties of the quaternary chalcogenide $\text{Ag}_2\text{SrTiSe}_4$ using Density Functional Theory (DFT). Discovering and characterising novel materials with suitable electronic structure and optical properties is key to developing photonic and optoelectronic devices. When materials provide suitable band structures, high optical absorption and nonlinear optical properties they have potential for investigation for novel materials for optical detection, frequency conversion and integration. In this article we have investigated many properties of $\text{Ag}_2\text{SrTiSe}_4$ including; structural properties, electronic properties,

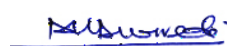
bonding, linear optical properties and nonlinear optical properties. We have proposed a tetragonal structure with space group I-42m (non-centrosymmetric). The equilibrium cell volume was found to be $410 \text{ \AA}^3$. The calculated indirect band gaps were 1.80 eV (PBE) and 2.50 eV (HSE06) respectively. The absorption edge is at 2.188 eV, static refractive index of 2.28, dielectric constant of 5.2 and static reflectivity of 15.23%. One of the most interesting features of this study was that the material has high UV absorption with an absorption coefficient of $6-7 \times 10^5 \text{ cm}^{-1}$. This suggests that the material has potential for further investigation as an optoelectronic material with UV detection capabilities. Additionally, the material has a refractive index, dielectric constant and reflectivity that could provide useful optical properties when using the material in theoretical studies. This article also investigates the nonlinear optical properties of the material. Due to the material having a non-centrosymmetric crystal structure, the material has potential to produce second harmonic generation and frequency conversion. Using a combination of electronic structure calculations and optical properties and symmetry calculations we demonstrate that $\text{Ag}_2\text{SrTiSe}_4$ is a potential material for further investigation for integrated photonics, optical coatings, UV detection and nonlinear optical applications. Similar to other first-principles studies, this study provides a foundation for the material to be further investigated. The material will need to be synthesised and the optical properties investigated experimentally. The stability of the material will need to be considered and the device tested. However, this demonstrates how materials science can be used computationally to investigate potential materials. The sixth article, "Numerical Modelling and Optimisation of a High Sensitivity Bismuth Silicate and Franckeite based Hybrid SPR Biosensor" by Gaurav Dixit et al., details a hybrid Surface Plasmon Resonance (SPR) biosensor. SPR sensors work by detecting changes in the optical properties due to changes in the refractive index near the metal/dielectric interface. The sensitivity of the sensor is dependent upon the optical properties of the layers, the thickness of each layer and the interaction of the electromagnetic field with the sensing medium. A Kretschmann configuration was proposed with a wavelength of 633nm. The design comprises a calcium fluoride prism used to couple light into the system, a 55nm thick silver layer, a 9nm thick bismuth silicate (BSO) layer, and a 0.5nm thick 2D Franckeite layer. The angular interrogation was simulated using the Transfer Matrix Method (TMM). The parameters of the structure were optimised with the analyte refractive index varying from 1.33 to 1.34. The bismuth silicate and Franckeite layers were proposed to be used as a bilayer. The dielectric layer and 2D layer were used to affect the evanescent electromagnetic field at the interface of the sensor. Additionally the bismuth silicate layer was proposed to act as a barrier to prevent oxidation of the silver layer underneath. The heterostructure

was optimised and compared to a conventional SPR biosensor using angular sensitivity, detection accuracy, full width at half maximum (FWHM) and figure of merit/quality factor. Unfortunately, the numerical values of these parameters were not provided in the abstract so the enhancement cannot be quantified. However, the overall approach of the design was to use numerical optimisation to investigate if the hybrid dielectric and 2D material would improve the optical properties of the SPR sensor. This highlights a trend in optical sensing where multi-layer interfaces are being designed to tune the optical field and resonance. To fully understand how significant this sensor is, the article should clearly state the sensitivity, sensitivity of conventional sensor, detection accuracy, FWHM, Figure of Merit and what unit they are in. Additionally stating how they were calculated. Experimentally investigating this design would help to determine how reliable the design is. Overall, hybrid SPR designs are an interesting area to investigate further. Overall, these six articles show the variety of current research within the optics and photonics field. Some articles focus on nanoscale electromagnetic structures and sensor based on resonance. Others focus on photovoltaic devices and first principles studies of materials. Although they all have different aims, they all focus on understanding how the structural parameters and material properties affect light-matter interaction. Both articles looking at sensors highlight different ways to tune the optical resonance. The lossy mode resonance article looks at how the polarisation and thickness of the multilayer affects the reflectance and detection properties. The hybrid SPR article investigates how the metal, dielectric and 2D material layers can be combined. The bowtie nanoantenna article shows how the geometry of the nanoantenna, specifically the feed gap size, will effect the local field enhancement. Overall, these articles show how you can tune the optical properties of your device by manipulating the nanoscale and multilayer structure. The photovoltaic articles highlight the importance of materials design and optimising the device. Both the tin based perovskite and CdTe articles focus on optimising the hole transport layer and absorber defects, transport layers and contact materials. Both of these articles use simulation to optimise the design of the device by considering various design parameters. The $\text{Ag}_2\text{SrTiSe}_4$ article looks at materials discovery by investigating the electronic structure and linear and nonlinear optical properties. An important point to note about all of the articles is that they all use computational methods. Whether it be finite element modelling, transfer matrix method, SCAPS-1D modelling or Density Functional Theory they can all give useful insights. However, they must be clearly stated how the model was designed,

