CHAPTER 46

PHYSICS AND ASTROPHYSICS

Doctoral Theses

504. AGGARWAL (NEHA)
Quantum Optomechanical Control of Bose-Einstein Condensates in Optical Cavities.
Supervisor : Dr. Aranya B.Bhattacharjee and Prof. Man Mohan
Th 22427

Abstract

The blend of two research fields, cavity optomechanics in quantum optics and Bose-Einstein condensates (BEC) in atomic physics has given rise to new area of investigation both theoretically and experimentally. Following is the brief description of the chapters of the thesis. In chapter 1, a relevant description is given about cavity optomechanical systems and BEC. In chapter 2, we have analyzed normal-mode splitting and selective entanglement for a two-mode optomechanical system comprising of two optical cavity modes and a single mechanical mode. Such strongly correlated two-mode optomechanical system can be exploited in order to realize quantum memories and interfaces within quantum communication networks. In chapter 3, a detailed study is presented in order to analyze the Dicke quantum phase transition within the thermodynamic limit for an optomechanically driven BEC confined in a cavity and to show how this system can be used to detect weak forces. In chapter 4, generation of atomic-squeezed states is studied for two different systems. First of all, the effect of periodically time-modulated cavity frequency on the generation of spin-squeezed states is investigated for a system consisting of two-level atoms inside a non-stationary cavity. We have also examined the effect of optomechanical coupling on the production of spin-squeezed states for a system formed by BEC confined within the lossless optomechanical cavity for three cases of initial cavity field, coherent state, squeezed vacuum state and squeezed state. Such correlated atomic states can be utilized in spectroscopy, entanglement detection and high precision metrology. At the end, conclusion of all chapters has been presented with suggestive outline of the future aspect of work done. In writing the thesis, treatment has been kept synoptic and organized. References are specified as numbers in square brackets at the end of each chapter. Captions of all the figures are mentioned below the figure.

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Influence of periodically modulated cavity field and optomechanical coupling on the generation of atomic-squeezed states. 5. Concluding remarks.

505. AJAY KUMAR

Search for the SM Higgs Boson in the H→WW→-lνjj & Probe of WW Production in Vector Boson Fusion Topology in the CMS Experiment at the LHC.

Supervisor : Dr. Kirti Ranjan

Th 22461

Abstract

The Large Hadron Collider (LHC) at CERN is the world's largest and highest energy particle accelerator built with the aim of allowing physicists to test the predictions of the Standard Model (SM) and beyond the SM of particle physics. The Compact Muon Solenoid (CMS) is one of the main experiments at the LHC. This thesis aims to work on two fundamental problems of the SM. First, a search for the SM Higgs boson (H) in H decaying to WW in the semileptonic final state (H → WW → lνjj, with l being e or μ) and second a measurement of WW production in vector boson fusion (VBF) topology. Both these analyses are performed using data recorded at $\sqrt{s}$ = 8 TeV in 2012 corresponding to an integrated luminosity of 19.3 fb^{-1}. The decay channel, H → WW → lνjj, is sensitive to higher Higgs boson masses (≥ 200 GeV). The analysis selects events with one well-identified lepton, large missing energy and at least two high transverse momentum jets. A multivariate discriminant is designed to control huge W+Jets background while preserving, as much as possible, the signal component. This analysis imposes limits on the SM Higgs cross-section in the high mass region of the Higgs boson, as well as on the heavy Higgs boson coupling and branching ratios in the BSM framework. This thesis also reports the first measurement of vector boson scattering in the semileptonic decay of the WWWW vertex. The final state consists of a lepton, missing energy, two central jets and two forward jets. A special jet selection technique is developed with an emphasis on having higher signal efficiency. We extract the VBF signal yield from an unbinned maximum likelihood fit to the dijet invariant mass distribution in the data. This work serves as a baseline for future WW scattering analysis.

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506. AKSHTA RAJAN

Metal (Au and Ag) Incorporated Zinc Oxide Thin Films for Development of Ultra Violet Photodetectors.

Supervisor : Dr. Monika Tomar

Th 22663

Abstract

Ultraviolet (UV) light detection is of immense interest in several applications. Wide-band gap semiconductor such as GaN offers attractive features for UV phototodector application, however, due to fanrication complications, high quality ZnO thin films

serve as a suitable alternate to GaN. Sol gel derived ZnO thin film UV photodetectors are not much explored, though sol gel method for film growth offers ease in development of thin films for commercial applications. In the present work, sol-gel derived pure ZnO thin films have been optimized with respect to annealing temperature and thickness. Integration of nanolayer/nanodots of Au with ZnO film has been studied for UV photodetector applications. Formation of Au_2O_3 which resulted in the change in the defect profile, schottky barrier formation at Au-ZnO interface and availability of free ZnO sites are envisaged as the major factors responsible for variation in UV properties. Concept of plasmonics came into the scenario when it was found that nanoclustering of Au takes place in Au nanodots/ZnO after annealing. Plasmonics has been explored in Si based solar cells. Incident light interacts with nanoparticles over cross-sections much larger than its geometrical cross-sections through coupling with surface plasmons. Emission of energy results in increase in path length of light, thereby leading to enhanced absorption of light. Chemically synthesized Au NPs were also dispersed on ZnO film which has exhibited enhanced photoresponse. The effect of varying size has been studied by varying the concentration and annealing temperature of NPs. The effect of addition of metals in ZnO has been studied. Optimum concentration of Ag and Au metals are found to enhance the UV photoresponse. The simultaneous lowering of dark current and enhancement in photocurrent results in increased photoresponse. The results obtained are encouraging for efficient UV photodetector.

Contents

507. ANITA

Dielectric and Ferroelectric Properties of Stoichiometric and A-site Substituted $BaBi_{4-x}M_xTi_4O_{15}$ (M=La, Sm) Ceramics.

