

Theoretical study of velocity of sound in heavy fermion superconductors

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Abstract : In this article, the microscopic theory of the temperature dependence of velocity of sound in superconducting heavy fermion system is reported. The Periodic Anderson Model Hamiltonian in presence of phonon interaction with the hybridisation between *f*-electron and conduction electrons as well as with the bare *f*-electron is taken for calculation. BCS type Cooper pairing is taken into consideration. The phonon Green's function is calculated exactly in closed form using the Green's function technique of Zubarev in the limit of zero wave vector and finite temperature. The variation of velocity with temperature is calculated numerically and studied for different model phonon parameters and electronic parameters of the atomic subsystem.

Keywords : Heavy fermion superconductor, electron-phonon interaction.

PACS Nos. : 74.70.Tx, 63.20.Kr

Study of defects in GaN/sapphire using Rutherford backscattering spectroscopy and channeling

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Abstract : III-V nitrides like GaN, AlN, InN have opened up new opportunities in low-wavelength optical light emitters and in high frequency and high power electronic devices working at high temperature. But it is difficult to grow these materials due to lattice-mismatched substrate. GaN on sapphire were grown by MOCVD technique. Rutherford backscattering spectra together with channeling along [0001] axis were recorded to study the defects at the interface. Detail calculation shows that defects are distributed into the whole thickness of the film and are dislocations mainly aligned along the growth direction.

Keywords : GaN, interface defects, RBS/C.

PACS Nos. : 78.66.-w, 73.21-b.

Study of spin coated organic thin film under spectrophotometer

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Abstract : Thin films of organic compound Calix resorcinarene are deposited by spin coating method at different spinning speed and different concentrations. Films are studied under UV double beam spectrophotometer. Film thickness data are estimated from absorption spectra which peaks around 454 nm. Peak absorbances are found to be in consistent with spinning speed and solution concentration. The relation between film thickness h and spin speed ω obey power law relation of the form $h \propto \omega^{3/2}$. This is in agreement with the theoretical model of spin coating mechanism. Increasing solution concentration results in thicker film. This is presumably because of increased fluid viscosity.

Keywords : UV absorption spectrophotometer, spin coating, Newtonian fluid, non-Newtonian fluid.

PACS Nos. : 78.20.-e, 77.55.+f

Transport coherence in frictional ratchets

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Abstract : We study the phenomena of noise induced transport in frictional ratchet systems. For this we consider a Brownian particle moving in a space dependent frictional medium in the presence of external white noise fluctuations. To get the directed transport, unlike in other ratchet models like flashing or rocking ratchets *etc.*, we do not require the potential experienced by the particle to be asymmetric nor do we require the external fluctuations to be correlated. We have obtained analytical expressions for current and the diffusion coefficient. We show that the frictional ratchets do not exhibit a pronounced coherence in the transport in that the diffusion spread overshadows the accompanying directed transport in system with finite spatial extensions.

Keywords : Ratchets, Brownian motors, noise, transport coherence.

PACS Nos. : 05.-40.Jc, 05.-40.Ca, 02.50.Ey

Interplay of Kondo effect and superconducting gap in heavy fermion system

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Abstract : The heavy fermion system in superconducting state is described by the Hamiltonian containing the conduction electron term, *f*-electron term besides the Kondo interaction and the Heisenberg interaction. The Hamiltonian is treated in mean-field approximation to find simultaneously the Kondo singlet term and antiferromagnetic correlation. The Kondo singlet parameter $\lambda = \langle f_{i,\sigma}^\dagger f_{i,\sigma} \rangle$ and *f*-electron correlation parameter $\Gamma = \langle f_{i,\sigma}^\dagger f_{j,\sigma} \rangle$ (nearest neighbours) are calculated by minimizing total energy of the system. In addition to this, a BCS type phonon mediated Cooper pairing is considered to find the superconducting gap equation. In this communication, interplay of Kondo effect and superconducting gap of the heavy fermion system is studied through the self-consistent solution of these two parameters.

