

Characterization of magnetic materials by Barkhausen noise measurement

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Abstract : Ferromagnetic materials generate magnetic Barkhausen noise (MBN) mainly due to 180° domain wall motion. MBN measurement can be used for the characterization of magnetic materials. In the present work, the direction of magnetic easy axis of a polycrystalline steel material has been studied in presence of different stresses using MBN measurement. The stress distributions around a circular shaped defect in a ferromagnetic material has also been investigated using the same measurement.

Keywords : Magnetic Barkhausen noise, applied stress, stress concentration.

PACS Nos. : 75.60.-d, 75.50.Bb, 75.70.-i

Some recent aspects of IV–VI based diluted magnetic semiconductors

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Abstract : This invited talk begins with a brief review of the progress made in semiconductor physics and devices in the last century. A concise historical sketch of research in IV–VI semiconductors is also presented. Some novel features of diluted magnetic semiconductors (dms) based on IV–VI systems are highlighted. Finally, recent results obtained by the authors's group are discussed.

Keywords : Diluted magnetic semiconductors, IV–VI semiconductors, magnetic transition and magnetisation.

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Band structure studies in solids using X-ray spectroscopy

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Abstract : The advent of X-ray photoelectron spectrometer and high energy synchrotron sources have renewed interest in X-ray spectroscopical investigation of matter, be it solid, liquid or gases. Out of all spectroscopies available for study of electronic structure of material, X-ray spectroscopy has a spectacular contribution like optical spectroscopy and has enriched the knowledge of electronic structure of atoms, molecules and condensed matter. The analysis of X-ray transitions between atomic levels is a very direct method of studying atomic structure and experimental determination of X-ray energy lines give proof to the theoretical models. Thus the spectra from metals, semiconductors and insulators in the form of pure element, alloys and compound provide detail information about the density of states near Fermi level as well as those in the conduction and valence bands. Non-diagrams lines or the satellites provide a lot of information about the quasi states and vacancies between valence and conduction bands. Shift of X-ray emission and absorption lines provide information on the valence of the elements charge associated with it and the bonding present in alloys and compounds. In this short paper, usefulness of X-ray spectroscopic investigation on some metals, alloys, semiconducting thin films and insulating materials is highlighted. Study on these samples have shown the type of bonding present in alloy thin films, charge associated with different atoms, density of states present on the top of valence band and near the Fermi level. Further, the role of Coster-Kronig process of vacancy production, many electron effects and exchange interaction between d and p states are also discussed.

Keywords : Band structure, electronic states, X-ray fluorescence.

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Structure of small and intermediate size silicon clusters

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Abstract : Tight-binding molecular dynamics methods are used to optimize geometries of mid-sized silicon clusters up to 23 atoms. The calculated equilibrium structures of the clusters are similar in both orthogonal and nonorthogonal tight-binding simulations. The results obtained in the tight-binding model are compared with those obtained using first principles methods. While in the first principles methods and experiments the structural phase transition is expected to occur at Si_{25} cluster, the tight-binding methods employed in this work predict near-spherical shape for Si_{19} , but prolate structure for Si_{20} . Some properties of these clusters are calculated using tight-binding methods and compared with results obtained from *ab initio* methods.

Keywords : Tight-binding method, molecular dynamics, clusters.

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Quantum current enhancement effect in hybrid rings at equilibrium

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Abstract : Current enhancement – a novel quantum phenomenon is found to occur in a mesoscopic hybrid ring at equilibrium. The hybrid system is described by a ring with bubble which is in turn coupled to a reservoir. In the system the ring encloses a magnetic flux γ while the bubble does not enclose any flux. The novelty of this work lies in the fact that while earlier current enhancement was observed in non-equilibrium systems (*e.g.*, a ring coupled to two reservoirs at different chemical potentials m_1 and m_2), herein we prove that current enhancement can also arise in equilibrium. In addition, we show that the closed system analog of our chosen open hybrid ring system violates parity effects. Finally, we bring to focus the discrepancy between the equilibrium magnetic moment (obtained *via* energy eigenvalues) and that calculated from the currents in the system.