Supervisor : Prof. K. Sreenivas

Th 22452

Abstract

The present thesis is focused on Barium Bismuth Titanate $BaBi_4Ti_4O_{15}$ (BBT) which finds potential usefulness for high temperature piezoelectric transducer and fine tolerance resonator applications. In this thesis (i) Un-modified BBT, (ii) BBT prepared with excess Bi_2O_3, (iii) Lanthanum (La) & Samarium (Sm) substituted BBT have been investigated in detail. Variations in the material properties are correlated with the changes in the chemical and crystallographic structure. The site selectivity and distribution of La and Sm substituents in BBT are identified. The sintering temperature of $BaBi_4Ti_4O_{15}$prepared by solid state reaction method has been optimized for various dielectric and ferroelectric properties. BBT sintered at 1050 °C for 5h is found to be optimum and yields a ceramic with high resistivity (4.6×10^{12} Ω-cm) and low dielectric loss ($\tan \delta \sim 0.02$). But high temperature sintering results in

bismuth and oxygen vacancies which degrade its electrical properties. Therefore, introducing excess bismuth oxide Bi_2O_3 (2-10 wt.%) in the starting powders further reduces the dielectric loss (tan d~ 0.01), dc conductivity ($\sigma_{dc} \sim 10^{-14}\ \Omega^{-1}cm^{-1}$) and improves ferroelectric and piezoelectric properties of BBT up to an optimum content of 6 to 8 wt.% of excess of bismuth oxide. The dielectric and ferroelectric properties of $BaBi_{4-x}M_xTi_4O_{15}$ (M = La, Sm) ceramics are analyzed in detail. A considerable reduction in dielectric loss, reduction in σ_{dc} and a large remnant polarization is observed and the results are explained in terms of changing oxygen vacancy concentration and structural relaxation using Raman spectroscopy. Temperature dependent dielectric data ε'(T) and ε"(T) fit well to the modified Curie – Weiss law and the Lorentz – type relation and confirm increasing diffuseness with increasing La and Sm content. The optimum contents of La and Sm show good relaxor characteristics in dielectric data of the ceramics with stable dielectric and ferroelectric properties.

Contents

508. ARORA (Kashima)
Development of Bioelectrodes Based on Metal Oxides Nanostructure Matrices.
Supervisor : Prof. Vinay Gupta
Th 22162

Abstract

Present thesis focuses on the fabrication of uric acid biosensor and breast cancer immunosensor based on tin oxide (SnO_2) and Nickel oxide (NiO) based matrices using electrochemical technique. $SnO_2$and NiO matrices have been grown by rf sputtering. Both prepared matrices possess high electron communications, enhanced electrocatalytic properties, and hence were used for detection of uric acid. Influence of growth parameters of SnO_2 and NiO matrices on biosensing response has been studied in detail and optimized deposition parameters are identified for enhanced response. The Uricase/SnO_2/Pt/Ti/glass and Uricase/NiO/Pt/Ti/glass bioelectrodes are developed and found to be highly sensitive towards detection of uric acid with high sensitivities of about 697μA/mM and 1273μA/mM respectively over a wide detection range from 0.05 to 1.00mM. For realization of immunosensor, the breast cancer specific biomarker, CA 15-3, having high isoelectric point (IEP) of 8.9 has been immobilized on the surface of SnO_2 ilm having low IEP of 4.5 using physical adsorption technique. Cyclic voltametric technique exploited for the detection of breast cancer using SnO_2 thin film based immunoelectrode showed a decrease in current with increase in the concentration of Antigen. This is expected to be due to the stearic hinderance caused by the immobilized biomolecules on the surface of

SnO_2 thin film matrix. This problem has been resolved successfully in three differnt ways separately. (1) By changing the type of transducer to Electrochemical Impedance Spectroscopy (EIS); (2) By employing an alternate novel design of immunoelectrode (Uniformly distributed microdiscs of SnO_2 immobilized with antibody CA 15-3) so as to overcome stearic hindrance caused to the flow of charge carriers; and (3) By changing the type of antibody (polyclonal) immobilized on different matrix (NiO). Results obtained in the present work indicate that the developed immunosensors can be efficiently utilized for estimation of breast cancer from the serum.

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509. BHADOLA (Pradeep)
Statistical Mechanics of RNA and Proteins: Insights from Random Matrix Theory and Network Analysis.
Supervisor : Dr. Nivedita Deo
Th 22428

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510. BHANDARI (Sonia)
Processing Lead Free Perovskite Ceramics, Single Crystal Growth and Characterization of Pure and Mn-doped $Bi_{0.5}(Na_{1-y}K_y)_{0.5}TiO_3$ Relaxor-like Ferroelectrics.
Supervisor : Dr. Binay Kumar
Th 22154

Abstract

Since the discovery of ferroelectricity in Rochelle salt single crystals (1921) and and barium titanate ($BaTiO_3$) during mid-1950s, there has been a continuous succession of new materials for technological developments that have led to a significant number of industrial and commercial applications based on piezoelectric and ferroelectric phenomenon. Ferroelectric materials are characterized by (i) higher dielectric constants as compared to ordinary insulating dielectrics, making them useful as capacitor and energy-storage materials, (ii) relatively low dielectric loss (tan δ) and (iii) electro-optic behavior. The hysteresis loop (polarization versus electric field) is the single most important measurement that can be made on a ferroelectric material. On the other hand, piezoelectric materials are widely used in modern industry to transform electrical signals into mechanical strain and vice versa enabling their use in electromechanical systems both as sensors and actuators. With the discovery of the electric field induced ultra high strain in lead-based materials such as $Pb(Zn_{1-}$

$_xTi_x)O_3$ (PZT), $Pb(Zn_{1/3}Nb_{2/3})O_3 - PbTiO_3$ (PZN-PT), $Pb(Mg_{1/3}Nb_{2/3})O_3 - PbTiO_3$ (PMN-PT) and $Pb_{1-x}La_x(Zr_yTi_{1-y})O_3$ (PLZT) their growth and electric characterization picked up pace. But due to the toxicity of lead compounds and environmental safety issues concerning the utilization, recycling and disposal of lead based materials, a heave is induced in modernizing lead-free ferroelectric and piezoelectric materials with high strain capability. My Thesis "Processing lead free perovskite ceramics, single crystal growth and characterization of pure and Mn-doped $Bi_{0.5}(Na_{1-y}K_y)_{0.5}TiO_3$ relaxor-like ferroelectrics" presents the processing of lead free ceramics and flux grown large sized single crystal of pure and Mn-doped $Bi_{0.5}(Na_{1-y}K_y)_{0.5}TiO_3$ relaxor-like ferroelectrics. The prepared materials were subjected to dielectric, piezoelectric, optical, mechanical and ferroelectric property characterizations. They exhibited impressive ferro-/piezo-/pyroelectricity. The results indicate them to be a promising candidate for environment friendly electromechanical transducer, solid state actuator, sensors and capacitor applications.

Contents

511. DALJEET KAUR

Development and Characterisation of RPC Detectors and Determination of Neutrino Oscillations Sensitivity for the INO-ICAL Experiment.