Keywords : Heavy fermions, Kondo effect, heavy fermion superconductivity.

PACS Nos. : 75.30.Mb, 75.20.Hr, 74.70.Tx

Superconducting state parameters of metals

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Abstract : The theoretical investigation of five superconducting state parameters (SSP) viz. electron-phonon coupling strength l , Coulomb pseudopotential U^* , transition temperature T_c , isotope effective exponent a and interaction strength N_0V of five monovalent (Li, Na, K, Rb and Cs), two divalent (Mg and Zn) and five polyvalent (In, Tl, Sn, Pb and Bi) metals have been carried out by our well-recognized and recently proposed model pseudopotential. We have employed here five different types of local field correction functions proposed by Hartree, Taylor, Ichimaru-Utsumi, Farid *et al* and Sarkar *et al* to study the exchange and correlation effects on the present computations. The recent local field correction functions due to Ichimaru-Utsumi, Farid *et al* and Sarkar *et al* have been employed for the first time in the study of SSP of metals. A very strong influence of all the exchange and correlation functions is found in the present study. Our results are in fair agreement with other available theoretical as well as experimental data. A strong dependency of the SSP of metals on the valency Z is found.

Keywords : Pseudopotential, superconducting state parameters.

PACS Nos. : 74.20.-z, 71.15.Dx

A proposal for the development of a fiber-optic interferometer for the determination of piezoelectric coefficient

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Abstract : The paper deals with the fabrication and characterization of different piezoelectric ceramics, polymers or their composites by finding their nonzero electromechanical coupling coefficients, the piezoelectric coefficients d_{ij} with the help of a self designed, sensitive, all-fiber Mach-Zehnder interferometer based on the principle of Pockels effect or acousto-optic effect with the aim of finding suitable materials in devices like variasters, electro-optic and acousto-optic modulators, transparent conductors, ultrasonic transducers, masers, phosphor and gas igniters *etc.*

Keywords : Pockels effect, acousto-optic effect, Mach-Zehnder interferometer, electromechanical coupling coefficients, perovskites, XRD, SEM image.

PACS Nos. : 07.60.Ly, 42.81.Wg, 77.65.Bn

Order parameter from birefringence studies of two mesogens : 4-propyl paraethoxy phenyl cyclohexyl carboxylate and 4-butyl paraethoxy phenyl cyclohexyl carboxylate

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Abstract : Texture and optical studies as a function of temperature have been conducted on two mesogenic members : code names D302 and D402 of the alkyl phenyl cyclohexyl carboxylates series to study the effect of increasing chain length. The transition temperatures of the two members were confirmed from texture studies. From birefringence studies, the refractive indices n_e and n_o were determined and density measurements were made to obtain the orientational order parameter at various temperatures. The effect of increasing chain length of the molecules on the optical properties and thereupon on the OOP has been discussed. Comparison of experimentally obtained values has been made with the theoretical values obtained from Maier-Saupe theory.

Keywords : Thermotropic, mesogens, birefringence, polarisability, order parameter.

PACS No : 61.30.-v

Universal diamagnetism : a diagnostic test for spinless bosonic excitations

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Abstract : It is well known that a classical gas of point charged particles do not show any effect of magnetic field in thermal equilibrium. Magnetism is truly a quantum phenomenon. We demonstrate explicitly that diamagnetism is a robust property of charged spinless bose systems. It will be shown that diamagnetism is a universal phenomenon of spinless bose systems at finite temperature regardless of their interactions. Starting from a single particle, the discussion will go on to N particles system and finally, end on to an interacting field theory in an arbitrary spatial dimension d . We will present an exact and non-perturbative result of the theory which is an interesting feature from the field theory aspect. In this theory, as a byproduct, we have also been able to develop a novel regularization scheme, particularly useful for magnetic field problems. Finally, as an application we will take up the cases of elementary bosonic type of excitations in condensed matter physics-one is the cooper pairs in superconductivity and other is the composite bosons in Fractional Quantum Hall Effect.