Keywords : Mesoscopic systems, current enhancement, parity effects, magnetic moments.

PACS Nos. : 73.23.-b, 05.60.Gg, 72.10.Bg, 72.25.-b

Phase transitions in $\text{Pb}[\text{Cu}_{1/2}\text{W}_{1/2}]\text{O}_3$ ceramic

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Abstract : $\text{Pb}[\text{Cu}_{1/2}\text{W}_{1/2}]\text{O}_3$ (PCW) ceramic has been prepared using solid-state reaction method. XRD-studies showed that PCW has a single phase with orthorhombic structure. The density of sample was found to be 93–95% of the theoretical value. Dielectric properties are measured in the frequency range 0.2 kHz to 10 kHz at 26°C and in temperature region 26°C to 250°C at 1 kHz and 10 kHz. PCW shows successive phase transitions at T_{c1} (upper T_C) = 87°C and T_{c2} (lower T_C) = 50°C at 1 kHz. This successive phase transition is similar to that observed in $\text{Pb}[\text{Co}_{1/2}\text{W}_{1/2}]\text{O}_3$ earlier. Diffuse phase transition is observed with the diffusivity parameter (s), as estimated from Kramer-Krönig relation and was found to be 1.52.

Keywords : Ferroelectrics, dielectric constant, diffuse phase transition, lead tungstate ceramic.

PACS Nos. : 77.22.Gm, 61.10.Nz, 77.80.Bh

Study of the effect of magnetic field on the impurity bound polaronic energy levels in a parabolic quantum dot**

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Abstract : The problem of interface optical polaron, bound to an impurity atom in a parabolic quantum dot near the semiconductor heterostructure has been investigated in the framework of canonical transformation method. An external magnetic field is applied in the growing direction of the quantum dot heterostructure (along the z-direction). A calculation has been proposed to study the dependence of the ground state energy on the magnetic field and the thickness of the well. The binding energy and hence the quantum confinement increases with the increasing magnetic field. The effect of the thickness on the induced potential and hence on the ground state energy has also been studied.

Keywords : Polaron, semiconductor heterostructure, magnetic field, canonical transformation method.

PACS No. : 71.38.-h

Transport characteristics and effect of Ag in controlling thermally activated phase-slip in Ca doped $\text{YBa}_2\text{Cu}_3\text{O}_{7-y}$

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Abstract : DC resistivity of $\text{Y}_{1-x}\text{Ca}_x\text{Ba}_2\text{Cu}_3\text{O}_{7-y}$ and $\text{Y}_{1-x}\text{Ca}_x\text{Ba}_2\text{Cu}_3\text{O}_{7-y}/\text{Ag}$ composite bulk sinter samples has been studied as a function of applied magnetic field and temperature. A percolative current conduction model was utilized to quantify granularity in the bulk in terms of such parameters like the weak link resistivity across grain boundaries, current path lengthening factor arising due to grain misalignment, and due to voids and cracks. Evolution of these parameters with Ag content in the sample indicates improved grain alignment and reduced structural defects (voids and cracks). The resistive broadening by magnetic field has been described by thermally activated flux creep or flux-flow behaviour which is much reduced in Ag composite sample. Hence the grain boundary which has much technical application is improved by Ag addition.

Keywords : Percolative conduction, flux creep, activation energy.

PACS Nos. : 74.72.Bk, 74.60.Ge, 74.62.Dh

Compensation of deterioration in microwave properties of GaInAs DDD due to mobile space charge and optical injection through modulation of impurity doping

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Abstract : GaInAs double drift diode (DDD) operating in the IMPATT mode has been designed and analyzed for several frequency bands of operation under varying operating conditions to study its microwave properties. The microwave performance characteristics show rapid deterioration when operating current density is increased (due to mobile space charge) and with the decrease of multiplication factor (due to optical injection and increase of saturation current). The authors have devised a technique to compensate the deteriorating effects of both the factors through modulation of flat doping concentration of GaInAs diode.