Supervisor : Dr. Md. Naimuddin

Th 22161

Abstract

To study the properties of atmospheric neutrinos, the India-based Neutrino Observatory (INO) has been approved to be set up at Theni district (Tamilnadu) in South India. A 50 kton magnetised Iron CALorimeter (ICAL) will be the prime experiment at INO. The main goals of INO is to determine the neutrino mass hierarchy, octant of θ_{23} and the precise determination of neutrino mixing parameters. In its first phase, glass Resistive Plate Chambers (RPCs) will be used as active detector to track the charged particles. This thesis presents results from an extensive R & D of RPC detector together with the simulation studies performed for estimating the detector response to hadrons and finally neutrino oscillation sensitivity study for the ICAL detector. The performance of RPCs is depends upon the quality of electrodes, therefore, different electrodes of Bakelite and Glass have been characterised for their various electrical properties. Further, single gas gap RPCs have been fabricated and observed under different operational conditions such as gas compositions, temperature and humidity. Using NIM/VME data acquisition system efficiencies, count rate and leakage current measurements for these RPCs have been observed. Based on these studies, we suggest the best electrodes for INO-ICAL RPC with appropriate operational conditions. The ICAL detector is sensitive to muons and hadrons produced

in neutrino interactions. A GEANT4 based simulation study has been performed to obtain the detector response for hadrons. Using the obtained ICAL detector resolutions, its sensitivity studies for the neutrino mixing parameters ($\sin^2\theta_{23}$ and $|\Delta m^2_{32}|$) have been performed. For physics analyses, muon neutrino events, generated through Monte Carlo NUANCE event generator. A marginalised χ^2analyses based on neutrino energy and muon zenith angle binning scheme has been performed to determine the sensitivity neutrino mass hierarchy, octant of θ_{23} and the precise determination of neutrino mixing parameters.

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512. GARG (Ritika)
Nuclear Structure Studies in A=135 Mass Region : Search for Magnetic Rotation Phenomenon.
Supervisor : Dr. Samit Kr. Mandal and Dr. Suresh Kumar
Th 22159

Abstract

This thesis is focussed to investigate the phenomenon of Magnetic Rotation in ^{135}La and ^{135}Pr nuclei. Two experiments have been performed to populate high spin states in above nuclei using reactions ^{128}Te(^{11}B,4n) and ^{123}Sb(^{16}O,4n) by using INGA at TIFR, Mumbai and IUAC, New Delhi. Nuclear energy levels have been established for on basis of γ-γ, γ-γ-γ coincidence relations and γ-ray intensity considerations. Spin and parity assignments to nuclear excited states have been done by using methods of DCO and IPDCO, respectively. Experimentally observed properties have been interpreted in terms of Tilted Axis Cranking (TAC) model. In ^{135}La, level scheme has been confirmed and extended along with observation of several new transitions. A new positive parity (ΔI=2) band has been observed and identified as a decoupled band. Two negative parity dipole bands (ΔI=1) have been established. Crossover E2 transitions have been observed for the first time in one of the dipole bands. A band crossing has been seen between the two dipole bands at hω≈0.41 MeV and I≈35/2$^-$. For TAC calculations, a 3qp configuration $\pi(h_{11/2})^1\otimes\nu(h_{11/2})^{-2}$ and a 5qp configuration $\pi(h_{11/2})^1(g_{7/2}/d_{5/2})^2\otimes\nu(h^{11/2})_{-2}$ have been taken for the two negative parity dipole bands. Comparision of experimental observables with TAC calculations supports configuration assignments for both dipole bands and suggests MR features for the bands. ^{135}Pr nucleus has been investigated for negative parity structure. Partial level scheme has been established for negative parity states with addition of new transitions. At high spin, dipole band has been reported. It consists of M1 transitions along with observation of new crossover E2 transitions. Band crossing has been seen at hω≈0.37 MeV and I≈35/2$^-$. TAC calculations have been performed by considering a 3qp configuration $\pi(h_{11/2})^1\otimes\nu(h_{11/2})^{-2}$ and a 5qp configuration $\pi(h_{11/2})^1(g_{7/2})^2\otimes\nu(h_{11/2})^{-2}$ for lower and upper part of band, respectively. Experimental results show a good agreement with TAC calculations.

Contents

513. GODARA (Sanjay)
Ferroelectric, Ferromagnetic, Dielectric and Structural Characterization of Pure and Substituted Multiferroic Bismuth Ferrite ($BiFeO_3$) Nanoparticles Synthesized by Auto-Combustion Route
Supervisor : Dr. Binay Kumar
Th 22163

Abstract

Recently, magnetoelectric multiferroics have attracted considerable research interests due to their distinguished characteristics and potential applications in various fields including compact and non-volatile storage devices, spintronics and electro-magnetic sensors. The perovskite-structured bismuth ferrite ($BiFeO_3$/BFO) has prevailed a prospective candidature in the field of single-phase multiferroics on account of having ferroelectric (T_C = 825 °C) and antiferromagnetic (T_N = 370 °C) orderings simultaneously well above the room temperature. However, it possesses some adverse peculiarities like compositional instability, higher leakage current, low remnant magnetization and high coercive field, which make it less favorable for real-world applications. Therefore, these issues should be sorted out in effective way to exploit it in futuristic magnetoelectric devices. In this way, the main emphasis of this thesis work was put on to enhance the multiferroic properties of BFO by synthesizing its stoichiometric pure-phase nanoparticles using low-temperature auto-combustion route and by substituting partially it sites, viz. Bi- and Fe-site, with other ions of importance. In this thesis, pure and chemically modified (Ce/Cr-codoped, Ba/Nb-codoped and Nd/TM-codoped; TM = Co, Cr, Ti, Nb) BFO nanoparticles have been synthesized via low-temperature organic fuel assisted auto-combustion route. Subsequently, their structural, ferromagnetic, dielectric, leakage current and ferroelectric properties have been systematically investigated. The results have been analyzed and discussed keeping in view of achieving enhancement in various properties of BFO for its possible multiferroic applications. The value of magnetization was observed to be a maximum for Ce-Cr co-doped BFO nanostructures (M_r = 0.74 emu/g). Whereas, maximum decrease in leakage current and thus, the most resistive sample was found to be Nd-Ti co-doped BFO, where dc resistivity = 1.85×10^{11} Ω-cm. The finest ferroelectric hysteresis loop with reasonable high polarization (P_r = 3.24 μC/cm^2) at maximum applied electric field of 175 kV/cm was observed for the 10% Ba-Nb co-doped BFO samples.

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& TM (Co, Cr, Ti and Nb) co-doped BFO NPs: synthesis and characterization 7. Conclusions and scope future work. List of publications.

