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Thermodynamic investigation of persistent complexes in Si–P melts

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Abstract : The Si–P alloy forms compounds SiP, Si_2P and SiP_2 in its solid phase. A statistical mechanical theory based on complex formation has been used to predict the possible compounds that could persist from the solid to the liquid state of Si–P melt at about 1750 K. The results show that Si_2P will exist in the liquid phase at lower concentrations of phosphorus. It also predicts the presence of Si_3P_2 which is strong and probably exists throughout the whole concentration range.

Keywords : Liquid alloys, concentration fluctuation, chemical complex.

PACS Nos. : 61.25.Mv, 82.60.–s, 82.40.Qt, 05.70.Ce

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Ferroelectric domains in pyroelectric ceramics

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Abstract : The photograph of five group specimens of Lead Titanat Zirconat ceramics with a base composition $Pb(Ti_xZr_{1-x})O_3$, x = 0.07 sintered at 1200°C for 1–11 hour were studied. It was observed that with increasing the sintering time, grain size increased, pyroelectric coefficient decreased and fluctuation of pyroelectric coefficient in temperatures between 20°C and 70°C decreased. By SEM photographs it is observed that the PZT pyroelectric ceramic have four types of ferroelectric domains with orientation 71°, 90°, 109° and 180°. The change of pyroelectric voltage and coefficient is due to move of these domains.

Keywords : Ferroelectric domains, pyroelectric ceramics.

PACS No. : 77.84.Dy

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Some thermoluminescence properties of synthetic quartz and its potential as high level gamma radiation thermoluminescence dosimeter material

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Abstract : The present paper reports the thermoluminescence (TL) glow curves observed in powder of 230–350 mesh grain size of synthetic (laboratory made) quartz crystals with and without gamma irradiation. It is found that the specimen does not exhibit natural thermoluminescence (NTL). The excitation of the material at room temperature with gamma radiation induces TL peaks at 110°C [peak-I], 210°C [peak-II] and 340°C [peak-III] temperatures. Among them, peak-I is found sensitive to low gamma doses and found absent in higher doses. In contrast to this, peak-II appears only at higher doses [70 Gy–6 kGy]. The examination of various dosimetric properties encourages the authors to suggest that peak-II present in synthetic quartz can be of use in the estimation of the higher-level-gamma doses used in radiation processing applications [100 Gy–6 kGy].

Keywords : Thermoluminescence, synthetic quartz.

PACS No. : 78.60.Kn, 87.53.Dq

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Study of shape of the yrast line and deformation changes in gadolinium isotopes

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Abstract : The Gamma ray studies of ^{147}Gd nucleus had been performed previously on the basis of gamma-gamma coincidence, angular distribution and excitation function measurements. In this nucleus (N = 83), two values for the effective moment of inertia are suggested which reproduce the energies of the non-yrast states, that are populated in the decay of the isomer. A comparison of the energy level patterns for the even gadolinium isotopes have been done by studying the changes in deformation through the so-called Gauge plots.

Keywords : Nuclear structure, yrast line, deformation, gauge space.

PACS No. : 21.10.–k

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Evaluation of lattice parameter and defect related studies of $(KBr)_x(NaBr)_{1-x}$ mixed crystals grown from aqueous solution

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Abstract : Mixed crystals of KBr–NaBr of different compositions were grown by slow evaporation technique. Crystals were doped with gold. Both the undoped and gold doped crystals were γ-irradiated using ^{60}Co source. All the irradiated samples were subjected to thermoluminescence, optical absorption and ESR studies. The present study shows the composition dependence of the parameters and enhancement in the luminescence intensity as well as the absorption coefficient with gold doping. For the non-irradiated samples, lattice parameter determination, microhardness and dielectric studies have been carried out. Results of the studies are reported.

Keywords : Mixed crystal, lattice parameter, microhardness, dielectric constant, thermoluminescence, optical absorption, electron spin resonance.