Keywords : Diamagnetism, spinless bosons, cooper pairs, composite bosons.

PACS Nos. : 72.80.Ng, 72.90.+y

Quantum spin glass phase boundary in transverse field Ising systems

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Abstract : Here we study zero temperature quantum phase transition driven by the transverse field for random $\pm J$ Ising model on chain and square lattice. We present some analytical results for one dimension and some numerical results for very small square lattice under periodic boundary condition. The numerical results are obtained employing exact diagonalization technique following Lanczos method.

Keywords : Quantum phase transition, spin glasses, transverse Ising model, exact diagonalization.

PACS Nos. : 05.70.Fh, 42.50.Lc, 75.10.Nr

Study of spectral response of plant pigments for remote sensing applications

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Abstract : A common aspect of different applications of remote sensing to plant sciences is to study the visible and infrared radiation reflected from vegetation canopies. The reflectance is governed by chlorophyll and other plant pigments and also by the presence of water, other tissues and the ground itself. Therefore the standardization of spectral response of the pigments is very important. The present work characterizes the visible spectral response of chlorophyll and carotenoids at different growth stages of the leaves and justifies its capability to monitor maturity stages of vegetation. Only the visible region of spectral band is chosen because that is mainly concerned with the property of the vegetation itself. Instead of the amplitude of the peak reflectance band, as considered conventionally, the wavelength corresponding to the peak reflectance is taken into account. To indicate crop maturity stages like “greenness” and “yellowness”, fuzzy operations over reflectance data are suggested so as to simulate human reasoning.

Keywords : Remote sensing, fuzzy logic.

PACS Nos. : 07.07.-a, 07.05.Fb

Impedance spectroscopy studies in polymer salt complex films with varying concentrations

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Abstract : We present some results based on impedance spectroscopy and morphology studies on SPE (Solid Polymer Electrolyte). Our host material is polyethylene oxide complexed with ammonium perchlorate [PEO(1- x)-NH₄ClO₄(x)], where x denotes the weight fraction. The Cole-Cole plot shows a semi circle and a spike. The spike is not vertical and may have a curvature. The real part of conductivity shows a power law variation with frequency. This is characteristic of disordered structures, which may also be fractal,

Keywords : Ion conduction, polymer, impedance spectroscopy.

PACS Nos. : 61.41+e, 66.10.Ed

Swift heavy ion induced interface modification in metal/Ge systems

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Abstract : This paper reports on swift heavy ion induced interface modification in metal/Ge thin film bilayer systems. 100 MeV Au⁷⁺ ions have been used for irradiation of the UHV grown thin films of Co/Ge and Ni/Ge at three different temperatures of 100 K, 300 K and 385 K and with fluences in the range of 5×10^{12} ions/cm² to 1×10^{14} ions/cm². Irradiation induced interfacial changes were studied by Rutherford backscattering spectrometry. The changes in the surface morphology and other structural aspects have been studied by transmission electron microscopy. Interface modification has been explained in terms of synergetic effect of electronic and nuclear energy loss processes.

Keywords : Swift heavy ion irradiation, alloy formation, electron microscopy.

PACS Nos. : 61.80.Jh, 68.55.Nq, 68.37.Lp

Positron annihilation studies on $\text{Li}_{0.25}\text{Mg}_{0.5}\text{Mn}_{0.1}\text{Fe}_{2.15-x}\text{In}_x\text{O}_4$ series

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Abstract : Positron annihilation spectroscopy is a well known technique for probing the electronic properties and defects in solids. The positrons coming out from the radioactive source ^{22}Na while entering a material thermalizes within 1 to 10 ps giving rise to different components of lifetime. Investigation has been done to observe the effect of diamagnetic In^{3+} ions in the $\text{Li}_{0.25}\text{Mg}_{0.5}\text{Mn}_{0.1}\text{Fe}_{2.15-x}\text{In}_x\text{O}_4$ series (with $x = 0, 0.3, 0.6, 0.9$) by positron annihilation lifetime spectroscopy. Variations in positron lifetime components and their corresponding intensities have been discussed on the basis of In^{3+} ion substitution in place of Fe^{3+} ion.

