

Materials for Optoelectronic Applications

First Edition

Capt. Dr. Vijendra Anant Chaudhari

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Acknowledgement

I am very much pleased to introduce an edited book entitled, Materials for Optoelectronic Applications and put in the hands of new researchers. This book also serves as a reference book for students at all levels of research for guidance while writing thesis or papers. The book comprises chapters from different branches of science. In this book, the corresponding author honestly tries to describe the innovative research ideas and it is a platform for exchanging acquired knowledge. Authors have submitted their original and unpublished work related to numerous disciplines that communicates current and innovative research.

The most important specialty of this book is that, it motivates and creates curiosity and research interest inside the students, so that they can get clear ideas about their concepts.

At the outset, I would like to place on record my deep sense of gratitude to Prof. Govind K. Bichile for his blessing and love. At the same time I take this opportunity to express sincere thanks to Prof. K. M. Jadhav (Senior Professor, Dept. of Physics, Dr. B. A. M. U. Aurangabad).

My special thanks to my friend Dr. Atul Wadagale who extended their excellent cooperation at critical times and spent their invaluable time during my work and also thanks for providing their generous help for rendering assistance all the time in various forms during this Book..

Last but not least, I would like to express my thanks to all co-authors, for completion of this reference book in a short period of time.

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Optical, Lower Microwave and radio frequency Response of Binary Mixtures of Organic Liquids - A dielectric approach

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Abstract: Each material displays an unique complex permittivity spectra in the radio/microwave frequency domain because of their different structures and varying dynamic responses to an external electromagnetic field. These spectra usually include one or more dispersions. A dielectric dispersion is mainly characterized by two parameters, dielectric decrement ($\epsilon_0 - \epsilon_\infty$) and relaxation time (τ_0). Complex permittivity of various concentrations 1-Propanol (1-PrOH) and its mixtures with N,N Dimethylformamide (DMF) were obtained in the radio and lower microwave frequency range using Vector network analyzer (VNA). Furthermore to have more insight the dielectric constant (ϵ') and dielectric loss (ϵ'') of these samples were also determined using standard X-band microwave test bench operated at 9.1 GHz. Optical dielectric constant ($\epsilon_\infty = n^2$) of these liquids samples were measured using Abbe's refractometer. These data points of different frequencies were fitted into Debye model to evaluate dielectric parameters like, a relaxation time (τ_0), static dielectric constant (ϵ_0). Excess of static dielectric constant (ϵ_0)^E and excess inverse relaxation time ($1/\tau_0$)^E are determined and fitted with Redlich-Kister polynomial equation to derive the binary coefficients and standard deviations. Kirkwood correlation factor (g) and Bruggeman factor (f_B) were also evaluated for this system. These parameters were used to interpret the molecular interaction between the molecular species of the liquid mixtures.

Keywords: Complex permittivity, Dielectric dispersion, Hydrogen bond, Relaxation time, Vector network analyzer.

On axis Harmonics Generation in Planer Electromagnet Undulator

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Abstract: In this paper we derive the equations for the harmonic generation of the planer electromagnet undulator. We also designed the schematic of the electromagnet undulator with respective dimensions of the lamination and copper conductor. With this schematic we can obtain have 7th harmonics possibly; beyond the 7th harmonic, we are not able to see the harmonic nature of the electromagnet undulator. This is due to the small undulator period length. Only on axis harmonics field are calculated.

Keywords: Magnetic field, Harmonics, electromagnet Undulator

Zinc Oxide Nano Thin film for Solar cell device Applications

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Abstract: Zinc Oxide (ZnO) thin film was deposited using simple low cost spray pyrolysis technique. The deposited film was characterized by X-ray diffractometer (XRD), Scanning Electron Microscope (SEM) and UV-Visible spectroscopy. XRD Spectra revealed that ZnO film represents polycrystalline wurzite crystal structure. Full Width at Half Maximum (FWHM) was estimated using Lorentz Fit of XRD data. The crystallite size calculated was to be 26.31 nm. The SEM image of ZnO thin film shows whole surface was uniformly coated with spherical ZnO grains of average size 111.55 nm. Purity of the deposited sample was investigated by using Energy Dispersive X-ray Analysis (EDX). The deposited ZnO film shows 78% transmittance. The optical band gap estimated by Tauc plot was 3.76eV.

Keywords: ZnO thin films, Spray pyrolysis, XRD spectra, SEM micrographs, optical band gap.

IOT based Object Sorting and portable skin tone meter System

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Abstract: There is an extensive convention of numerous products in our daily life and built-up of this products are completed in various big scale and petite scale industries. Arranging causes class uniformity problem. Currently the major intricacy explicitly faced subsequent to the manufacture is of categorization. Arranging of objects in an industry is a tedious contemporary procedure, which is done actually. Consistent physical necessitate of this variety of machine in the industries will assist in arrangement the machine according to their load, bulk, color, shape, etc. This paper gives succinct information regarding the categorization of objects according to their color using TCS3200 sensor, Arduino UNO and servo motors. The recognition of color is made by frequency scaling of color detection.

