materials

MDPI

Article

Fabrication and Characterization of Eco-Friendly Thin Films as Potential Optical Absorbers for Efficient Multi-Functional Opto-(Electronic) and Solar Cell Applications

Mohamed H. El-Newehy [1,2,*], Ahmed M. El-Mahalawy [3], Badr M. Thamer [1] and Meera Moydeen Abdul Hameed [1]

[1] Department of Chemistry, College of Science, King Saud University, Riyadh 11451, Saudi Arabia; bthamer@ksu.edu.sa
[2] Department of Chemistry, Faculty of Science, Tanta University, Tanta 31527, Egypt
[3] Thin Films Laboratory, Physics Department, Faculty of Science, Suez Canal University, Ismailia 41522, Egypt; ahmed_elsayed@science.suez.edu.eg
* Correspondence: melnewehy@ksu.edu.sa

Abstract: The necessity for reliable and efficient multifunctional optical and optoelectronic devices is always calling for the exploration of new fertile materials for this purpose. This study leverages the exploitation of dyed environmentally friendly biopolymeric thin films as a potential optical absorber in the development of multifunctional opto-(electronic) and solar cell applications. Uniform, stable thin films of dyed chitosan were prepared using a spin-coating approach. The molecular interactivity between the chitosan matrix and all the additive organic dyes was evaluated using FTIR measurements. The color variations were assessed using chromaticity (CIE) measurements. The optical properties of films were inspected using the measured UV-vis-NIR transmission and reflection spectra. The values of the energy gap and Urbach energy as well as the electronic parameters and nonlinear optical parameters of films were estimated. The prepared films were exploited for laser shielding as an attenuated laser cut-off material. In addition, the performance of the prepared thin films as an absorbing organic layer with silicon in an organic/inorganic heterojunction architecture for photosensing and solar energy conversion applicability was studied. The current-voltage relation under dark and illumination declared the suitability of this architecture in terms of responsivity and specific detectivity values for efficient light sensing applications. The suitability of such films for solar cell fabrications is due to some dyed films achieving open-circuit voltage and short-circuit current values, where Saf-dyed films achieved the highest V_{oc} (302 mV) while MV-dyed films achieved the highest J_{sc} (0.005 mA/cm^2). Finally, based on all the obtained characterization results, the engineered natural cost-effective dyed films are considered potential active materials for a wide range of optical and optoelectronic applications.

Keywords: dyed chitosan thin films; laser cut-off filter; nonlinear optical parameters; heterojunction photosensors; solar energy conversion

check for updates

Citation: El-Newehy, M.H.; El-Mahalawy, A.M.; Thamer, B.M.; Moydeen Abdul Hameed, M. Fabrication and Characterization of Eco-Friendly Thin Films as Potential Optical Absorbers for Efficient Multi-Functional Opto-(Electronic) and Solar Cell Applications. *Materials* **2023**, *16*, 3475. https://doi.org/10.3390/ma16093475

Academic Editors: Bogdana Mitu and Dewei Zhao

Received: 17 March 2023
Revised: 13 April 2023
Accepted: 26 April 2023
Published: 29 April 2023

1. Introduction

Despite the dependence of global economic growth on rapid industrial development supported by continuous experimental and laboratory research results, global public awareness has ignored the negative effects and hazards on the environment and human health resulting from the overreliance on fuel-based manufacturing processes of synthetic plastics. In this context, over the last few years, many countries have resorted to the exploitation of eco-friendly materials and sustainability concepts for supporting economic growth along with social requirements, in addition to tackling climate change and environmental protection. This can be achieved by replacing harmful toxic chemical materials for manufacture with eco-friendly natural materials for industry [1–3].

Ultra Thin Films For Opto Electronic Applications

S Ashworth

Ultra Thin Films For Opto Electronic Applications:

Ultra-thin Films for Optoelectronic Applications Naoya Ogata,Chitose inst of science and technology (Japan),1999 Optically active poly thiophene with a high regioregularity was synthesized for the first time by using a Rieke zerovalent zinc catalysts Head to Tail Poly 3 2 S 2 methylbutoxy ethylthiophene HT P S MBET was an optically active polymer with more than 93% of the Head to Tail linkages For comparison purposes regiorandom R P S MBET and achiral HT P MBET were also synthesized They are fully characterized by using proton and carbon 13 NMR spectroscopies optical rotatory power measurements circular dichroism gel permeation chromatography and UV Vis spectroscopy Both electrical conductivities and third order optical nonlinearities were measured in order to examine opto electronic properties of these ultra thin films It was suggested that electrical and optical properties were little affected by chirality An anisotoropies of electrical conductivity for HT P MBET SA mixed LB films were in close agreement with results of structural analyses The electrical and optical properties of HT P S MBET SA LB films were superior to those of spin coated films From these results it was concluded that the regioregular poly thiophene s enhanced opto electronic properties owing to the extended conjugation length of main polymer chains **Ultrathin Two-Dimensional Semiconductors for Novel Electronic Applications** Mohammad Karbalaei Akbari,Serge Zhuiykov,2020-07-30 Offering perspective on both the scientific and engineering aspects of 2D semiconductors Ultrathin Two Dimensional Semiconductors for Novel Electronic Applications discusses how to successfully engineer 2D materials for practical applications It also covers several novel topics regarding 2D semiconductors which have not yet been discussed in any other publications Features Provides comprehensive information and data about wafer scale deposition of 2D semiconductors ranging from scientific discussions up to the planning of experiments and reliability testing of the fabricated samples Precisely discusses wafer scale ALD and CVD of 2D semiconductors and investigates various aspects of deposition techniques Covers the new group of 2D materials synthesized from surface oxide of liquid metals and also explains the device fabrication and post treatment of these 2D nanostructures Addresses a wide range of scientific and practical applications of 2D semiconductors and electronic and optoelectronic devices based on these nanostructures Offers novel coverage of 2D heterostructures and heterointerfaces and provides practical information about fabrication and application of these heterostructures Introduces the latest advancement in fabrication of novel memristors artificial synapses and sensorimotor devices based on 2D semiconductors This work offers practical information valuable for engineering applications that will appeal to researchers academics and scientists working with and interested in developing an array of semiconductor electronic devices Advanced Luminescent Materials and Quantum Confinement M. Cahay,1999

Conductive Polymers II R. H. Friend,1993 This report explains the theory of polymer conductivity and discusses developments in the synthesis of the major polymers A detailed section on practical applications follows a discussion of the improved electrical and mechanical properties and environmental stability which make such applications possible An

additional indexed section containing several hundred abstracts from the Rapra Polymer Library database provides useful references for further reading **Handbook of Optoelectronic Device Modeling and Simulation** Joachim Piprek,2017-10-12 Optoelectronic devices are now ubiquitous in our daily lives from light emitting diodes LEDs in many household appliances to solar cells for energy This handbook shows how we can probe the underlying and highly complex physical processes using modern mathematical models and numerical simulation for optoelectronic device design analysis and performance optimization It reflects the wide availability of powerful computers and advanced commercial software which have opened the door for non specialists to perform sophisticated modeling and simulation tasks The chapters comprise the know how of more than a hundred experts from all over the world The handbook is an ideal starting point for beginners but also gives experienced researchers the opportunity to renew and broaden their knowledge in this expanding field **Inorganic Materials** Dhirendra Bahadur,Satish Vitta,Om Prakash,2004 Contains contributed articles discussing various aspects of processing properties and applications including computational aspects of Magnetic and electronic materials Electro optical materials Biomaterials and Nanomaterials **Optoelectronic Integrated Circuit Materials, Physics, and Devices** M. Razeghi,Yoon-Soo Park,Gerald L. Witt,1995 **Physics and Simulation of Optoelectronic Devices VI** Peter Blood,1998 *Physical Concepts of Materials for Novel Optoelectronic Device Applications II* ,1991 *Progress in Semiconductors II - Electronic and Optoelectronic Applications: Volume 744* B. D. Weaver,2003-04-16 Recent years have witnessed dramatic success in the development of semiconductor materials and related quantum structures for applications in electronics and optoelectronics Progress has also been made in manufacturable low cost high volume growth and processing of semiconductor materials for such device structures Novel approaches have been proposed to integrate compound semiconductor devices with conventional silicon processing This book provides a comprehensive overview of the progress on growth properties and processing of semiconductor materials and quantum structures as well to underscore the progress on devices such as transistors light sources detectors and modulators Brought to maturity these devices will likely see widespread application in infrared imaging chemical and biological sensing surveillance short links space based applications solar cells high bandwidth communications and more Topics include electronic devices Si Ge devices and technology zinc oxide and related compounds emitters lasers and photovoltaics nanostructures innovative materials and devices detectors and III nitride materials and devices *Thin-Film Structures for Photovoltaics: Volume 485* Eric D. Jones,1998 Contains 49 papers from the December 1997 symposium The contributions are organized into three sections devoted to silicon II VI and III V based thin films as well as a section on general thin films A number of processes are dealt with including VEST ion beam plasma laser low temperature sputter and metalorganic chemical vapor depositions and various growth techniques In addition analysis and modeling methodologies are discussed Annotation copyrighted by Book News Inc Portland OR Current Developments in Optical Engineering II ,1987 **Optoelectronic Interconnects** ,1998