Keywords : Ferrites, positron annihilation spectroscopy, defects.

PACS Nos. : 78.70.Bj, 75.50.Gg

Enhancement in resistivity with annealing temperature in the nanoparticles of Li-Mg ferrite thin films

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Abstract : Nanocrystalline thin films of $\text{Li}_{0.25}\text{Mg}_{0.5}\text{Mn}_{0.1}\text{Fe}_{2.15}\text{O}_4$ have been prepared by R F magnetron sputtering technique using Si (100) as substrate. These thin films have been annealed under oxygen atmosphere at 650 °C, 700 °C, 800 °C and 900 °C. X-ray diffraction measurement reveals variation in grain sizes proportional to the annealing temperatures. Resistivities of the films have been measured by two-probe method. Interestingly it is observed that resistivity of this ferrite system increases with increase in grain size. Variation in resistivity is explained from the viewpoint of the combining effect of crystal growth and electron-phonon interaction in small volumes.

Keywords : Ferrite thin films, resistivity, crystal growth, electron-phonon interaction.

PACS Nos. : 25.75.-q, 61.82.Ms, 29.17.+w

Investigation of tin-incorporated nanocomposite diamond like carbon film

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Abstract : Semiconducting Sn-incorporated nanocomposite diamond like carbon (Sn-DLC) films were synthesized by DC plasma-enhanced chemical vapour deposition (PECVD) method using $\text{SnCl}_2 \cdot 2\text{H}_2\text{O}$ salt dissolved in methanol solution as the doping source and acetylene as the carrier gas. Fourier transform infrared spectroscopy (FTIR) measurements showed different vibrational modes of tetrahedrally bonded carbon and also some small peaks due to Sn-C bonding vibrations. Transmission electron microscopy (TEM) image and electron diffraction pattern also confirmed the incorporation of nanocrystalline Sn particles into the amorphous DLC matrix. Due to presence of Sn clusters optical band gap of the films decreased sharply compared to the intrinsic material. It was found that resistivity of Sn-incorporated DLC films decreased drastically by eight orders of magnitude than that of the undoped DLC film. Also the films exhibited good field emission properties at lower turn-on field.

Keywords : Diamond like carbon, nanocomposite, TEM, field emission.

PACS Nos. : 81.15.Gh, 73.61.-r, 79.70.+q

Electro-optical properties of ZnO : Al thin films produced by sol-gel route

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Abstract : Both undoped and aluminium doped ZnO thin films of high quality were prepared by sol-gel route on glass substrates. Zinc acetate and isopropyl alcohol were taken as precursor materials. The conditions for preparations were optimized. Aluminium nitrate ($\text{Al}(\text{NO}_3)_3 \cdot 9\text{H}_2\text{O}$) was doping material for aluminium doping and Zn/Al ratio was varied in the solution to vary doping concentration in the film. Structural characterizations were performed by XRD and TEM studies. The optical and electrical properties of the films were studied in detail and they were correlated with the doping concentrations and preparations conditions. The films deposited at optimized conditions on glass substrates showed electrical conductivity $\sim 1.39 (\Omega \text{ cm})^{-1}$ and a transmission of about 90% in the visible region. Electrical properties were studied in detailed which indicated that the films showed activated electronic conduction and the activation energies were found to depend on the doping concentrations in the films. Room temperature Seebeck co-efficient was obtained $-91.65 \mu\text{V/K}$ in optimized condition.

Keywords : Zinc oxide, sol-gel route, aluminium doping.