514. GOYAL (Savi)
Investigation of Dynamical Effects in Fusion-fission Reaction Mechanism for Mass Region Above 200 Using Neutron Multiplicity Measurement Technique.
Supervisor : Dr. Samit Kr Mandal
Th 22150

Abstract

Since its discovery, the fission process has proved to be a powerful probe for the properties of the nuclear matter. The recent experimental works based on the analysis of the number of tools, which characterizes the fission process, are the experimental evidences that nuclear matter is highly viscous in nature. A number of probes exist to study dissipation effects, out of all probes, the pre-scission neutron multiplicity (M_{pre}) is most commonly used probe because in the de-excitation of an excited nucleus, neutron emission is usually the dominant mode of decay. In the present thesis, a study of fusion-fission dynamics of excited nuclei is presented with a view to extract knowledge about the dissipative properties of hot fissioning nuclei. Main idea behind this study is to investigate the isotopic dependence of the nuclear structure on the neutron multiplicity and the dissipation strength in a heavy-ion induced fission reaction. For this study, two experiments were carried out using National Array of Neutron Detectors set-up at the laboratory of IUAC to measure the neutron multiplicities for the $^{16}O+^{204,206,208}Pb$ systems and $^{28}Si+^{204,206,208}Pb$ systems. The extracted prescission neutrons were observed to be increasing with the excitation energy of the compound nucleus. Since the intermediate nuclei for the two sets of isotopes are same, any strong isotopic dependence of the M_{pre} was not observed. It is observed that the statistical model calculations without dissipation (Bohr-Wheeler fission width) considerably under-estimate the M_{pre}, but the total neutron multiplicities are reasonably well reproduced. This result indicates that the statistical model is not sufficient to describe the experimentally observed properties of the fission process and one has to include the dynamical effects in description of fission dynamics.

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515. KUMAR ATMJEET
Cosmologial Magnetogenesis.
Supervisor : Prof. T. R. Seshadri
Th 22151

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516. MALHOTRA (Shivali)
Model Independent Search for New Physics at LHC Energies.
Supervisor : Dr. Md. Naimuddin
Th 22408

Abstract

In 2010, protons were collided first time using the particle accelerator Large Hadron Collider(LHC). Successful running of LHC machine resulted in an enormous amount of data collection during three consecutive years. The Compact Muon Solenoid(CMS) is designed to measure the tracks & momentum of particles produced during collisions at centre of mass energy of 7 & 8TeV. This further helps in measurement of the parameters of Standard Model(SM) & search for new physics. The classical approach for searches of physics beyond SM assumes some specific theoretical model & try to obtain events having certain signature characteristics for new theory. Model Independent approach is another way to tackle the problem, relying on the knowledge of SM & suitable to spot any deviation in data. Using this approach, one can also look for some deviations related to the theories which are not yet thought of. Several hundreds of the final state topologies are looked upon using few variables which are sensitive to deviation. The final states are classified into different event classes with respect to their particle content (like muons, electrons, photons, jets and missing transverse energy) and no potential deviation was observed to claim new physics. The model-independent approach is also applied for measuring the properties of newly discovered boson. In this case, ratio of the production cross section times decay branching fraction; called Double Ratios; are evaluated which results in cancellation of theoretical and systematic uncertainties. This ratio is calculated for different sets of two decay modes (out of 5 prominent Higgs decay modes: $H\rightarrow\gamma\gamma$, $H\rightarrow WW$, $H\rightarrow ZZ$, $H\rightarrow\tau\tau$ and $H\rightarrow bb$) & dependence on the individual production cross-section cancels out for same production modes. These measurements show that properties of new boson discovered are compatible with those expected for SM Higgs boson.

Contents

517. MANGLA (Onkar)
Fabrication of Electronic Nanomaterials Using Plasma Methods and Their Characterization.
Supervisor : Prof. M. P. Srivastava
Th 22158

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518. PAHUJA (Poonam)

Synthesis and Characterization of Modified Multiferroic Composite System $Ba_{0.95}Sr_{0.05}TiO_3$ - $Ni_{0.8}Co_{0.2}Fe_2O_4$.

Supervisor : Prof. R P Tandon

Th 22156

Abstract

Multiferroic materials exhibit coupling between electric and magnetic order parameters. These materials find applications in magnetic field sensors, current sensors, memory devices, spintronic devices, microwave devices (phase shifters, actuators, filters and oscillators) and switches etc. In the present thesis, multiferroic composites are prepared by selecting $Ba_{0.95}Sr_{0.05}TiO_3$ (BST) as ferroelectric phase and $Ni_{0.8}Co_{0.2}Fe_2O_4$ (NCF) as ferrimagnetic phase. Detailed study of addition of smaller amount of nanoparticles of NCF (prepared by sol-gel method) on structural, microstructural, dielectric, ferroelectric, magnetic and magnetoelectric properties of multiferroic composite system BST-NCF have been performed. It was observed that dielectric constant of the composite samples decreases with increase in NCF content. Addition of ferrite (NCF) in ferroelectric material results in enhanced coercive field of Polarization vs. Electric field (P-E) loops in the composites. The values of remanant magnetization and saturation magnetization of composite samples increase with increase in ferrite content. Effects of preparation method of NCF (Sol-gel, Solid State and Co-precipitation) on various properties of multiferroic composite system $Ba_{0.95}Sr_{0.05}TiO_3$ - $Ni_{0.8}Co_{0.2}Fe_2O_4$ have been explored. It was observed that preparation of both the constituents BST and NCF via solid state results in highest value of magnetoelectric coefficient. Based on results of above study, dependence of various properties on the content of NCF has been investigated. Apart from these, effects of rare earth modified $Ba_{0.95}Sr_{0.05}TiO_3$ i.e. $Ba_{0.95-1.5x}Sr_{0.05}R_xTiO_3$ (where x = 0.00, 0.01, 0.02, 0.03 mole fraction and R is Rare earth Dy, Gd or Sm) on different properties multiferroic composites has been summarized. It is observed that substitution of rare earth ions Dy^{3+}, Gd^{3+} and Sm^{3+} increases grain size and dielectric constant of BST and composite samples. These ions although weaken the magnetic properties of composite samples but increases the value of magnetoelectric coefficient.