Keywords: Internet of Things (IoT), Color Sensor, Arduino Uno, TFT LCD, Blynk Platform.

Structural and Optical Properties of Lead Zirconate Titanate Prepared by Solid State Route.

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Abstract: Polycrystalline samples of $\text{PbZr}_x\text{Ti}_{1-x}\text{O}_3$ [referred as PZT] where $x = 0.0, 0.2, 0.4, 0.6, 0.8$ and 1.0 have been synthesized by a high-temperatures solid-state reaction technique. One of the objective of this work was to optimize carefully the process variables which influence the structural and microstructural properties of the samples prepared. Structural phase evolution studies of $\text{PbZr}_x\text{Ti}_{1-x}\text{O}_3$ (PZT) system have been carried out as function of Zr/Ti ratio using room temperature X-ray powder diffractometric studies. The analysis of the X-ray diffraction patterns for the sample with $0.0 \leq x \leq 0.4$ confirmed the tetragonal phase formation and no impurity peaks were observed. With increase in Zr content i.e. for $x = 0.6$ and 0.8 the observed diffraction peaks indicate the presence of rhombohedral phase in this composition range. With further increase in Zr content i.e. $x = 1.0$ the observed diffraction pattern confirmed the presence of single phase orthorhombic structure. The average linear particle sizes for all the compositions estimated using Scherrer's formula lie in the rang 400-500 nm. Microstructural studies for all the samples have been carried out using SEM. The SEM analysis of the samples also showed nearly uniform grain distribution i.e. uniform microstructure with no abnormal grain growth. The values of average grain size were obtained using mean intercept method and the value of grain size lie between 1-2 μm . Vibrational spectroscopy data obtained in the wavenumber region 350 to 800 cm^{-1} for the samples showed characteristic peaks corresponding to the vibrational modes of perovskite structure and a shift in the frequency of the peaks towards the lowered side with the increase of Zr content has been observed.

Keywords: crystals/crystallization; ferroelectricity/ferroelectric materials; grain growth; leads zirconate titanate (PZT); particle size.

Preparation of ZnO Thin Films by Modified Chemical Methods

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Abstract: Zinc Oxide (ZnO) thin films were deposited onto the glass substrates by a successive ionic layer adsorption and reaction method, which is based on the alternate dipping of substrate in a zinc nitrate solution complexes with NH₄OH and distilled water heated at 75°C. The time duration for which a substrate is dipped in the distilled water, plays an important role and it has been shown in this work that the time period for which a substrate is dipped in distilled water, which we referred as rinsing period, affects significantly on the properties. These samples are characterized by different characterization techniques such as Scanning Electron Microscopy (SEM) with Energy dispersive X-Ray Analysis (EDAX) etc.

Keywords: ZnO, Thin Films, SEM, EDAX.

An Intelligent Agricultural Manipulations using IOT

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Abstract: India's agriculture field has diversity and their practices are ranging from traditional village farming to developing farms utilizing from past era. Lack of modern and modern agricultural technologies. However, this sector is mostly depends upon monsoon and other ecosystem changes hence it is uncontrollable factor. This all results in low level of intelligence in this field. Encouraging modern technology and its applications in agriculture will solve a number of problems faced by farmers updated information and expert's results in production loss and crop harvest. This proposed system is designed to overcome these problems. This system will provide an intelligent and efficient monitoring platform and framework for agriculture ecosystem based on IOT. This is going to be catalyst for the evolution from traditional farming into modern farming. This will also provide opportunity for creating new technology and service sector development in IOT based farming application. The IOT makes everything connected. Modern agriculture practices have a great promises for the economic development of a nation. So we have designed an innovative system for the welfare of farms and also for the nations GDP.

Keywords: Catalyst, GDP, IOT, Monsoon, Production loss.

Zn doped CdS thin films by Chemical bath deposition (CBD) technique

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Abstract: The present article deals with effect of Zn doping on CdS thin films deposited by using the cost effective chemical route onto the glass substrate at room temperature. The as deposited and Zn doped thin films are characterized for structural, compositional using the X-ray diffraction pattern. The XRD pattern obtained shows polycrystalline nature of the materials with orientation along (110) plane upon doping shift in the peak position along with increment into the crystallite size is observed. The elemental compositions obtained from the EDAX spectra represent the balanced and used chemical in-gradient proportions. The surface morphology exhibits modification into the surface structure on doping with Zn elements.

Keywords: Zinc, CdS thin films, Surface morphology.