PACS Nos. : 73.61.Ga, 78.30.Fs

Mobility of a forced Brownian particle

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Abstract : We study the mobility of a underdamped Brownian particle in a washboard (inclined 'periodic') potential system with a similarly periodic space dependent friction coefficient. We find that depending on the phase difference between the potential function and the friction coefficient the average mobility of the particle differs with respect to the sign of the slope of the washboard potential. We discuss the possible implications of the result.

Keywords : Mobility, Langevin equation, hysteresis.

PACS Nos. : 05.40.a, 05.40.Jc, 05.60.Cd

Dielectric properties of acceptor-doped SrTiO_3 ceramics

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Abstract : 0.5 atom % Ni-doped SrTiO_3 was prepared by solid-state reaction route. Average grain sizes of un-doped and doped samples were 1.3 and 4.1 micron respectively. Relative permittivity of ST ceramics was found to increase with Ni-doping. Capacitance was measured at temperatures ranging from 400° to 700°C in the frequency range 10 Hz to 13 MHz. Grain and grain boundaries relaxation frequencies were shifted to higher frequency with temperature. Impedance measurements were conducted at 400°C to separate grain and grain-boundary contributions. Bulk and grain-boundary resistance were evaluated from impedance complex plain plot. Bulk resistance of doped and un-doped ST ceramics was more or less same. Single grain boundary resistance of doped sample was higher than un-doped one, indicating GB resistance increases with acceptor doping.

Keywords : Ni-doped SrTiO_3 , dielectric properties, impedance spectroscopy, grain-boundary, acceptor.

PACS No. : 77.84.-s

Lifetime of minority charge carriers in $\text{MoS}_x\text{Se}_{2-x}$ layered compounds

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Abstract : The study on measurement of lifetime of the minority charge carriers in grown crystals of transition metal dichalcogenides (TMDC) material $\text{MoS}_x\text{Se}_{2-x}$ has been reported for stoichiometric variation $X = 0, 0.5, 1, 1.5$. The electrical field excitation method has been used for illuminating of the single crystal $\text{MoS}_x\text{Se}_{2-x}$. The lifetime of minority charge carriers have been evaluated from the analysis of exponential decay curve of the output voltage traced under swiping mode of CRO. It is found from the present investigation that as X in the $\text{MoS}_x\text{Se}_{2-x}$ TMDC layer compounds increases, the lifetime of the charge carrier is also increases. The possible causes of such dependency of the lifetime of charge carriers on the stoichiometric variation in such TMDC layer compound are explained.

Key words : Life time, TMDC material.

PACS No. : 68.55.-a

A simple theory for thermodynamics of liquids

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Abstract : A simple theory for the thermodynamic properties of liquids is developed, based on the physical interpretation of the reciprocal of activity. Expressions for the effective pair potentials are derived for different thermodynamic properties of the fluid. The theory is applied to estimate the effect of the triple dipole potential on the equation of state and excess free energy of the liquid. The effect of the triple dipole potential, which increases with the increase of the atomic mass, is found to be small.

Keywords : Effective pair potential, triple dipole potential.

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Study of magneto-resistivity in manganite systems

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Abstract : We consider here the band Jahn-Teller distortion in dynamic limit and the ferromagnetism in the same itinerant e_g band of the manganese atom in presence of an external field. The electron Green's functions are calculated by Zubarev's technique for the colossal magnetoresistance system in presence of electron-phonon interaction. The Jahn-Teller distortion (e) and the magnetization (m) are calculated self consistently. The resistivity for the system is calculated from the electron relaxation time in Drude model taking into account the phonon frequencies in the Einstein limit. The temperature dependence of magneto-resistance is studied for different lattice coupling parameters and external magnetic field strengths. It is observed that the temperature variation of resistivity explains experimental results qualitatively.

Keywords : Electron-phonon interaction, colossal magnetoresistance, metal-insulator transition.

