Arabian Journal for Science and Engineering (Arab J Sci Eng)

Research Article - Physics
January 2015, Volume 40, Issue 1, pp 257-262

Polymer–Fullerene Bulk Heterojunction-Based Strain-Sensitive Flexible Organic Field-Effect Transistor

- Muhammad Yasin , T. Tauqeer , Hamood Ur Rahman , Kh. S. Karimov , Sait E. San , Ali V. Tunc

Abstract:

In this work, we have fabricated organic field-effect transistor using the blend of poly (3-hexylthiophene) and [6,6]-phenyl C61-butyric acid methylester as active layer. Transistor was fabricated in MESFET-type configuration with top gate and bottom drain/source contacts on flexible PET substrate. Drain and source contacts were made using silver (Ag), whereas gate contact was made by depositing aluminium (Al) on the active layer. Active layer showed ohmic-type contact with drain/source electrodes and Schottky-type contact with gate electrode, which was discussed with the help of energy band diagram. Current–Voltage (*I*–*V*) characteristics of the transistor were found similar to p-type mode *I*–*V* characteristics of a typical low-voltage ambipolar field-effect transistor. Strain sensing properties of the device were investigated by bending it at 0° and 90° with respect to the direction of drain-to-source current for different strains of 1, 1.6, and 3.2 %. Significant proportional variation in the drain-to-source current was observed due to the bending from both sides; however, sensitivity of the device was found higher when strain was applied at 90° with respect to drain-to-source current. Sensitivity values were found to be equal to 0.18 and 0.65 μA/ % when a constant bending strain of 3.2 % was applied at 0° and 90° with respect to the direction of drain-to-source current, respectively.

Arabian Journal for Science and Engineering (Arab J Sci Eng)

Research Article - Physics
January 2015, Volume 40, Issue 1, pp 269-278

Interface Reconstruction of Multiple Immiscible Fluids

- Juraj Onderik, Michal Chládek , Roman Ďurikovič

Abstract:

We present a particle-based approach for animating multiple interacting liquids that can handle a number of immiscible fluids. We solve the usual problem of robust interface tracking by reconstructing the zero level set of our novel composite implicit function. Its recurrent formulation handles directly interfaces between any number of liquids including their free surfaces. To further enhance visual quality of the interfaces, we identify and refine particles in the vicinity of the surface. Our extraction scheme of near-surface particles robustly handles irregular distributions and rapid oscillations during the marking process. The surface is refined by upsampling new points along splines formed between neighbor particles. This strategy gives us smoother interfaces while having faster computation compared to a full simulation in a higher resolution. The proposed improvements can be easily implemented into the common smoothed-particle hydrodynamics framework.

Arabian Journal for Science and Engineering (Arab J Sci Eng)

Research Article - Physics
January 2015, Volume 40, Issue 1, pp 263-268

Characterization of InGaN by Means of *I–V* Measurements of Respective Light-Emitting Diode (LED) by DLTS

- H. M. Noor ul Huda Khan Asghar, Zaheer Abbas Gilani , M. S. Awan , I. Ahmad , Yi Tan

Abstract:

Indium gallium nitride (InGaN) has been characterized by means of deep-level transient spectroscopy (DLTS). The current–voltage measurement of respective schottky diode is performed by standard method available in our DLTS setup. The current–voltage measurement of InGaN is performed at various temperatures under same biasing conditions. From these measurements, the behavior of the materials is studied in detailed and listed in the following: The ideality factor, calculated to be 8.839, is found to increase with decreasing temperature of the material. However, values increased with decrease in temperature for the material. The higher value of ideality factor is attributed to high diffusion or tunneling current. The barrier height of InGaN is calculated as 0.851 eV which decreased with decrease in temperature. The change in the barrier height is related to the effective leakage current at high temperature. In InGaN, the value of reverse saturation current at room temperature is calculated as 8.22×10^{-11} *A*, and the calculated values are found to decrease at lower temperatures.