Contents

519. PALIWAL (Ayushi)
Growth and Characterization of Metal Oxide Thin Films for Optical Device Applications.
Supervisor : Prof. Vinay Gupta
Th 22414

Abstract

Surface Plasmon Resonance (SPR) and electro optic (EO) effect are two most important phenomenon for the development of optical devices. The present thesis aims towards the development of SPR and Long range surface plasmon (LRSP) based optical sensors (physical, chemical and biological) and realization of EO effect in bulk and thin films. A table top SPR setup has been indigenously developed in the present work for versatile applications. The know-how of the setup has been transferred to an industry M/s Optiregion, Delhi. Tungsten Oxide (WO_3) thin film has been used as sensitive layer for the development of SPR based temperature sensor having sensitivity 2.5×10^{-4} RIU/K. Further, Mn doped Bismuth Ferrite (BFMO) thin films have been exploited for detection of magnetic field with high sensitivity»147 °/Tesla. A highly sensitive room temperature operated Nitrogen dioxide (NO_2) and ammonia (NH_3) gas sensors have been developed using WO_3 and tin oxide (SnO_2) sensitive films respectively exhibiting quick response and high sensitivity towards target gases over a wide concentration range (0.05-250 ppm). The SPR technique has also been successfully exploited for study of the dielectric properties of various biomolecules (GOx, Urs, Uri, ChOx) while maintaining their biofunctionality. Optical biosensors have been realized after immobilizing the specific bioreceptors on the ZnO sensitive matrix (pre-coated on Au/Prism system). LRSP mode was realized using lithium fluoride (LiF) and magnesium fluoride (MgF_2) as the dielectric layers in symmetric configuration. LRSPR based prism/MgF_2/Au/Urs biosensor has high sensitivity (0.0731^o/mg/dl) in comparison to prism/LiF/Au/Urs biosensor over a wide concentration range (25-200 mg/dl) of Urea. The modulation of signal using EO effect in lithium niobate (LN) single crystal (bulk) and proton exchanged (PE-LN) waveguide based on Senarmont compensation method has been studied. Effective EO coefficient was about r_c =25 pm/V for LN single crystal which is higher in comparison to PE-LN layer (16 pm/V).

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520. PANDEY (Kumar Priyabrat)
Black Holes, Branes and Strings : Aspect of Quintessence in Cosmology and Origin of Dark Energy.
Supervisor : Dr. Supriya K. Kar
Th 22157

Abstract

My PhD thesis research primarily deals with a non-perturbation theory of emergent quantum gravity in five dimensions originally constructed by me and my collaboartors in the department of Phsyics and Astrophysics at the University of Delhi. In particular, I consider a geometric three form propagation in 1.5 order formulation, underlying the non-linear U(1) gauge dynamics of a Kalb-Ramond (KR) form on a D4-brane in type IIA superstring theory. The formalism incorporates a non-perturbative effect via a dynamical geometric correction to the torsion free geometries or an emergent metric. It has been shown that a global NS two form in superstring theory plays a significant role via its perturbative coupling to a dynamical KR form in an emergent gravity scenario on a gravitational pair of 3-brane and anti 3-brane universes. In particular an emergent de Sitter universe is shown to emerge at the past horizon with a Big Bang by the KR form quanta in the gauge theory. Interestingly the emergent scenario has been shown to incorporate a quintessence dynamics which is believed to source the dark energy in universe. The quintessence dynamics is naturally described by an axion on an anti 3-brane universe hidden to our 3-brane universe. The axion dynamics ensures $-1<\omega_Q<{-1/3}$, where ω_Q is described by the thermodynamic equation of state for an ideal fluid. Our analysis may suggest that a D-instanton, underlying an axionic scalar in the string-brane set-up, can source the dark energy in universe.

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521. PRADEEP KUMAR
Theoretical & Experimental Investigations of Structural, Electronic, Optical and Elastic Properties of Scintillator Materials BaX_2 (X=CI, Br, I).
Supervisor : Prof. A G Vedeshwar
Th 22148

Abstract

The layere structured materials, particularly barium halides are being explored more experimentally at present about their possible use as scintillators which could possibly meet their increasing demand in X-ray radiography/tomography for medical diagnosis and other nondestructive testing. The electronic, optical and elastic properties (with their pressure dependence) of the three scintillator materials (Barium halides) have been carried out using theoretical (DFT calculations) and experimental approaches.The calculated band gap was found to be of direct type at Γ point and the valence and conduction band density of states were found to be dominated by that of halogens and Barium respectively. The calculated various optical properties show slight anisotropy along the three perpendicular directions of the unit cell. Three halides become covalent at an applied pressure of 50 GPa. The scintillation efficiency of three halides is found to scale with the DOS of conduction band. Thin film growth

of these three halides revealed that BaI_2 prefers six different (hkl) oriented growth under different growth conditions while $BaBr_2$ prefers three growth orientations and $BaCl_2$ shows no growth orientation. Further, the relation between residual stress and band gap of various film orientations reveal the anisotropy in both band gap and its pressure coefficient. The positive and negative pressure coefficients of band gap observed in different film orientations in BaI_2 and $BaBr_2$ are attributed to the strain in halogen-halogen (or Ba-Ba or both) and Ba-halogen distances along (hkl) respectively. The average pressure coefficient of band gap (-0.071 eV/GPa) of only six film orientations of BaI_2 still compares well with that calculated by volumetric pressure (-0.047 eV/GPa) which is the average of all (hkl) orientations. Similarly, the average pressure coefficient of band gap (-0.0193 eV/GPa) of only three film orientations of $BaBr_2$ is quite comparable with that calculated by volumetric pressure (-0.0434 eV/GPa).

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522. RANJEET
Performance Characteristics of Si Sensors at Collider Experiments.
Supervisor : Dr. Ashutosh Bhardwaj
Th 22429

Abstract

Large Hadron Collider upgrade to the high luminosity LHC (HL-LHC) is planned between 2022 to mid 2025 with a five-fold increase in luminosity. To cope with the increase in luminosity, Si sensors in CMS tracker have to be replaced with radiation hard sensors with higher granularity. To test the available materials for radiation hardness, CMS collaboration has irradiated different sensor design in the HL-LHC like scenario with protons and neutrons to the expected fluence values. The sensor measurements were complemented with the device simulations. A device simulation group was formed within CMS Tracker group to carry out the sensor simulations and also to come up with design criterion for the radiation hard Si sensors. This work contains the Si sensor simulation, using commercially available Silvaco TCAD tool, for the CMS Tracker campaign. The Silvaco TCAD tool was used to carry out detailed simulations for the non-irradiated and irradiated Si sensors of the CMS Tracker upgrade campaign. Systematic simulation studies were carried out for the various geometries of non-irradiated and irradiated Si sensors. The bulk radiation damage to the Si sensor is implemented into TCAD using a effective radiation damage model, while the surface damage is incorporated using the available measurements. These simulations, along with extensive measurements, helped the CMS Tracker group to finalize device design for Phase 2 upgrade. The simulation framework was also used to optimize the various sensor parameters for the n-on-p strip sensor design. Further improvements in the simulation framework have been carried out by reducing the free

parameters in the bulk damage model and by incorporating the interface trap states to simulate the effect of surface damage. Apart from reproducing the earlier simulation results, the new simulation framework provides new insights into radiation damage effects and is helpful in understanding radiation damage effects on Si sensor.