PACS Nos. : 71.38.-k, 75.47.Gk, 71.30.+h

Effect of charge density wave (CDW) on magnetization in manganite systems

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Abstract : The manganite system exhibits colossal magneto-resistance which is presumed to be explained by the lattice distortion in addition to the double exchange mechanism. In the present communication we consider a simple Hamiltonian consisting of the hopping term arising due to the itinerant electrons of Mn atom in presence of Charge-Density-Wave (CDW) distortion and the external magnetic field in the e_g band. The nested pieces of the Fermi surface with strong electron-phonon interaction brings about the formation of a CDW with an accompanying periodic lattice distortion. The induced ferromagnetism in the e_g band originates due to the more localized t_{2g} electrons. The appropriate electron Green's functions are calculated leading to the calculation of the magnetization and CDW gap. The magnetization and CDW gap are solved numerically and self-consistently. The results are discussed taking into account different model parameters of the system.

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

PACS Nos. : 71.38.-k, 75.10.Jm, 75.30.Kz

Model study of interplay of superconductivity and magnetism in cuprate superconductors

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Abstract : The competition between magnetism and superconductivity is investigated in cuprate superconductors of type $R_{1-x}M_xCuO_4$ [$R = La, Nd; M = Sr, Ba, Ce$]. The anti-ferromagnetic long range ordering and the superconducting ordering are associated with the same conduction electrons and hence there is strong interplay between the two phenomena. A model is proposed for the interplay of the two types of orderings. Zubarev's double time Green's function technique and equations of motion method is used to evaluate the superconducting gap and anti-ferromagnetic staggered field. The interplay is studied by varying the coupling parameters, the position of the f -level and the hybridisation. The results are discussed.

Keywords : Anti-ferromagnetic order, magnetic superconductors, Cu-O plane.

PACS Nos. : 71.38.-k, 74.72.-h, 75.50.Ee

Electrical properties of $\text{Pb}_2\text{Sb}_3\text{DyTi}_5\text{O}_{18}$ ceramic

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Abstract : Single phase orthorhombic tungsten bronze ceramics of $\text{Pb}_2\text{Sb}_3\text{DyTi}_5\text{O}_{18}$ (PSDT) were prepared by a high temperature solid-state reaction method. Electrical impedance, phase angle, dielectric constant and dielectric loss have been measured in the frequency range 0.1 kHz to 3 MHz in the temperature region 28°C to 350°C. Dielectric studies show PSDT have low dielectric constant, low loss and undergo diffuse phase transition at 301°C. AC impedance analyses suggested the phase element to be capacitive. The activation energy has been estimated to be 0.62 eV from the temperature variation of dc resistivity. The nature of variation of resistivity with temperature suggested NTCR behaviour.

Keywords : Phase transition, dielectric constant, ceramics, tungsten-bronze structure.

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

Diffuse phase transition in $\text{Pb}_2\text{Bi}_3\text{GdTi}_5\text{O}_{18}$ ceramic

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Abstract : Single phase orthorhombic tungsten bronze ceramics of $\text{Pb}_2\text{Bi}_3\text{GdTi}_5\text{O}_{18}$ (PBGT) were prepared by a high temperature solid-state reaction method. Electrical impedance, phase angle, dielectric constant and dielectric loss have been measured in the frequency range 0.1 kHz to 3 MHz in the temperature region 25°C to 300°C. Dielectric studies show PBGT have low dielectric constant, low loss and undergo diffuse phase transition at 226°C. AC impedance analyses suggested the phase element to be capacitive. The activation energy has been estimated to be 0.598eV from the temperature variation of dc conductivity. The nature of variation of conductivity with temperature suggested NTCR behaviour.

Keywords : Phase transition, dielectric constant, ceramic, tungsten-bronze structure.