Keywords : IMPATT Diode, double drift diode, optical injection.

PACS Nos. : 84.40.-x, 07.57.-c

Theory for equation of state of hard D -sphere fluid mixture

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Abstract : The equation of state for a fluid mixture of hard D -sphere is discussed. The approach is based on the physical interpretation of the reciprocal of activity. Using the physical interpretation of the reciprocal of activity, an unified expression is derived for the equation of state of D -dimensional fluid mixture of hard D -spheres. The results for binary mixture of hard D -spheres are discussed.

Keywords : Fluid mixture, equation of state, dimensionality.

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Electric field induced tunneling process in the quantum wells

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Abstract : In this study, the field induced direct tunneling and phonon-assisted tunneling of electrons from the single quantum well based on the AlGaAs/GaAs heterojunction are reported. The barrier lowering due to the applied electric field favours electrons to tunnel out of the well. The longitudinal optic phonon at a finite temperature scatters electrons to the continuum and then the electron escapes out of the well in the direction of the electric field. The thermally excited electrons also escape from the well by the thermionic process. The dark current is calculated taking different field induced tunneling mechanisms. The electron absorbs photons and generates photo-current in the direction of the electric field. The magnitude of the photo-current is an order of magnitude higher than the dark current.

Keywords : Single quantum well, electron tunneling, dark current.

PACS Nos. : 73.40.-c, 73.61.Ey, 63.20. Kr

Interplay of ferromagnetism and static band Jahn-Teller distortion in $\text{La}_{1-x}\text{Sr}_x\text{MnO}_3$

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Abstract : The manganite system $\text{La}_{1-x}\text{Sr}_x\text{MnO}_3$ is a ferromagnetic metal in presence of static Jahn-Teller distortion. The system is described by an electronic Hamiltonian containing the hopping terms as well as the ferromagnetic interaction term arising out of the same itinerant e_g electrons of Mn ion in presence of lattice distortion. The one particle Green's functions of the electrons are calculated by Zubarev technique using equations of motion method. The magnetization and lattice strain are calculated and solved self-consistently taking into account the impurity and chemical potential. The interplay between ferromagnetism and lattice distortions is discussed in this communication.

Keywords : Electron-electron interaction, magnetically ordered materials, exchange and super exchange.

PACS Nos. : 75.10.Jm, 75.30.Kz

Sound velocity study of NiMo systems

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Abstract : Sound velocity study of a disordered alloy system NiMo, was undertaken. The interest is to dilute a purely ferromagnetic metal with a compatible non-magnetic component and systematically study how the magnetic properties of the system changes consequently. We here report the study on 10% Mo system. Besides conventional resistivity, magnetic susceptibility and Mössbauer studies, we also performed sound velocity measurements on this system. The sound velocity measurements were done by a vibrating reed apparatus, and the data show close similarity with the other measurements.

Keywords : Sound velocity, magnetic alloys, NiMo systems, Mössbauer study.

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Optical parameters of spun on films of Calix-4-resorcinarene molecules by attenuated total reflection technique

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Abstract : Surface plasmon resonance (SPR) measurements under attenuated total reflection (ATR) were taken in air as well as in pure water, for an overlayer containing Calix-4-resorcinarene (Azo1) molecules spun on Au coated slides. SPR data for both media used throughout this work were fitted to Fresnel reflection theory for a four layered (glass-Au-Azo1-air or water) system. By varying the Azo1 film thickness during the fitting procedure, different solutions have been obtained for the film dielectric constant and hence its refractive index. The refractive index *versus* thickness for both media were plotted and from the intersecting point of the two curves an exact solution was found which gives film optical parameters of organic overlays.

Keywords : Refractive index, dielectric constant, thickness, attenuated total reflection.