PACS Nos. : 61.72.Hh, 78.60.Kn, 77.22.Gm, 78.20.Ci

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Structural and photoelectronic properties of vacuum evaporated CdSe thin films

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Abstract : Thermally evaporated CdSe thin films deposited at high substrate temperature $T_S \geq 473$ K are found to be polycrystalline with hexagonal ZnS type structure. The grain size increases with T_s. Film crystallinity shows the most preferential orientation along [002] reflection. The sublinear behaviour of photocurrent – light intensity characteristics, measured at different experimental condition for the films deposited at different T_s and t, clearly confirms the defect controlled photoconductivity in CdSe films. Activation energies in dark and under illuminations are calculated from the temperature dependence of dc conductivity of the films. The reduction of activation energy under illumination is explained on the basis of the grain boundary effect. The photocurrent in the films increases whereas the photosensitivity decreases exponentially with the rise of ambient temperature within the range 303– 403 K which is attributed to the effect of different types of scattering on carrier mobility. Spectral response shows a direct transition at 725 nm with an additional absorption around 975 nm which also confirms the existence of inherent defect states in CdSe films.

Keywords : CdSe thin film, X-ray diffraction, defects, grain boundaries, annealing.

PACS Nos. : 71.55.Gs, 68.55.–a, 72.40.+w, 81.15.Ef

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Studies on microhardness, compatibility and thermal stability of poly(ethylmethacrylate) (PEMA) and poly(ethyleneoxide) (PEO) polyblends

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Abstract : Microhardness study on polyblends of poly(ethylmethacrylate) (PEMA) and poly(ethyleneoxide) (PEO) is carried out by Vicker's microhardness testing. Thermal stability of this blend is investigated by Thermogravimetric analysis (TGA) and Differential thermal analysis (DTA). The decrease in the value of surface microhardness with increasing content of PEO in the blend reveals plasticization effect. The variation in thermal stability with increasing content of PEO is observed by TGA. The variation in compatibility and crystallinity of blend with increasing content of PEO is observed by DTA. Attempts have been made to correlate the results of microhardness and TGA-DTA.

Keywords : Polyblend, microhardness, TGA, DTA, thermal stability, plasticization, compatibility, crystallinity.

PACS Nos. : 61.41.+e, 62.20.Fe, 81.40.Gh, 81.40.Lm

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Interatomic force constants, ionicity and microhardness of binary tetrahedral semiconductors

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Abstract : A simple relation between lattice energy (U), bond stretching and bond bending force constants (α, β), ionicity (f_i) and microhardness (H) developed for $A^{II}B^{VI}$ and $A^{III}B^{V}$ semiconductors. The results are in excellent agreement with the values reported by different investigators.

Keywords : Lattice energy, force constants, ionicity, microhardness, tetrahedral semiconductors.

PACS Nos. : 62.20.Qp, 05.50.+q, 34.20.Cf

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Vibrational properties of nanocrystalline *fcc* Ni_3Fe

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Abstract : The phonon dispersion relations and phonon density of states (DOS) of nanophase *fcc* Ni_3Fe are calculated using the Born-von Karman model. The calculated phonon DOS agrees with the experimental results. An anisotropic stiffening in the nearest neighbour interatomic force constants in the nanophase as compared to the bulk phase leads to an enhancement in the phonon DOS at low and high energies. The phonon dispersion relations of nanophase are compared with those of bulk phase. The specific heat in the nanophase at high temperatures (above 100 K) is greater than that in the bulk phase but at low temperatures it is nearly the same in both the phases. The Debye temperature (Θ_D) of nanophase at zero kelvin temperature is 512.8 K which is higher than that of 476 K of the bulk.

Keywords : Nanocrystalline Ni_3Fe, phonon DOS, Born-von Karman model, specific beat.

PACS Nos. : 78.67.Bf, 63.22.+m

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Strain field due to transition metal impurities in Cu

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Abstract : The strain field due to substitutional transition metal impurities in Cu metal are investigated using the discrete lattice model using Kanzaki lattice static method. The effective ion-ion interaction potential due to Wills and Harrison is used to evaluate dynamical matrix and the impurity-induced forces. The results for atomic displacements due to 3*d*, 4*d* and 5*d* impurities (Co, Ni, Pd, Ag, Pt and Au) in Cu are given up to 20 NN's of impurity and these are compared with the available experimental data which are found in agreement. The lattice shows expansion due to Co, Pd, Ag, Pt and Au impurities and contraction due to Ni impurity. The maximum displacements of 2.3% of 1 NN distance are found for CuAu alloy, while the minimum displacements of 0.43% of 1 NN distance are found for CuNi alloy respectively. The relaxation energies for Ni and Pd impurities are found less than others impurities in Cu, therefore these impurities may easily be solvable in Cu.