what materials were used, what boundary conditions were used, what parameters were optimised and what parameters were measured. The predictions made should be seen in the context of the model. If any claims are made about device performance then the design should be experimentally validated. Looking forward there are some exciting opportunities with these articles. Connecting theory to practice, improving reproducibility, understanding stability of the materials and interfaces, and evaluating device performance. Furthermore, collaboration between different disciplines will be key. Often photonic devices will require a combination of optical physicists, materials scientists, electrical and electronics engineers, chemists and computational modelling experts. We would like to thank the authors for providing their research to our first issue of "Science of Optics and Photonics". Thank you to the reviewers for taking the time to review the articles using their expert knowledge. Thank you to the editorial team and publishing team for their efforts. The aim of this journal is to provide a platform for high quality research to be published within the optics, photonics, optical materials, optoelectronics, imaging, sensing and light based technologies fields. We want to receive articles that will improve our fundamental understanding of the field, introduce new promising materials/device concepts, improve modelling and measurement techniques, and critically analyse emerging technologies. It is important that scientific integrity is maintained throughout this journal with careful peer review, clear editorial practices, responsible reporting and respect for the integrity of the research. We warmly invite researchers, academics, engineers, and students from around the world to engage with the journal as authors, reviewers, and readers. We hope that the contributions in this first issue will stimulate further discussion, encourage interdisciplinary collaboration, and inspire new investigations into the science and applications of light. The launch of Science of Optics and Photonics marks the beginning of an ongoing scholarly endeavour. We look forward to supporting the exchange of ideas and the development of research that connects fundamental optical science with meaningful technological advances.

Welcome to Science of Optics and Photonics !!

Sincerely,



Prof. D. K. Dwivedi

Editor-in-Chief

Science of Optics and Photonics

Ariston Publications

ABOUT THE EDITOR-IN-CHIEF



Prof. D.K. Dwivedi is a Professor and former Head of the Department of Physics and Material Science at Madan Mohan Malaviya University of Technology (MMMUT), Gorakhpur, India. He obtained his M.Sc. and Ph.D. degrees from D.D.U. Gorakhpur University, Gorakhpur. He began his professional career as a Scientific Officer at the Bhabha Atomic Research Centre (BARC), Mumbai, in 2001. He subsequently served as a Lecturer in Physics at D.D.U. Gorakhpur University for nearly eight years before joining MMMUT as a Reader in 2009. He was promoted to Professor in 2015. Prof. Dwivedi is internationally recognized for his research contributions and was included among the world's top 2% of scientists in 2023, 2024, and 2025. His scholarly record includes more than 365 publications in SCI-indexed international journals, 42 papers in national journals, and 218 conference papers. He has delivered 63 invited lectures and authored five books. He

has supervised 17 doctoral theses, with eight additional doctoral researchers currently under his supervision, and has guided 50 M.Sc. and M.Tech. students in dissertation projects. He has also been awarded three major research projects and organized 11 national-level conferences, workshops, and short-term courses.

His research interests include amorphous semiconductors, nanostructured materials, energy-storage devices, particularly lithium-ion batteries, solar-cell devices, and photonic-crystal-fibre sensors. His work encompasses materials science, energy technologies, sensing systems, and optoelectronic applications.

Prof. Dwivedi has held numerous academic and administrative leadership positions throughout his career. These include Head of the Department of Physics and Material Science; Dean of Undergraduate Studies and Entrepreneurship; Dean of Postgraduate Studies and Research and Development; Dean of Faculty Affairs; Chairman of the Administrative Committee, Recruitment Cell, Board of Studies, Departmental Purchase Committee, and Council of Student Activities; Member of the Board of Management; Member Secretary of the Internal Quality Assurance Cell (IQAC); and QIP Coordinator. He has also served on the Space Advisory Committee, Examination Committee, University Admission Committee, University Student Grievance Redressal Committee, Project Monitoring Unit of RUSA, Research and Consultancy Management Committee, Flexible Cadre Structure Committee, and boards of studies at various universities. His other responsibilities have included serving as an officiating Vice-Chancellor.

In addition to his academic and administrative contributions, Prof. Dwivedi has made significant contributions to scholarly publishing. He serves as an Associate Editor of IEEE Sensors Journal, IEEE Sensors Letters, and Journal of Optics (Springer). He has served as an editor for 12 journals, including Scientific Reports (Nature Portfolio) and Journal of Inorganic and Organometallic Polymers and Materials. He has also reviewed manuscripts for more than 60 international journals. His intellectual property contributions include three national patents. Prof. Dwivedi is a Life Fellow of the Optical Society of India, a Senior Member of IEEE, and a member of OPTICA. He is also associated with six national and international academic societies, professional bodies, and associations.

His research and academic achievements have been recognized through several prestigious awards. These include the Har Gobind Khorana Diamond Jubilee Medal and the Best Researcher Award (2023) in sensing technology, presented in connection with Sensors 2023. He has also received multiple awards under the Research Excellence Awards programme of Uttar Pradesh, recognizing his contributions to research, academic excellence, and research project development.

His reported honours include the Premium Researcher Award and Commendable Researcher Award under the First Research Excellence Awards for the period 1 July–31 December 2024; the Academic Excellence Award 2025, presented by the Hon'ble Governor of Uttar Pradesh on 26 August 2025, in recognition of excellence in academics, research, and university administration; and the Premium Researcher Award, Commendable Researcher Award, and Research Project Award under the Second Research Excellence Awards for the period 1 January–30 June 2025. He also received recognition under the Third Research Excellence Awards, including the Commendable Researcher Award presented on 25 March 2026 for the period 1 July–31 December 2025.

Through his contributions to research, teaching, academic administration, professional service, and scholarly publishing, Prof. Dwivedi continues to contribute to the advancement of materials science, photonics, energy technologies, and sensor research.