Optoelectronic Interconnects V Ray T. Chen,Julian P. Bristow,1998 *Polymer Preprints, Japan* ,2002 ICO20 Wei Lu,Jeff Young,2006 Proceedings of SPIE present the original research papers presented at SPIE conferences and other high quality conferences in the broad ranging fields of optics and photonics These books provide prompt access to the latest innovations in research and technology in their respective fields Proceedings of SPIE are among the most cited references in patent literature **Dissertation Abstracts International** ,2007 *Annual Meeting* Kōbunshi Gakkai (Japan), Proceedings of the ASME Turbo Expo ... ,2005 Electrical & Electronics Abstracts ,1997

Unveiling the Energy of Verbal Beauty: An Emotional Sojourn through **Ultra Thin Films For Opto Electronic Applications**

In a world inundated with monitors and the cacophony of instant interaction, the profound energy and emotional resonance of verbal beauty usually diminish into obscurity, eclipsed by the continuous onslaught of noise and distractions. Yet, nestled within the musical pages of **Ultra Thin Films For Opto Electronic Applications**, a charming work of fictional beauty that pulses with raw emotions, lies an wonderful journey waiting to be embarked upon. Composed with a virtuoso wordsmith, this interesting opus instructions visitors on a psychological odyssey, softly revealing the latent possible and profound affect stuck within the complex internet of language. Within the heart-wrenching expanse of this evocative analysis, we can embark upon an introspective exploration of the book is main subjects, dissect their charming publishing model, and immerse ourselves in the indelible effect it leaves upon the depths of readers souls.

https://ftp.barnabastoday.com/About/publication/HomePages/Womans_Bible_Elizabeth_Cady_Stanton_Ebook.pdf

Table of Contents Ultra Thin Films For Opto Electronic Applications

Ultra Thin Films For Opto Electronic Applications Introduction

In the digital age, access to information has become easier than ever before. The ability to download Ultra Thin Films For Opto Electronic Applications has revolutionized the way we consume written content. Whether you are a student looking for course material, an avid reader searching for your next favorite book, or a professional seeking research papers, the option to download Ultra Thin Films For Opto Electronic Applications has opened up a world of possibilities. Downloading Ultra Thin Films For Opto Electronic Applications provides numerous advantages over physical copies of books and documents. Firstly, it is incredibly convenient. Gone are the days of carrying around heavy textbooks or bulky folders filled with papers. With the click of a button, you can gain immediate access to valuable resources on any device. This convenience allows for efficient studying, researching, and reading on the go. Moreover, the cost-effective nature of downloading Ultra Thin Films For Opto Electronic Applications has democratized knowledge. Traditional books and academic journals can be expensive, making it difficult for individuals with limited financial resources to access information. By offering free PDF downloads, publishers and authors are enabling a wider audience to benefit from their work. This inclusivity promotes equal opportunities for learning and personal growth. There are numerous websites and platforms where individuals can download Ultra Thin Films For Opto Electronic Applications. These websites range from academic databases offering research papers and journals to online libraries with an expansive collection of books from various genres. Many authors and publishers also upload their work to specific websites, granting readers access to their content without any charge. These platforms not only provide access to existing literature but also serve as an excellent platform for undiscovered authors to share their work with the world. However, it is essential to be cautious while downloading Ultra Thin Films For Opto Electronic Applications. Some websites may offer pirated or illegally obtained copies of copyrighted material. Engaging in such activities not only violates copyright laws but also undermines the efforts of authors, publishers, and researchers. To ensure ethical downloading, it is advisable to utilize reputable websites that prioritize the legal distribution of content. When downloading Ultra Thin Films For Opto Electronic Applications, users should also consider the potential security risks associated with online platforms.

Malicious actors may exploit vulnerabilities in unprotected websites to distribute malware or steal personal information. To protect themselves, individuals should ensure their devices have reliable antivirus software installed and validate the legitimacy of the websites they are downloading from. In conclusion, the ability to download Ultra Thin Films For Opto Electronic Applications has transformed the way we access information. With the convenience, cost-effectiveness, and accessibility it offers, free PDF downloads have become a popular choice for students, researchers, and book lovers worldwide. However, it is crucial to engage in ethical downloading practices and prioritize personal security when utilizing online platforms. By doing so, individuals can make the most of the vast array of free PDF resources available and embark on a journey of continuous learning and intellectual growth.