Contents

1. Introduction 2. Si sensors and radiation damage effects 3. Si sensors for CMS tracker and device simulation 4. Si sensors design optimization for CMS tracker upgrade 5. Improvement in radiation damage modeling 6. Summary. Appendices and bibliograpy.

523. REKHA
Thermal and Dense Electronic Excitation Induced Phase Transformations in Iron-Platinum Magnetic Multilayers
Supervisor : Prof. S. Annapoorni
Th 22149

Contents

1. Introduction 2. Experimental techniques 3. Stoichiometry dependent structural and magnetic properties of $Fe_{100-X}Pt_X$ films 4. Evidence of chemical ordering in equiatomic FePt films 5. Engineering strain, densification, ordering and magnctic properties of FePt films by Dense Electronic Excitations 6. Interlayer diffusion driven Ll_0 ordering in Pt-Fe_3Pt multilayers 7. Ll_0 ordering and microstructure of Ag/Fe_3Pt/Pt films 8. Summary and conclusions. Appendix. Publications.

524. SACHDEVA (Sonali)
Investigation of galaxy morphology Tools and Application to High Redshift Galaxies.
Supervisor : Prof. H.P. Singh
Th 22409

Abstract

More than 97% of the galaxies observed in the local Universe can be broadly classified to have an elliptical or spiral structure. However, almost all the distant galaxies, i.e, more than 8 billion light years away, are observed to have irregular and peculiar structure. Examining the development of galaxies from irregular morphologies at earlier times (~6 billion years) to the present epoch (13.7 billion years), where they have settled into few distinctly identifiable categories, is critical to understand the major physical processes involved in galaxy formation and evolution. In this thesis work, this work has been undertaken using data from latest telescopes and surveys. Presence of disc galaxies in the Universe which do not have any merger remnant (or bulge) in their centre, challenge the accepted hierarchical model of galaxy formation that is based on continuous mergers and violent interactions. The reason for their survival has been examined by studying the evolution in their various defining parameters. Additionally, efforts have been made to obtain insight into the relative role of internally and externally driven processes in the growth of bulges in disc galaxies from z~1 to the present epoch. Their role is important to be established

to understand the presence of disc galaxies of varied bulge types in the local Universe. This work has been carried out in the optical as well as infraredwavelengths.

Contents

1. Introduction. 2. Tools and techniques 3. Magnitude and size evolution of bulgeless galaxies. 4. The evolution of disc galaxies with and without classical bulges since z~1. 5. Present work and future prospects. Bibliograpy.

525. SANJEEV KUMAR
Study of Boson Stars.
Supervisors : Prof. Daya Shankar Kulshreshtha and Dr. Usha Kulshreshtha
Th 22410

Abstract

In this thesis entitled "Study of Boson Stars" we have studied in details the subject of boson stars and boson shells in gravity theory. In this work we have studied the bosonic compact objects called boson stars and boson shells in scalar electrodynamics with a self-interacting massive complex scalar field coupled to gravity. The existence of fermionic compact objects like the neutron stars, leads to postulate the existence of bosonic compact objects composed of scalar particles. These boson stars and boson shells are stationary configurations of scalar field bounded by gravity and they are self-gravitating compact objects. We consider a theory defined by a certain action involving a massive complex scalar field, a vector gauge field, a cosmological constant and gravity in the presence of a specific potential. We study the properties of boson star and boson shell solutions in the presence of a cosmological constant which we treat as a free parameter. Further, we allow both the positive as well as negative values for this constant which implies that we study this theory in the de Sitter (dS) space as well as in the Anti de Sitter (AdS) space. We also study the above theory in the absence of vector gauge field. We study the properties of these solutions and determine their domains of existence for a set of values of the parameters of the theory (similar solutions have been found before by Kleihaus, Kunz, Lämmerzahl and List for the massless scalar field theory with a V-shaped scalar potential). We have also studied the case of the phantom boson stars and boson shells invoving massive complex scalar field with negative kinetic energy called the phantom field.

Contents

1. Introduction. 2. Review of literature work. 3. Mathematical formalism of the theory of complex scalar field coupled to a U (1) gauge field and gravity in the presence of a cosmological constant $\wedge$ in a general potential $V(|\Phi|)$. 4. Boson stars and boson shells in a theory of complex scalar field in the presence of a U (1) gauge field and gravity in the potential $V(|\Phi|) = 1/2\ m^2 (|\Phi|+a)^2$. 5. Boson shells in a theory of comlex scalar field in the presence of a U(1) gauge field and gravity and a cosmological constant ($\wedge$) in the potential $V(|\Phi|) = (m^2|\Phi|^2+2\lambda|\Phi|)$. 6. Boson Stars and boson shells in a theory of complex scalar field coupled with gravity in the presence of a cosmological constant $\wedge$ in the potential $V(|\Phi|) = (m^2|\Phi|^2 + 2\lambda|\Phi|)$. 7. Summary and conslusions. Bibliography.

526. SHARMA (Richa)
Synthesis and Characterization of Barium Titanate Based Multiferroic Composites.
Supervisor : Prof. R P Tandon
Th 22153

Abstract

Recently, the growing demand of electronic device miniaturization and multi-functionality with high performance and low cost has intensified a significant research activity to find novel multifunctional materials. One possible way to realize this is by the use of "multiferroic composites" made by combining ferroelectric and magnetic materials together. These composites exhibit magnetoelectric (ME) effect in which electric polarization can be produced by the application of magnetic field or magnetization can be produced by the application of electric field and have potential applications as spintronic devices, high sensitivity magnetic field sensors, current sensors, memories, and so on. In present thesis work, multiferroic particulate and laminated composites have been synthesized by solid state reaction method and their structural, microstructural, dielectric, ferroelectric, magnetic and ME properties are investigated in detail. $BaTiO_3$ and $Ba_{0.95}Sr_{0.05}TiO_3$ have been selected as the ferroelectric phase. For the magnetic phase $CoFe_{1.8}Zn_{0.2}O_4$ and $Ni_{0.7}Zn_{0.2}Co_{0.1}Fe_2O_4$ have been chosen. For the preparation of the particulate composites, constituent phases are mixed together and then sintered at elevated temperature. To fabricate trilayer composites, magnetic phase is sandwiched between the layers of the ferroelectric phase and then different layers are bonded together by co-firing at high temperature. X-ray Diffraction and Scanning electron Microscopy analysis of the composites are carried out to examine the structure and morphology. The dependence of the dielectric properties of the composite samples in a wide range of temperature and frequency has been investigated. Furthermore, ferroelectric and magnetic properties of the composite samples are also analysed. In addition, ME coefficient of the composites is measured as function of dc magnetic field. The effect of ferrite content on the above mentioned properties has also been discussed. Among the prepared composites, the highest value of ME coefficient achieved is 2.58 mV/cm Oe for the particulate composite series $Ba_{0.95}Sr_{0.05}TiO_3$ - $Ni_{0.7}Zn_{0.2}Co_{0.1}Fe_2O_4$.