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Theoretical study of superconducting gap in correlated cuprates

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Abstract : The interplay between superconductivity (SC) and anti-ferromagnetism (AF) in strongly correlated High Temperature Superconductor systems : $R_{2-x}M_xCuO_4$ ($R = Nd, La, \dots$ and $M = Sr, Ce$) is very interesting to study both theoretically and experimentally. We present a microscopic theoretical model for the system to study its superconducting gap equations in absence of anti-ferromagnetism. Superconductivity is assumed to be in copper 3d electrons in presence of hybridization between conduction band and f -level of the Ce impurity atom. Green's functions are calculated by Zubarev technique and the SC gap equation was solved numerically by self-consistent method under half-filled band situation. The effect of the impurity f -level and its hybridization with conduction band on superconducting gap is investigated theoretically and results are discussed in this communication.

Keywords : Magnetic superconductors, antiferromagnetic order, Cu-O planes.

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A comparative study of n - and p -type DAR IMPATT diode structures based on InP material

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Abstract : A comparative study of small signal and noise behaviour of $n^+p\text{In}p^+$ (n -type) and $n^+p\text{ppn}^+$ (p -type) structures of DAR IMPATT diode based on InP material has been made by computer simulation method developed by our group. Both the structures are taken of a fixed width of 800 nm. Multiple peaks for negative conductance and mean square noise voltage are obtained for both type of structures. It is observed that the device negative conductance ($-G_p$) as well as the device negative resistance ($-Z_{Rp}$) for the p -type InP DAR IMPATT diode is much higher than those of the n -type InP DAR IMPATT diode, both for operation in W -band and D -band. Similarly, the mean square noise voltage peaks for the p -type InP DAR IMPATT diode are observed to be higher than the corresponding peaks of the n -type InP DAR IMPATT diode. This is obvious because of the fact that the high power generating mechanism also creates a higher noise. However, the p -type InP DAR IMPATT diode can be used for high power performance with a moderate noise by suitably choosing the frequency of operation.

Keywords : IMPATT, DAR, noise

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Phonons in some fluoride scheelites

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Abstract : The infrared and Raman scattering measurement on some Fluoride Scheelites have revealed two facts. These are (i) absence of several modes in the spectrum, which is thought to be either due to their non-identification or of non-observed nature and (ii) softening of few specific phonon modes in some systems. To account these unusual observations in some systems we propose a strong electron-phonon interaction in these systems. We consider the Periodic Anderson Model (PAM) with electron-phonon interaction as applied to Heavy Fermion (HF) systems. However unlike the case of HF systems, we conjecture the coupling of phonon with f -electrons is stronger compared to that of hybridization. With this we reproduce a large number of phonon peaks even in the static case ($\omega = 0$) and softening.

Keywords : Fluoride Scheelites, electron-phonon interaction, periodic Anderson model, spectral density function.

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Effect of NDOS structure on the transition temperature and resistance anomaly in impure Zr–Cu metallic glasses

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Abstract : The suppression of superconducting transition temperature and the anomaly in the resistance peak of $\text{Zr}_{50}\text{Cu}_{50}$ doped with dilute anti-ferromagnetic impurities have been studied. The change in normal density and the resistivities are calculated for 11 ppm of Mn in $\text{Zr}_{50}\text{Cu}_{50}$. The theoretical results agree with the reported experimental values qualitatively justifying the model proposed.

Keywords : NDOS structure, transition temperature, Zr–Cu metallic glasses.

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Physics of binding between cell-adhesion molecules (CAMs) in biosamples

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Abstract : The binding mechanisms in biological systems which are very useful to explain the pattern formation are discussed on the physics like model of interaction due to CAMs. The morphogenesis of animals is discussed from the analogy of one dimensional systems with interactions equivalent to cell-cell and cell-background interactions in biosamples. Some very interesting comments can be made regarding the color morphogenesis of some animals by drawing the analogy from one dimensional Ising model.

Keywords : Morphogenesis, Ising model, pattern formation.

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