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Appendix

Abstracts & Titles, No. 71~74

BULLETIN OF THE FACULTY OF ENGINEERING HOKKAIDO UNIVERSITY NOTICE

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Outline of Damage to Buildings due to the Nemurohanto-oki Earthquake of June 17, 1973

Takuji SHIBATA, Osamu JOH

Abstract

On June 17, 1973, an earthquake with a magnitude of 7.4 occurred off the Nemuro Peninsula. The seismic intensity in the areas of Nemuro-shicho and Kushiro-shicho was announced as V according to Japanese seismic scale.

This earthquake was scrutinized from a view point of geophysics and seismology rather than building engineering because the occurrence of the earthquake was predicted by some geophysicists. Although the degree of the damage to buildings was generally rather minor, some valuable suggestions for disaster prevention are given from the phases of damage to buildings and chimneys.

The paper is a general report of an investigation on the damage to buildings due to the present earthquake.

Multi-phase diffusion in the Cu-Zn system

Yasuhiro FUNAMIZU, Katsuya WATANABE

Abstract

Multi-phase diffusion in the Cu-Zn system was investigated in a temperature range of 300° to 400°C.

All of the three intermediate phases, namely β' , γ and ϵ , existing in the equilibrium phase diagram, were observed in the diffusion zone within the limit of this experiment. The rate of layer growth for β' phase was very slow compared with the rate of the other two phases. It may safely concluded that the growth of each intermediate phase was controlled by the process of volume diffusion since the rate of layer growth obeyed the parabolic law. The apparent activation energies found for the growth of γ and ϵ phases are 12.7 and 22.3 kcal/mol, respectively.

The interdiffusion coefficients for γ and ϵ phases at each temperature increased with the increase of Zn concentration, and this tendency was most remarkable at γ phase. The activation energies for interdiffusion in γ and ϵ phases were estimated from the temperature dependence of the interdiffusion coefficients. The energy for γ phase decreased with the increase of Zn concentration from 28 to 19 kcal/mol. On the contrary, it can be considered that there is a lesser effect of concentration on the activation energy for ϵ phase.

The Kirkendall effect showed that Zn atoms diffused predominantly in this system.

The concentrations of the phase boundaries in γ and ϵ phases shifted to the zinc side by about one or two atomic percent compared with the equilibrium values.

Dynamic Behavior of a Body Colliding with a Stretched Cable

Toshihiro IRIE*, Gen YAMADA* and Kazuhiko MURASE**

Abstract

In the present paper, fundamental equations were derived for studying the motion of a body colliding with a stretched elastic cable and the resulting variation of the cable tension produced by the collision. For the simplicity of theoretical treatment, it is assumed that the body moves in a plane including the cable and that no other forces act on the body except the reaction and frictional forces of the cable. And the effects of inertia and bending rigidity of the cable are neglected.

The motion of a mass point and a rectangular body which collides with a cable is simulated on digital computer and the results were found to agree with that of the experiment obtained on some models qualitatively. The following conclusions were obtained from the study. When the initial velocity of the body and the angle between the cable and body are larger, the deflection and tension of cable become larger. In contrast, when the angle is larger, the length which the body slides along the cable becomes shorter. The frictional force between the body and cable does not have a large effect on the deflection, but the distance which the body slides along the cable is shortened to some extent when the coefficient of friction increases.

On the Dynamic Response of a Thin Cylindrical Shell to Pulse Loading

Toshihiro IRIE*, Gen YAMADA* and Yasuo YANAGI*

Abstract

According to Flügge's method, the equations of motion are derived, for the purpose of theoretical studies of the deflection and stress of thin cylindrical shell caused by pulse load acting on a narrow surface. The solution is expressed by Fourier series in a general form which can be applied to the studies of the dynamic response to any transient loading under arbitrary boundary conditions. The response function is obtained on a circular cylindrical shell with a simple support at both ends, when the half-sinusoidal side pressure acts inwards on a square surface area located at the midpoint of the cylinder.

The following conclusions are obtained from the numerical calculation based on the theory. Tensile stress occurs on the inner surface and compressive stress occurs on the

outer surface. The maximum deflection and stresses occur immediately after the end of loading and remarkable deformation and stresses are produced in a range of two or three fold loaded surface during a double loading period. When the duration of loading becomes short, the deflection and stress levels increase and the time at which the maximum stresses occur becomes fast. The result of the numerical calculation agrees with that of the experiment qualitatively.

Thermal Stresses in an Infinite Medium with a Spherical Cavity

— Quasi-Static Solutions in the Thermoelastically Coupled Field —

Masashi DAIMARUYA, Hiromasa ISHIKAWA and Kin-ichi HATA

Abstract

The present paper is concerned with the coupled thermoelastic problem of an infinite medium with a spherical cavity, whose surface is suddenly subjected to uniform heating. The medium is assumed to be undisturbed and at a constant temperature initially. The solution is developed by using the method of thermoelastic displacement potential and the Laplace transform. The results are compared with those in the absence of thermoelastic coupling.