Arabian Journal for Science and Engineering (Arab J Sci Eng)

Research Article - Physics
July 2015, Volume 40, Issue 7, pp 2085-2093

Effects of Inhibitor on PbS Thin Films Obtained by Chemical Bath Deposition

- Barış Altıokka

Abstract:

Thin films of polycrystalline lead sulfide (PbS) have been deposited on glass substrates by chemical bath deposition at 20 ± 1 $^{\circ}$C in alkaline solutions. Aqueous solutions of lead nitrate ($Pb(NO_3)_2$), potassium hydroxide (NaOH), thiourea ($CS(NH_2)_2$) and sodium thiosulfate ($Na_2S_2O_3$) were used together for the first time to obtain thin films of PbS. The chemical kinetics was investigated according to the amounts of Pb^{2+} concentrations measured by atomic absorption spectroscopy during the precipitation of PbS. It was found that sodium thiosulfate had an inhibitor effect for alkaline solutions. The structures of the films were characterized by X-ray diffractometer and showed that all the films had a galena-type cubic structure. The morphological characteristics of the PbS thin films were studied by scanning electron microscope and revealed that when the $Na_2S_2O_3$ compound was used, the shape of the nanoparticles changed from the polymorphic form to the pyramidal form and pinhole-free PbS thin films could be produced.

Arabian Journal for Science and Engineering (Arab J Sci Eng)

Research Article - Physics
July 2015, Volume 40, Issue 7, pp 2111-2115

Optical Amplification in Dilute Nitride Hot Electron Light Emission–VCSOAs Devices

- Faten Adel Ismael Chaqmaqchee

Abstract:

We have demonstrated an optical amplification of hot electron light emitting and lasing in semiconductor heterostructure (HELLISH) vertical-cavity semiconductor optical amplifiers (VCSOAs) at wavelength operation of $\lambda=1.29\mu m$. These devices were characterized using optical pumping, electrical pumping and optical–electrical pumping. HELLISH–VCSOA device of 500-μm contact separation is a surface emitter based on longitudinal injection of electron and hole pairs in their respective channels. Dilute nitride $Ga_{0.35}In_{0.65}N_{0.02}As_{0.08}$/GaAs is used as an active material for operation in the $\lambda=1.3-\mu m$ window of the optical communications. The device has undoped distributed Bragg reflectors (DBRs), and the current is injected longitudinally into the active layers without passing through DBRs. The issues are associated with refractive index contrast, and current injections through the DBR layers are avoided.

Arabian Journal for Science and Engineering (Arab J Sci Eng)

Research Article - Physics
July 2015, Volume 40, Issue 7, pp 2095-2101

Radon Concentrations and Effective Radium Contents in Local and Imported Phosphate Fertilizers, Saudi Arabia

- Fatimh Alshahri , Muna Alqahtani

Abstract:

Radon concentrations and effective radium contents were measured using CR-39 solid-state nuclear track detectors. In this study, 27 local and imported phosphate fertilizer samples (liquid and solid) were collected from markets in eastern Saudi Arabia. The radon concentrations were found to vary from 3.23 ± 1.2 to 1547 ± 162 Bq m^{-3}. The radon exhalation rates and effective radium contents ranged from 1.77 ± 0.7 to 848 ± 89 mBq $m^{-2}h^{-1}$ and from 3.53 ± 1.1 to 2246 ± 236 Bq m^{-3}, respectively. The highest annual effective dose was from a local fertilizer sample (39 ± 9.8 mSv y^{-1}); this value was higher than the world allowed dose. Therefore, these fertilizers can be a significant source of radiological hazards to human health. Strong correlations were found between the radon concentrations, exhalation rates and annual effective doses from the local and imported phosphate fertilizers. The radon concentrations in all fertilizer samples were compared with the recommended value from ICRP (200 Bq m^{-3}).

Arabian Journal for Science and Engineering (Arab J Sci Eng)

Research Article - Physics
July 2015, Volume 40, Issue 7, pp 2103-2110

Effect of Austenizing Temperature on High-Carbon Steels and Its Characterization by Eddy Current Nondestructive Technique

- S. H. Khan, A. Nusair Khan

Abstract:

The objective of this study is to investigate the effect of austenizing temperature on high-carbon steels. Two types of steels, i.e., AISI-440C and AISI-A2 were selected in this regard. Specimens of these steels were austenized from 950 to 1250°C and then air-cooled; this resulted in major microstructural changes in the specimens. These microstructural changes altered the electrical resistivity and magnetic permeability of the materials. XRD studies revealed that about 80% austenite formed when the subject steels were heat-treated to 1200°C. Eddy current technique was applied for the assessment of these microstructural changes, which influence the eddy current response in the coil. Similar hardness trend was observed for both steels. The magnitude of eddy current can be used to estimate the volume fraction of phases present in these steels. This study revealed that a good correlation existed between eddy current measurements and microstructural changes in these steels.