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527. SHARMA (Surender Kumar)
Fabrication and Characterization of Polymer Based Conducting Nanocomposites for Eletromagnetic Interference (EMI) Shielding Application.
Supervisor : Prof. R.P. Tandon
Th 22412

Abstract

Electromagnetic (EM) pollution is considered as a problem of global concern due to its associated health risks and undesirable interference in electronic devices. The level of this electromagnetic pollution is continuously increasing with growing use of mobile phones and other wireless/GHz electronic devices. This has created a demand for development of practical and effective light weight shielding materials to shield the sensitive equipment. Conducting polymer composites (CPCs) are considered as a versatile material for EMI shielding application. However, the main problem associated with CPCs, fabricated using conventional fillers such as carbon black or metal particles, is their high filler loading required to obtain acceptable electrical conductivity and EMI shielding. My research work focuses on minimizing the conductive filler content of CPCs without much affecting their electrical properties and EMI shielding effectiveness (EMI SE), which is important for their use in EMI shielding application. In order to accomplish the objectives, multi-walled carbon nanotubes (MWCNTs) and graphene were selected as the conductive fillers, due to their commendable electrical properties and growing industrial applications. Polystyrene (PS) and acrylonitrile butadiene styrene (ABS) were used as the polymer matrices. For fabrication of composites, a low cost, solvent free processing technique was developed and investigated. This technique involves the mixing of conductive filler and polymer powders in a tumbler for an optimized time, followed by hot compression at elevated temperature. The approach is quite effective for reducing the percolation threshold of CPCs and results in improved electrical conductivity and EMI SE. The research work carried out in this thesis revealed quite low values of percolation threshold and good EMI SE, better than earlier reported values in the literature. The study presented in this thesis is important and may contribute towards better understanding of CPCs and their commercialization for many applications particularly for EMI shielding.

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528. SINGH (Beerandra)
Study of Optical and Electrical Transport Properties of Poly (3-HEXYLTHIOPHENE) and its Nanocomposites.
Supervisor : Dr. Amarjeet Kaur
Th 22152

Contents

1. Conducting polymers 2. Samples perparation and characterization technique 3. Characterizations of P3HT and P3HT-ZnX nanocomposites 4. DC conduction mechanism in P3HT and P3HT-ZnX nanocomposites 5. Low ferquency AC conduction and dielectric relaxation in P3HTand P3HT-ZnS nanocomposites 6. Pholoconductivity of P3HT-ZnX nanocomposites 7. Summary and References.

529. SINGH (Manoj Kumar)
Gel Polymer Electrolytes Based Electrical Double Layer and Hybrid Supercapacitors
Supervisor : Dr. S A Hashmi
Th 22160

Abstract

I, Dr. Manoj Kumar Singh, have completed my Ph.D. under the supervision of Dr. S. A. Hashmi, Department of Physics & Astrophysics, University of Delhi. My Ph.D. thesis is entitled as "Gel Polymer Electrolytes based Electrical Double Layer and Hybrid Supercapacitors". The thesis contains seven chapters focused on the development of flexible, quasi-solid-state supercapacitors. Supercapacitors are highly efficient charge/energy storage devices exhibiting high power density, moderate specific energy (comparable to that of rechargeable batteries) and longer cycle life. The materials used in supercapacitor have been characterized by various physical, structural and electrochemical techniques such as XRD, BET, Raman, FTIR, DSC, TGA, ionic conductivity, Electrochemical stability window. The performance studies of the Hybrid Supercapacitor have been examined by Open circuit voltage (OCV), Electrochemical impedance spectroscopy (EIS), Cyclic voltammetry (CV), and charge-discharge characteristics at different current drains. The electrolyte is one of the important components of the supercapacitor that determines its operating voltage range, resultant specific energy, and specific power. The gel polymer electrolyte has been used as electrolyte/separator to meet latest generation of portable devices requires flexible, solid-state supercapacitors with high energy and power densities. Electrical Double Layer supercapacitors (symmetric supercapacitors) have been prepared by carbons especially, GNPs and MWCNTs due to high surface area and define meso-pore size. Further, MWCNTs has been modified by ionic liquid and level as bukcy gelled MWCNTs, a significant improvement has been observed but its specific energy performance is low in comparison to Battery. Further, asymmetric hybrid supercapacitors prepared to improve the energy performance using battery cathode and EDLC carbon anode. Finally, my deepest gratitude and warmth regards to Dr. S. A. Hashmi and advisors Dr. Amita Chandra, and Prof. Vinay Gupta during the whole Ph.D. research work is gratefully acknowledged.

Contents

1. Introduction Experimental techniques 3. Studies on poly (vinylidenc fluoride-co-hexafluoro propylene) based lithium ion conducting gel polymer electrolytes 4. Studies on flexible and solid state electrical double layer capactiors using graphene nano-platelets as electrode 5. Studies on flexible and solid-state electrical double

layer capacitors using “Bucky Gel” of multiwalled carbon nanotubes as electrodes 6. Studies on solid-state hybrid supercapacitors using $LiFePo_4$-based cathode 7. Summary and Conclusions. Appendices.

530. SINGH (Manveer)
Dosimetric Characteristics of Some Low-Z Micro and Nanocrystalline TLD Phosphors.
Supervisors : Prof. P D Sahare and Dr. Pratik Kumar
Th 22155

Contents

1. Introduction 2. Characterization techniques 3. Redox reactions in Cu-Activated nanocrystalline LiF TLD 4. Synthesis and dosimetry characteristics of a new high sensitive TLD phosphor $NaLi_2PO_4$ doped with rare earth 5. Synthesis and dosimetric characteristics of low-Z MgB_4O_7 doped with Mn and Tb 6. Summary and scope for future. Reference and research papers.