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

Magnetic relaxation in nanoparticles of iron oxides : magnetic recording applications

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Abstract : The single domain anisotropic magnetic particles with high coercivity are suitable for magnetic recording and therefore magnetic relaxation effect which tends to destroy their magnetization is important. A quantum mechanical model was recently developed by the author to calculate the magnetic relaxation rate of nano-particles of iron oxides (magnetite and hemetite). These results have been applied to estimate their particle size for magnetic tapes/films on the consideration that the relaxation rate (magnetic fluctuation) must not be too high to wash out the magnetization produced by audio and visual electrical signals which operate at frequencies 10^2 – 10^6 and 10^9 – 10^{10} Hz respectively. In the first approximation it appears that particles of size 240–270 Å (diameter) are suitable for audio recording and those of 190–200 Å for video recordings. It is the first calculation of this type.

Keywords : Magnetic relaxation, recording, data storage, nano particles.

PACS Nos. : 75.50.Ss, 75.30.Mb, 75.75.+a

Thermal effect on mobility of colour centers in alkali halide crystals

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Abstract : Electron injection has been carried out in single crystals of pure KCl and KBr under constant field for different temperatures. The injection current and optical density as a function of time are measured for both growth and decay process to estimate the mobility of colour center. The activation energy for bleaching of trapped centers and corresponding dissociation energy have been calculated.

Keywords : Alkali-halide, colour center.

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Simple equilibrium theory for equation of state of hard convex body fluids

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Abstract : Using the physical interpretation of the reciprocal of activity, an expression is derived for the equation of state of hard convex body fluids. The theory is applied to evaluate the equation of state of hard ellipsoid of revolution, hard dumbbells and prolate hard spherocylinders. In all these cases, the agreement with simulation results is fairly good.

Keywords : Hard convex-body fluid, reciprocal of activity, equation of state.

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Strain modification of $\text{La}_{0.67}\text{Sr}_{0.33}\text{MnO}_3$ CMR thin films using structural transitions of ferroelectric (001) BaTiO_3 substrate

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Abstract : Effects of drastic change of 3-dimensional film lattice strain associated with Jahn-Teller strain by substrate structural transformations, on the transport and magnetic properties of tensile strained epitaxial rf-sputtered 500 Å $\text{La}_{0.67}\text{Sr}_{0.33}\text{MnO}_3$ thin film have been studied using BaTiO_3 as the template. A change of 10-12% in the resistivity of LSMO around the structural phase changes of BTO is observed, whereas a sudden change of 15-70% is found in case of magnetization. Application of high magnetic field (50 kOe) suppresses both the electrical transport and magnetization jumps to a large extent. The magneto-transport studies, with magnetic field along longitudinal, transverse and perpendicular to the film plane, have been carried out at several temperatures down to 4 K in the magnetic field range of -6 T – 0 T – 6 T. Maximum CMR effect is observed around 32% at 300 K. The magnetization loop measured below the transition temperature (282 K) is nearly square and has well-defined saturation and coercive fields, consistent with behaviour along magnetic easy axis, while the behaviour above the transition (290 K) exhibits much higher saturation field and nearly zero remanence indicating hard axis.

Keywords : CMR manganites, biaxial strain, Jahn-Teller strain, magnetic anisotropy, magnetic hysteresis.

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Magnetic field induced excess conductivity in $Y_{1-x}Ca_xBa_2Cu_3O_{7-y}/Ag$ composite superconductors

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Abstract : Temperature dependent electrical resistivity has been studied in a set of $Y_{1-x}Ca_xBa_2Cu_3O_{7-y}/Ag$ composite bulk samples. Partial doping of Ca and composite formation with Ag modifies the microstructure and enhances the conductivity of the system. These two aspects, one modifying the intragranular and the other modifying the intergranular properties of the YBCO superconductor have a profound influence on SCOPF region. In the present work fluctuation induced excess conductivity in presence of magnetic field has been calculated from $\bar{\rho}$ vs T data in the framework of Aslamazov and Larkin (AL) and Lawrence and Doniach (LD) theories. In addition to the 3D Gaussian fluctuation on approaching the transition temperature from higher side, we observed a genuine critical regime which is consistent with the predictions of the full dynamic 3D-XY universality class with model-E dynamics. Still closer to T_c^{mf} , when magnetic field is applied, evidence is found for a fluctuation regime beyond 3D-XY which can be interpreted as the occurrence of ultimate first order character of the superconducting transition. In contrast to the 3D-XY model, the samples showed a reduced critical exponent on application of magnetic field. We attribute the reduction of the critical exponent at higher magnetic field to an enlarged or extended critical region.