Arabian Journal for Science and Engineering (Arab J Sci Eng)

Research Article - Physics
July 2015, Volume 40, Issue 7, pp 2079-2084

Influence of (La, Cu) Doping on the Room Temperature Multiferroic Properties of $BiFeO_3$ Ceramics

- A. Sathiya Priya , I. B. Shameem Banu , Murthy Chavali

Abstract:

A series of $Bi_{1-x}La_xFe_{0.98}Cu_{0.02}O_3$ (x = 0.01, 0.03 and 0.05) ceramics were synthesized by sol–gel method. The prepared ceramics were characterized by X-ray diffractometer (XRD), vibrating sample magnetometer (VSM) and dielectric measurement. XRD patterns reveal that $Bi_{1-x}La_xFe_{0.98}Cu_{0.02}O_3$ (x = 0.01, 0.03 and 0.05) ceramics crystallize in single-phase rhombohedral structure with R3c space group without distortion, and the average crystallite size was in the range of 31–92 nm. VSM exhibited a weak ferromagnetism for La- and Cu-co-doped $BiFeO_3$ ceramics. The squareness ratio of the hysteresis loop decreases as La concentration increases in $Bi_{1-x}La_xFe_{0.98}Cu_{0.02}O_3$. However, these materials show improved dielectric properties compared to undoped $BiFeO_3$ ceramic.

Arabian Journal for Science and Engineering (Arab J Sci Eng)

Research Article - Physics
July 2015, Volume 40, Issue 7, pp 2063-2077

Approximate Solutions of the Dirac Equation for the Hua Plus Modified Eckart Potential

- A. N. Ikot, E. Maghsoodi , A. D. Antia , H. Hassanabadi , S. Zarrinkamar

Abstract:

The relativistic symmetries of the Dirac equation with Hua plus modified Eckart potential including the generalized tensor interaction are presented. We obtain the energy eigenvalues and the corresponding eigenfunction using parametric Nikiforov–Uvarov method. We compute the bound-state energy spectrum to show the effects of the tensor interaction, and by using an approximate scheme to the centrifugal term, the arbitrary-state solutions are reported and the scattering states are studied. Our results show that the presence of the generalized tensor interaction removes the degeneracies between spin and pseudospin doublets. Some special cases of this potential are also discussed.

Arabian Journal for Science and Engineering (Arab J Sci Eng)

Research Article - Physics
July 2015, Volume 40, Issue 7, pp 2059-2062

AC Field Effects on Vortex Avalanches in $Mg_{0.975}Al_{0.025}B_2$ Superconductors

- A. F. Salem , K. A. Ziq , A. A. Bahgat

Abstract:

Magnetization measurements have been performed on $Mg_{1-x}Al_xB_2$ superconductors (x = 0.025) in the temperature range 4–35 K and in a magnetic field up to 9T using VSM. At low fields (< 2 T), large vortex instabilities (vortex avalanches) are observed in the doped samples. As the temperature increases, the positions of avalanches are shifted to lower fields. An external AC field has been applied to shake the vortices. Upon shaking, the positions of avalanches have been observed to shift to higher fields.

Arabian Journal for Science and Engineering (Arab J Sci Eng)

Research Article - Physics
July 2015, Volume 40, Issue 7, pp 2049-2057

The Influence of Precursor Ratio on Structure, Morphology and Resistivity of Thin ZnS Films Sprayed by Improved Method

- Rangnath V. Zaware , Bhiva G. Wagh

Abstract:

Thin ZnS films were prepared by improved spray pyrolysis (ISP) method for precursor (Zn/S) ratios (1:1) to (1:6) in the initial solution. The ISP parameters such as carrier gas flow rate, solution flow rate and substrate temperature were controlled with an accuracy of ±0.25lpm,±1ml/h and ±1∘C , respectively. The solution was sprayed in a pulse mode. The chemical and physical properties for these thin films were investigated as a function of solution precursor ratio. The films were fairly smooth with satisfactory crystallinity. The films have exhibited a polycrystalline cubic structure. A gradual increase in (S/Zn) atomic ratio from 0.82 to 1.01 with the increase in solution precursor ratio was observed. The properties such as crystal size, texture coefficient, band gap, grain size and electrical resistivity for thin ZnS films showed a gradual improvement with the increase in their (S/Zn) atomic ratio. The behavior of non-stoichiometric (zinc excess) thin films was like n-type extrinsic semiconductors. The thin film (1:6) have the larger crystal size of 5.59 nm, grain size of 72 nm, band gap of 3.634 eV and electrical resistivity of 6.85×106Ωcm . These features of ISP-prepared thin ZnS films make the films more appropriate for optical and photovoltaic applications.

Arabian Journal for Science and Engineering (Arab J Sci Eng)

Research Article - Physics
January 2016, Volume 41, Issue 1, pp 301–310

Synthesis and Antibacterial Activity of CuO Nanoparticles Suspension Induced by Laser Ablation in Liquid

- Khawla S. Khashan, Ghassan M. Sulaiman, Farah A. Abdulameer

Abstract

In the present study, copper oxide (CuO) colloidal nanoparticles (NPs) were synthesized using laser ablation of copper pellet immersed in deionized water. Pulsed Nd: YAG laser was used to irradiate the targets at different laser energies and various ablation times. NP suspensions were characterized by UV–Vis spectroscopy, XRD, and TEM. The absorption spectrum exhibited a peak at ~275 nm and another peak with low intensity at ~645 nm. The XRD pattern of the NPs proved the presence of (–111) and (112) planes assigned to the CuO phase. The TEM images showed nearly spherical shape nanoparticles CuO NPs with size of 3–40 nm. The antibacterial activity of CuO NPs was first carried out against four types of bacteria: *Escherichia coli*, *Pseudomonas aeruginosa*, *Proteus vulgaris* and *Staphylococcus aureus*, by liquid medium method. CuO NPs showed the highest antibacterial activity against *E. coli* at the highest concentration(1000 μg mL^{-1}). CuO NPs and amoxicillin had a synergistic effect on inhibiting *E. coli* and *S. aureus* growth; this effect was also tested using the well diffusion method. In this method, CuO NPs at a concentration of 1000 μg mL^{-1} along with amoxicillin showed the inhibition zone against *E. coli* (26.0 ± 1.00 mm), as well as complete inhibition of bacteria against *S. aureus*.

Arabian Journal for Science and Engineering (Arab J Sci Eng)

Research Article - Physics
January 2016, Volume 41, Issue 1, pp 311–323

Multivariate Statistical Analysis of High Background Radiation Area on the Hadhramout Coast

- H. M. Badran, A. A. Bin-Jaza, T. Sharshar

Abstract

This work focuses on the radiometric characteristics of beach sand along the Hadhramout coast, Gulf of Aden, Yemen. Beach sands samples were collected from 27 locations. The activity concentrations of the terrestrial radionuclides ^{226}Ra, ^{232}Th, and ^{40}K were determined. The results obtained provide pioneering data on the radioactivity levels in the coastal areas of Hadhramout. The radioactivity concentration of ^{232}Th was found to be a major contributor to the enhanced level of radiation in some beaches. The radiological data were processed using one-way analysis of variance to find out the differences between the elevated and non-elevated ^{232}Th groups of locations and multivariate statistical analysis, i.e., principal component analysis, discriminant analysis, and clustering analysis, to find similarities and correlation between the various samples and to discriminate between the two groups of locations. From the radiation hazard point of view, the outdoor annual effective dose for the region varied from 5.1 to 155.5 mSv with a mean value of 34.9 ± 31.9 mSv. The highest radiation level was found in Al-Jraf beach, where the highest absorbed dose rate of 126.8 nGyh^{-1} was recorded and the radiation hazard index exceeded twice the recommended limit of unity.