531. SINGH (Parminder)
Nucleosynthesis in a Linearly Coasting Universe.
Supervisor : Prof. Daksh Lohiya
Th 22460

Abstract

My thesis looks at aspects of the primordial nucleosynthesis in a linearly coasting universe. Due to the linear evolution of scale factor with time, the Hubble expansion rate is much slower in this case as compared with the standard model of cosmology. Even with such an enormous difference in the evolution of universe, we successfully achieve the observed amount of ^{4}He (Y$\rm{_p} = 0.254$) with a significant amount of metallicity $\rm{Z} \sim 10^{-8}$. This is due to the different dynamics of the linear coasting model. We see that the production of ^{4}He requires a high baryon to photon ratio, $\eta \approx 1.1\times10^{-8}$ which in turn gives $\Omega_B \approx 0.70$ (assuming the neutrino degeneracy parameter to be zero). Also, the metallicity level meets the minimum metallicity bounds that are required for the cooling and fragmentation of collapsing proto-stellar gas clouds. Such metallicity in the standard cosmology can only be produced by invoking hypothetical PopIII stars which have not been observed till date.The high estimate of the baryonic density noted above is larger than the dynamic mass estimates (obtained from measured velocity dispersion of stars in galaxy and of galaxies in clusters) by a factor of ≈ 2.5. We resolve this issue by incorporating non-zero neutrino degeneracy parameter. We find that the observed abundances of ^{4}He (Y$\rm{_p}=0.254\pm0.003$), and the minimum metallicity ($\rm{Z}=\rm{Z_{cr}}=10^{-6}\rm{Z_{\odot}}$) constrain the baryon to photon ratio, $\eta=(3.927\pm0.292)10^{-9}$, corresponding to a baryonic matter density, $\Omega_B=0.263\pm 0.026$ and $\xi_e=-2.165\pm0.171$.

Contents

1. An introduction. 2. Nucleosynthesis in a linearly coasting universe. 3. Lepton asymmetry in LCN. 4. Coulomb screening in linear coasting nucleosynthesis. 5. Discussion

and conclusion. Analytical calculation of thermonuclear reaction rates. Bibliography.

532. TAK (Manvi)
Growth and Characterization of Hybrid Composite Thin Films for Biosensing Applications
Supervisor : Dr. Monika Tomar
Th 22413

Abstract

Disease diagnosis and prognosis are the key issues of health care which demand highly sensitive and simple detection techniques. A number of biosensors depending upon different metabolites are utilized for monitoring clinically important analytes such as blood glucose, urea, cholesterol, uric acid etc. In the present work, ZnO thin films were deposited by chemical solution deposition technique for biosensing application. The optimized ZnO matrix (thickness 140 nm and annealed at 300 ^{o}C) has been used for the detection of glucose and urea using the specific enzyme GOx and urease respectively. Electrochemical detection techniques (CV, EIS and DPV) have been utilized for the biosensing work in the present thesis. The ZnO-MWCNT/ITO hybrid nanocomposite having 0.10 wt. % of MWCNTs is identified as the optimized matrix to study the biosensing response towards glucose and urea. The ZnO-MWCNT based bioelectrode is found to give high sensitivity of 4.40 μA $(mg/dl)^{-1}cm^{-2}$ and 7.09 μA $(mg/dl)^{-1}cm^{-2}$ for glucose and urea detection respectively. Ni as dopant (6 %) of suitable quantity was incorporated in ZnO thin film to provide redox property. The Ni-ZnO matrix exhibits the enhanced electrochemical properties towards detection of glucose and urea with good sensitivity of 0.64 μA $(mg/dl)^{-1}cm^{-2}$ and 3.72 μA $(mg/dl)^{-1}cm^{-2}$ respectively, high selectivity and long shelf life. Flower-like ZnO nanostructured (ZnONF) based electrode show very high sensitivity for detection of glucose (~2.92 μA $(mg/dl)^{-1}cm^{-2}$) as well as for urea (~21.78 μA $(mg/dl)^{-1}cm^{-2}$). All the optimized ZnO based matrices (ZnO, ZnO-MWCNTs, Ni-ZnO, ZnONF) have been utilized for the development of bioelectrode for detection of meningitis DNA. The selectivity of prepared biosensors has been verified using the non-complementary target DNAs. Maximum sensitivity of 84.32 mV/decade for the ZnO nanostructured matrix is obtained, which highlight the importance of the present work and paves way for the realization of highly efficient meningitis biosensors.

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533. TYAGI (Nidhi))

Structural, Piezoelectric, Ferroelectric, Dielectric and Mechanical Properties in Amino Acid Based Single Crystals.

Supervisor : Dr. Binay Kumar

Th 22411

Abstract

In the recent years, amino-acid family crystals are of interest due to their piezoelectric and ferroelectric properties. Glycine is one of the simplest amino acid whose compounds show ferroelectric properties at different temperature. So a new step to find the new piezoelectric and ferroelectric amino acid based compound is encouraging the development of piezoelectric and ferroelectricity in the biological compound, which may be very useful for advance electronic devices. The thesis focuses the growth of amino acid based single crystals from aqueous solution and investigation of the structural, dielectric, piezoelectric ferroelectric and mechanical behaviour of the grown crystal. In this thesis, amino acid based semi organic bulk single crystals Glycine sodium nitrate (GSN), L-histidinium tetrafluoroborate (LHFB), L-histidinium dihydrogen arsenate orthoarsenic acid (LHAS), Bis(glycine) squarate (BGSQ) and L histidine sodium nitrate (LHSN) single crystals were grown by the slow evaporation method. The morphology of grown crystals has been carried out WinX-morph software. The growth rates and morphological studies of the various planes for the LHAS crystal were computed by Bravais–Friedel–Donnay–Harker (BFDH) law. Single crystal XRD and powder XRD analysis have confirmed the structure of grown crystals. Hirshfeld surface gives the information about intermolecular-interaction within the crystal structure and the fingerprint plot shows the nature and type of intermolecular close contact experienced by the molecules in a crystals. Presence of characteristic functional groups was confirmed in FTIR analysis. Thermal analysis reveals the melting point and thermal stability of grown crystals. The dielectric behaviour of the crystals in the frequency range 20 Hz - 2 MHz at different temperatures is reported. The crystals have shown high piezoelectric charge coefficient (d_{33}). Hysteresis loop gives evidences for spontaneous polarization. Hardness value shows the stability of the grown crystals.

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