Keywords : Excess conductivity, SCOPF parameter, critical fluctuation.

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Quantum treatment of the Anderson-Hasegawa model – superexchange and polaronic heat capacity

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Abstract : We revisit the Anderson-Hasegawa double-exchange model and critically examine its exact solution when the core spins are treated quantum mechanically. We show that the quantum effects, in the presence of an additional superexchange interaction between the core spins, yield a term, the significance of which has been hitherto ignored. The quantum considerations further lead to new results when polaronic effects, believed to be ubiquitous in manganites due to electron-phonon coupling, are included. The consequence of these results for the magnetic phase diagrams and the thermal heat capacity are analysed.

Keywords : Double-exchange, superexchange, electron-phonon interaction.

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Thermodynamic properties of associating chain molecules

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Abstract : When a molecule has two or more anisotropic attraction sites, chain ring and tree-like cluster can form. The fraction of clusters of a given size can be estimated using purely statistical arguments. The effect of molecular associations on the attractive centers is investigated. Such a system's thermodynamic properties can be calculated by using expressions based on a theory recently proposed by Wertheim. The approach is extended to examine associating chain molecules. In this study, the separate effects of molecular and chain size on the coexistence properties are investigated.

Keywords : Associating chain molecules, compressibility.

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The spin-density-wave (SDW) in quaternary borocarbide superconductors

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Abstract : A large family of quaternary borocarbides RNi_2B_2C ($R = Lu, Y, Ho, Dy$) was discovered which have separate phase of anti-ferromagnetism (AFM), superconductivity (SC) and co-existent anti-ferromagnetic superconductivity. We propose a spin-density-wave (SDW) state as a possible mechanism of the anomalous anti-ferromagnetism in the borocarbide superconductors. In this SDW state, the electron-hole pair amplitude changes its sign in the momentum space. The BCS type mean field superconductivity and a mean field SDW in Hubbard model are considered. The superconducting gap and SDW gap are calculated by Zubarev's technique of equation of motion method and are solved self-consistently for different model parameters. The co-existence of superconductivity and anti-ferromagnetism for both of the cases *i.e.* $T_c > T_N$ and $T_c < T_N$ are explained.

Keywords : Quaternary borocarbides, spin density waves.

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Simulation of I - V characteristics of Josephson junctions array : magnetic field effect

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Abstract : The I - V characteristic of the Intrinsic stacked Josephson junctions (ISJJ) as a function of magnetic field are simulated. ISJJ has been modelled as one dimensional series array of Josephson junction. Each Josephson junction of the series is considered as resistively shunted junction model in which the effect of capacitance, inductance and a current source producing white noise are included. The critical currents of the ISJJ as function of magnetic field shows Fraunhofer like pattern. The simulated results have been compared with the Tl2212 mesas experimental results. It has been found that the simulated results are in good agreement with the experimental one.

Keywords : Josephson junction array, intrinsic stack, superconductivity.

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On the biological pattern formation from model calculations

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Abstract : We review some calculations to demonstrate the basic properties of biological pattern formation obtained from some models. Assuming a shallow gradient of source distribution, one can show that a striking pattern of activator concentration may be obtained with a maximum at the terminal of high source density for three models viz. depletion model, activator-inhibitor model assuming common sources and that with different sources.

Keywords : Morphogenesis, pattern formation, depletion model, activator-inhibitor model.

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