Arabian Journal for Science and Engineering (Arab J Sci Eng)

Research Article - Physics
January 2016, Volume 41, Issue 1, pp 325–332

Incoherent Interaction Between Bright–Bright Photovoltaic Soliton in an Unbiased Series Two-Photon Photorefractive Crystal Circuit: Self-Deflection Investigation

- Zahra Abbasi, Alireza Keshavarz, Mohsen Hatami, Ghahraman Solookinejad

Abstract

We investigated the effects of self-deflection on incoherent interaction between photovoltaic bright–bright soliton pairs in photorefractive crystals under steady-state condition in an unbiased series two-photon photorefractive crystal circuit in one dimension. The numerical schemes according to the Crank–Nicholson and Runge–Kutta methods are applied to simulate the propagation of incoherent interaction for studying self-deflection by considering the diffusion process with different normalized separation distances, different amplitude and different δ. We also offer some applications about this subject.

Arabian Journal for Science and Engineering (Arab J Sci Eng)

Research Article - Physics
June 2016, Volume 41, Issue 6, pp 2333–2338

Dosimetry Commissioning of Tunisian Electron Beam Accelerator

- A. Mejri, K. Farah, F. Hosni, J. Chatti, H. Trabelsi, Z. Trabelsi, M. Kraiem

Abstract

The Tunisian Beta irradiation facility (LINAC, CIRCE III) has been put into operation at the end of 2009. Such facility is designed essentially for sterilization of medical devices and conservation of foodstuff. The delivery and validation of a specified dose are key concerns of operators of electron beam irradiation facilities. In order to adjust the treatment conditions and to control the optimal operation of the accelerator, it is necessary to evaluate the absorbed dose and its distribution within material in the radiation field. Consequently, aspects from installation qualification to operation qualification are described together with the associated process variables. Technical parameters that directly influence the absorbed dose distribution in the product were examined by dosimetric measurements and compared to the data specified by the facility manufacturer. Two dosimeter types were used for measurements: radiochromic B3 and cellulose triacetate films.

Arabian Journal for Science and Engineering (Arab J Sci Eng)

Research Article - Physics
June 2016, Volume 41, Issue 6, pp 2339–2344

Comparative SAXS, DSC and FT-IR Spectra of Polyurethane Coatings Filled with Hexagonal and Sword-like Zinc Oxide

- Chitnarong Sirisathitkul, Chat Pholnak, Thanida Chareonsuk, Pornsak Panchawirat, Supagorn Rugmai

Abstract

The loading and morphology of zinc oxide (ZnO) affect the bonding and segmentation in commercial polyurethane (PU) coatings. By virtue of surface modification, hexagonal ZnO microprisms can be uniformly dispersed in PU matrix even at a loading as high as 25 wt%. However, the disruption of ZnO fillers can be observed with the suppression of characteristic PU absorption bands in Fourier transform infrared (FT-IR) spectra and the enthalpy reduction in differential scanning calorimetry (DSC) thermograms. The morphological effect is highlighted by the significant changes in DSC and FT-IR spectra when hexagonal ZnO is substituted with the sword-like counterpart. The results suggest that more sword-like ZnO can be loaded in PU coatings with a less disruption in bonding and segmentation.

Arabian Journal for Science and Engineering (Arab J Sci Eng)

Research Article - Physics
June 2016, Volume 41, Issue 6, pp 2345–2351

Effects of External Alternating Magnetic Field on ZnO Films Obtained by Electrodeposition

- Barış Altıokka, Ayça Kıyak Yıldırım

Abstract

Zinc oxide (ZnO) films have been prepared by electrodeposition from aqueous solutions of $Zn(NO_3)_2 \cdot 6H_2O$ on indium tin oxide substrates applying both classical and modified methods. In the modified method, two coils were placed reciprocally outside of deposition bath. The coils were connected to an alternative current power supply. The energy band gaps of the films obtained by the classical method were found to be between 3.32 and 3.38 eV, while those of the films obtained by the modified method were found to be between 3.74 and 3.77 eV. The structures of the films were characterized by X-ray diffractometer (XRD). The XRD patterns showed that all of the films had a hexagonal grain structure. In addition, it was calculated by XRD results that the crystallite sizes of the films were between 29 and 59 nm. It was concluded from the film thicknesses that the reaction rate was decreased approximately in half due to the magnetic field. The morphological characteristic of the ZnO films was studied with a scanning electron microscope. It was seen that the nanorods filled the surfaces of the films obtained by the classical method densely. However, the nanorods on the surfaces of the films obtained by the modified method formed much sparsely.