FAQs About Ultra Thin Films For Opto Electronic Applications Books

What is a Ultra Thin Films For Opto Electronic Applications PDF? A PDF (Portable Document Format) is a file format developed by Adobe that preserves the layout and formatting of a document, regardless of the software, hardware, or operating system used to view or print it. **How do I create a Ultra Thin Films For Opto Electronic Applications PDF?** There are several ways to create a PDF: Use software like Adobe Acrobat, Microsoft Word, or Google Docs, which often have built-in PDF creation tools. Print to PDF: Many applications and operating systems have a "Print to PDF" option that allows you to save a document as a PDF file instead of printing it on paper. Online converters: There are various online tools that can convert different file types to PDF. **How do I edit a Ultra Thin Films For Opto Electronic Applications PDF?** Editing a PDF can be done with software like Adobe Acrobat, which allows direct editing of text, images, and other elements within the PDF. Some free tools, like PDFescape or Smallpdf, also offer basic editing capabilities. **How do I convert a Ultra Thin Films For Opto Electronic Applications PDF to another file format?** There are multiple ways to convert a PDF to another format: Use online converters like Smallpdf, Zamzar, or Adobe Acrobats export feature to convert PDFs to formats like Word, Excel, JPEG, etc. Software like Adobe Acrobat, Microsoft Word, or other PDF editors may have options to export or save PDFs in different formats. **How do I password-protect a Ultra Thin Films For Opto Electronic Applications PDF?** Most PDF editing software allows you to add password protection. In Adobe Acrobat, for instance, you can go to "File" -> "Properties" -> "Security" to set a password to restrict access or editing capabilities. Are there any free alternatives to Adobe Acrobat for working with PDFs? Yes, there are many free alternatives for working with PDFs, such as: LibreOffice: Offers PDF editing features. PDFsam: Allows splitting, merging, and editing PDFs. Foxit Reader: Provides basic PDF viewing and editing capabilities. How do I compress a PDF file? You can use online tools like Smallpdf, ILovePDF, or desktop software like Adobe Acrobat to compress PDF files without significant quality loss. Compression reduces the file size, making it easier to

share and download. Can I fill out forms in a PDF file? Yes, most PDF viewers/editors like Adobe Acrobat, Preview (on Mac), or various online tools allow you to fill out forms in PDF files by selecting text fields and entering information. Are there any restrictions when working with PDFs? Some PDFs might have restrictions set by their creator, such as password protection, editing restrictions, or print restrictions. Breaking these restrictions might require specific software or tools, which may or may not be legal depending on the circumstances and local laws.

Find Ultra Thin Films For Opto Electronic Applications :

womans bible elizabeth cady stanton ebook
wolf spirit healing wolves wonder ebook
woensdag 21 mei 1975
winning friends for the school library a pr handbook professional growth
woman alone and other plays
wiring diagram for polaris scrambler 400 atv
winterwille it tredde boek oer jan en klas
women bound in tights
women at war declaring a cease fire on toxic female relationships
wizard of id weve got to stop meeting like this
withheld judgment manual guide
women and the economy a reader
wolf girl and black prince dubbed
~~winter is not forever seasons of the heart volume 3~~
~~wipneus en pim in de zilveren raket~~

Ultra Thin Films For Opto Electronic Applications :

New Cutting Edge Intermediate Workbook (answer key) New Cutting Edge Intermediate Workbook (answer key) Cutting Edge 3rd Ed: Intermediate | Workbook + Answer Key Description · A strong grammar syllabus develops effective and accurate use of language · High-frequency vocabulary helps students say what they want to say ... Cutting Edge 3rd Ed: Elementary | Workbook + Answer Key Description · A strong grammar syllabus develops effective and accurate use of language · High-frequency vocabulary helps students say what they want to say ... cutting edge 3rd edition intermediate

