

Article

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

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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/cm²). 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



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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

Tao Wei



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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 3,2,5-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 Anisotropies 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 Karbalaee 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

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