Arabian Journal for Science and Engineering (Arab J Sci Eng)

Research Article - Physics
June 2016, Volume 41, Issue 6, pp 2353–2362

Cladding of Ni–20Cr Coatings by Optimizing the CO_2 Laser Parameters

- M. Mudassar Rauf, Muhammad Shahid, Yaseer A. Durrani, A. Nusair Khan, A. Hussain, R. Akhter

Abstract

Ni–20Cr alloy was deposited on stainless steel using air plasma spray. Inherent defects in coating like porosity, oxides and splat boundaries are considered as potential sources for oxygen ingress during high-temperature application. In order to minimize such flaws, the plasma-sprayed coating was remelted and solidified, using continuous wave CO_2 laser. Microstructural optimization was achieved by optimizing process parameters such as laser power and defocus distance. The laser-treated surfaces were characterized using optical and scanning electron microscopy as well as by XRD. At 500 W power, a 60 mm defocus distance was found to be optimum to avoid outward diffusion of iron. However, stresses were observed to be present in the plasma-sprayed coating before and after laser remelting and solidification, as determined by XRD of the treated samples.

Arabian Journal for Science and Engineering (Arab J Sci Eng)

Research Article - Physics
June 2016, Volume 41, Issue 6, pp 2363–2376

Particle Dispersion Model for Predicting the Percolation Threshold of Nano-Silver Composite

- M. Zulkarnain, A. B. Muhamad Husaini, M. Mariatti, I. A. Azid

Abstract

In the current study, particle dispersion models of electrically conductive adhesives are developed through establishing the effects of 80 nm of silver (Ag) particles by employing van der Waals attraction energy, which acts as an energy of interaction of particles that are embedded in an epoxy solution system. The arrangement of the particle dispersion in the epoxy colloidal system is determined by identifying the morphology in the experimental works. The characteristics of particle dispersion are analyzed based on electrical conductivity effect with respect to the volume fraction factor, which is set in the range of 2–8 vol%. In developing the particle dispersion model, the model was simulated through representative volume elements (RVEs) by implementing the standard error of the RVE size model versus electrical conductivity (S/cm^2). The model size was determined by the ratio between the width of the RVE model and the particle size, which was set as 3, 4, 5, 6, 7, and 8. The accurate size that represents the precision of the estimation of the electrical conductivity result has been successfully determined by a particle dispersion model developed at a model size of $\delta = 6$. A significant improvement in the optimization of the particle dispersion model's synergistic effect on electrical conductivity has been obtained with new techniques in relation to the experimental data. The numerical results were almost the same as the experimental results, where the percolation threshold occurred at a filler loading of 6 vol% and reached at 1.32×10^{-1} S/cm

Arabian Journal for Science and Engineering (Arab J Sci Eng)

Research Article - Physics
June 2016, Volume 41, Issue 6, pp 2377–2384

Facile Synthesis, Characterization and Photocatalytic Activity of Band Gap Engineered Cobalt Selenide Nanoparticles

- Farha Firdaus, Noor-e-Iram, Mohd Shoeb Khan, Umair Baig

Abstract

Here we report the synthesis, characterization and photocatalytic studies of cobalt selenide nanoparticles. Synthesized cobalt selenide nanoparticles were characterized by using X-ray diffraction analysis and transmission electron microscopic analysis, which revealed that the nanoparticles are crystalline in nature, circular and having particle size of 20–25 nm in diameter. Furthermore, thermogravimetric behavior (thermogravimetric analysis/differential thermal analysis), optical and photocatalytic activity of the cobalt selenide nanoparticles were also evaluated. Thermogravimetric results revealed that the cobalt and selenide are strongly interacting, which is also supported by the selective area energy dispersive X-ray spectroscopic analysis. We have applied the synthesized cobalt selenide nanoparticles for an efficient photocatalysis of rhodamine B under ultraviolet light illumination, which resulted in the production of chemically reactive molecules containing oxygen by the cobalt selenide nanoparticles. Based upon the present results, we conclude that the synthesized cobalt selenide nanoparticles are environmentally significant. Moreover, the energy band gap as computed by the Tauc formula was observed to be in the range of E g =1.8 Eg=1.8 eV.