Keywords : Strain field, transition metal dilute alloys, point defects and Kanzaki method.

PACS Nos. : 61.72.Ji, 62.20.–x

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Azimuthal angle dependence of two and three particle dynamical correlation among target fragments in ^{28}Si-AgBr interactions at 14.5 AGeV

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Abstract : This paper reports an investigation on the two particle and three particle short range dynamical angular correlation in emission angle space among the target fragments produced in ^{28}Si-AgBr interactions at 14.5 AGeV on different range of azimuthal angles $0° \leq \phi \leq 90°$, $90° \leq \phi \leq 180°$, $180° \leq \phi \leq 270°$ and $270° \leq \phi \leq 360°$. The experimental data have been compared with the Monte Carlo simulated events to extract dynamical correlation. The analysis reveals that both two and three particle dynamical correlation among target fragments depend on the azimuthal angle space.

Keywords : Target fragmentation, correlation, azimuthal angle dependence.

PACS Nos. : 25.75–q, 25.70.Mn

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Optical model studies for elastic scattering of protons

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Abstract : The angular distribution of protons elastically scattered from ^{12}C, ^{16}O, ^{27}Al, ^{28}Si, ^{40}Ca, ^{58,60,62,64}Ni, ^{63,64,65}Cu, ^{64,66,68}Zn, ^{90}Zr, ^{108}Ag, ^{116}Sn, ^{197}Au, ^{208}Pb at different energies ranging from 28 MeV to 61.4 MeV, have been analyzed in terms of the spherical optical model. Independent energy search at each energy and common geometry optical model calculations have been performed. An over all satisfactory agreement has been obtained. The best fit parameter values of the depth, radius and diffusivity of all the real, imaginary and spin orbit parts of the potential are obtained by the method of least square. Systematic trends of variation of different potential depths are investigated. Imperical formulae have been developed for the real potential depths of the proton scattering.

Keywords : Optical model potential, sensitivity of potential parameters.

PACS Nos. : 25.70.–z, 27.50.+e, 24.10.Ht, 25.55.Ci

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LMA MSW solution from the inverted hierarchical model of neutrinos

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Abstract : We examine whether the inverted hierarchical model of neutrinos can explain the large mixing angle (LMA) MSW solution of the solar neutrino problem or it is completely ruled out. The left-handed Majorana neutrino mass matrix for the inverted hierarchical model is generated through the seesaw mechanism using the diagonal form of the Dirac neutrino mass matrix and the non-diagonal texture of the right-handed Majorana mass matrix. In a model-independent way, we construct a specific form of the charged lepton mass matrix having a special structure in 1–2 block, which contribution to the leptonic mixing (MNS) matrix leads to the predictions $\sin^2 2\theta_{12} = 0.8517$, $\sin^2 2\theta_{23} = 0.9494$ and $|V_{e3}| = 0.159$ at the unification scale. These predictions are found to be consistent with the LMA MSW solution of the solar neutrino problem. The inverted hierarchical model having opposite signs of mass eigenvalues generally gives stability against the quantum radiative corrections in the MSSM. A numerical analysis of the renormalisation group equations (RGEs) in the MSSM shows a mild decrease of the mixing angles with the decrease of energy scale and the corresponding values of the neutrino mixings at the top-quark mass scale are $\sin^2 2\theta_{12} = 0.8472$, $\sin^2 2\theta_{23} = 0.9399$ and $|V_{e3}| = 0.1509$ respectively.

Keywords : Majorana neutrino mass, inverted hierarchical, mixing angles, mass eigenvalues, radiative correction.

PACS Nos. : 12.10.Dm; 12.15.Ff; 14.60.Pq