workbook with key Book overview. Cutting Edge 3rd edition edition builds on the task-based learning approach that has made. Cutting Edge so popular. With fresh, new, integrated ... Cutting Edge Pre İntermediate Workbook Key - english Cutting Edge Pre İntermediate Workbook Key ; 51. EAW3 answerkey - Effective Academic Writing 3 Answer key will help your essay writing skill to ; 106. Cutting Edge 3rd Edition Intermediate Workbook + Answer ... This fully-revised edition builds on the task-based learning approach that has made Cutting Edge so popular. With fresh, new, integrated DVD material and ... ZZ:Cutting Edge 3rd Edition Intermediate Workbook with ... The Workbook contains extra practice and exercises with answer key. There is also an audio CD for listening exercises. Paperback. Published January 11, 2013. Cutting Edge | Intermediate Workbook + Answer Key Workbook + Answer Key. ISBN: 9781447906520. Course: Cutting Edge 3rd Edition. Workbook + Answer Key (Intermediate). Cutting Edge 3rd Edition Workbook + Answer ... CUTTING EDGE - Elementary - Third Edition - Workbook CUTTING EDGE - Elementary - Third Edition - Workbook - Free download as PDF File (.pdf) or read online for free. edge. Cutting Edge 3rd Edition Intermediate Workbook with Key Engaging texts new video content and a comprehensive digital package are just some of the features that make this fully revised edition even more effective. Arena Spectacles - Classics Argues that arena spectacles were a mechanism for linking center and periphery in the Roman Empire, spreading Roman culture, and establishing civic order. Arena Spectacles: Oxford Bibliographies Online Research ... This ebook is a selective guide designed to help scholars and students of the ancient world find reliable sources of information by directing them to the ... Arena Spectacles: Oxford Bibliographies Online Research Guide This ebook is a selective guide designed to help scholars and students of the ancient world find reliable sources of information by directing them to the ... Arena Spectacles: Oxford Bibliographies Online Research ... This ebook is a selective guide designed to help scholars and students of the ancient world find reliable sources of information by directing them to the. Arena Spectacles Oxford Bibliographies Online Research Guide ... E. Norman Gardiner 2012-06-11 Concise, convincing book emphasizes relationship between Greek and Roman athletics and religion, art, and education. Arena Spectacles: Oxford Bibliographies Online Research ... Read reviews from the world's largest community for readers. The Roman games: A sourcebook. Malden, MA: Blackwell. Includes Ancient sources in translation… Arena Spectacles: Oxford Bibliographies Online Research Guide Arena Spectacles: Oxford Bibliographies Online Research Guide is written by Kathleen Coleman and published by Oxford University Press, USA. Oxford Bibliographies Online | The New York Public Library A collection of research guides for a wide variety of subjects. Includes topic overviews and annotated bibliographies. JP 07.19 Online Roman city life Oxford Bibliographies: Arena Spectacles, DOI: 10.1093/OBO/9780195389661-0004 – ... (eds.), Oxford Handbook of Roman Studies,. Oxford: OUP, 651–70. Coleman, K ... Sport-Classics (Oxford Bibliographies Online) Offering a wealth of insights to our current understanding of the role of sport and spectacle in the ancient world, "A Companion to Sport and Spectacle in Greek ... Sistem Informasi Manajemen Pt Telkom (2023) revised algase wandering scale raws shine 695933 pdf pdf- rob swanson blitz

wholesaling system 11 mp4s 4 mp3s 1 pdf 1 doc 1 rtf 1 csv 6 png 2 jpg pdf. Convert PNG to JPG Images for Free | Adobe Express Convert your PNG to JPG in a snap. Get started with the free online JPG to PNG converter to add transparency or improve file quality. Upload your photo. PNG to JPG – Convert PNG images to JPEG This free online tool converts your PNG images to JPEG format, applying proper compression methods. It aslo supports mass conversion and bulk download. Converting transparent png to jpg powershell Powershell (very) junior here, I'm trying to batch convert a bunch of transparent pngs to jpgs and the below cobbled powershell works but ... Batch converting PNG to JPG in linux Nov 16, 2009 — As for batch conversion, I think you need to use the Mogrify tool which is part of ImageMagick. Keep in mind that this overwrites the old images ... Free PNG to JPG converter: Change PNG images to JPG Use Canva's online PNG to JPG converter to compress files, free up storage space, and make high-quality images ready for sharing on the web or social media. Nelson functions and applications 11 solutions manual pdf Rob Swanson Blitz Wholesaling System 11 MP4s 4 MP3s 1 PDF 1 DOC 1 RTF 1 CSV 6 PNG 2 JPG. Linear Algebra And Its Applications Lay Solutions Manual 4th Edition. . Convert png to jpeg using Pillow - python Apr 6, 2017 — I am trying to convert png to jpeg using pillow. I've tried several scrips without success. These 2 seemed to work on small png images like this ... Nelson functions and applications 11 solutions manual pdf Rob Swanson Blitz Wholesaling System 11 MP4s 4 MP3s 1 PDF 1 DOC 1 RTF 1 CSV 6 PNG 2 JPG. Linear Algebra And Its Applications Lay Solutions Manual 4th Edition. . Convert PNG to JPG Jun 3, 2017 — With Simple Photo Converter, you can choose one or more photos and convert them to other image formats. Hope the above information helps. 5 ...