The rule of superposition of solutions does not hold for a coupled thermoelastic problem and the method of thermoelastic displacement potential can not generally be applied to the problem of this kind, however in problems of infinite or semi-infinite media this method comes into force and as a result solutions can readily be obtained. The thermoelastic coupling effect arising as a consequence of the coupling between the strain and temperature fields is essentially the damping effect for temperature and displacement, and also acts on the stress distributions with a similar effect.

On Some Examples of Generalized Sampling Theorem

Ei Iti TAKIZAWA*, Shih Ming HSIEH**, and Jyi Cherng HORNG***

Abstract

New examples of the generalized sampling theorem are given, in which a function can be reconstructed from its sampled values and sampled derivatives. The formulae presented here can be used effectively as interpolation or extrapolation formulae. Especially, a sampling formula, which contains a generalized sampling function of polynomial form, can be used as an extrapolation formula.

Study of Chemoforming

—A Process for Improving a Deposition Rate—

Noriko KUSANAGI and Toshikazu SATO

Abstract

A chemoforming method which has recently been attracting attention, shows advantages because the thickness of the deposited layer is uniform and has little internal stresses during the plating process. On the other hand, one of its defects is that the deposition rate is relatively low.

The object of this study was to investigate a chemoforming process which makes it possible to increase the deposition rate. A process in which a flowing plating solution was used to increase the deposition rate gave a deposition rate several times as large as that of the conventional immersion process.

In this paper, the results of studies of the deposition rate mentioned is described, and the mechanical features of these deposited layer were studied and interpreted in terms of the deposition rate dependence. The effect of heat treatment on the mechanical feature is also described.

Parameter Identification of a Non-Linear Dynamic System

Akihiko SATO and Shoichi KOYAMA

Abstract

This is a report on parameter identification of a non-linear dynamic system, which will describe a certain type of catalytic reaction system. This discussion was not made from a chemical point of view but by a technique which involves a reasonable set of parameters where the solution of least squares fit the experimental data by means of considering the mathematical model of a given reaction system. The main purpose of this paper is to find an efficient probing method for parameter identification of such non-linear dynamic systems dealt with here. For this reason we examined the contour lines of an error surface in detail of a given example. The model was simulated on a hybrid computer and a digital computer.

A Method of Calculating a Magnetic Field Taking into Account the Hysteresis Effect

—Simulation of Variation in Time and Space—

Hiroshi TODA, Ichiro FUKAI, Norinobu YOSHIDA and Jun-ichi FUKUOKA

Abstract

In the simulation by numerical computation of transient phenomena of a magnetic field in a magnetic medium, the hysteresis characteristics for each step of computation must be determined. In this paper we have presented an efficient algorithm for the computation of the hysteresis characteristics, led forth by approximating the hysteresis loop as a line which passes the follows two points namely the residual magnetic flux density and coercive force, on a B-H plane. Further we have presented the transient solution of a magnetic field distribution for a sinusoidal magnetizing input computed by this method.

An Attempt to recording CNV

Fumio MORI

Abstract

A preliminary experiment was conducted to investigate the effects of Stimulus-Response relation upon CNV by means of simple verbal conditioning. The subject was a healthy student and the recording was carried out using a 13 channel EEG equipment coupled with ATAC-501-10 type mini-computer. During the experimental series a flash light was used as the stimuli and the subject was required to count the number of flashes.

One hundred responses were summed up for each of the average responses. The results were obtained in the form of evoked potential on photographs through a memoscope. It is assumed that the CNV appear precisely in the case of S_1 - S_2 -R (R: verbal counting) only and thus, it is necessary to design the trigger device according to this data and to examine the nature of CNV more exactly.

Base-Loading-Antenna for a Slots-unipole Antenna System

Kiyohiko ITOH, Ryuichi WATANABE, Kaijiro NAKAOKA,
Tadashi MATSUMOTO

Abstract

Radio signal received by moving vehicles in mountainous regions or in cities with high buildings may exhibit violent amplitude fluctuations because of the existence of standing-wave patterns. An Energy density antenna system which samples the electromagnetic energy density was suggested as a means for coping with this spatial fading phenomenon.

One of the authors has proposed a unipole and crossed slots combination as a new and universal energy density antenna system. It was also reported that a shallow-cavity-backed

slot antenna is convenient as the slot for the above mentioned slot and unipole combination system.

This report deals with the mechanism of a unipole antenna, at the base of which a rectangular cavity is located, and it was clarified that the unipole antenna is suitable for mounting on a mobile unit because it is possible to shorten its height by means of using the shallow-cavity as a inductance.

The measured and calculated results of the shortening and the matching at a feeding point are also described.

Slot Antenna Excited by a Strip Transmission Line

Kaijiro NAKAOKA, Ken-ichi KIMURA, Kiyohiko ITOH
and Tadashi MATSUMOTO

Abstract

Recently, antennae fabricated on metallized dielectric substrates, printed-antennae, have attracted special interest. This type of antenna has an advantageous point in that it is used in common with Microwave Integrated Circuits.

Printed antennae can be classified into the following two types (models) according to their structure; these are cases utilizing linear antenna and slot antenna. We have continued our investigation on the later antenna namely a printed slot antenna. As a result of our series of studies it was clarified that the most difficult problem in the development of this antenna was the feeding-method. To solve this problem, we have previously proposed a method utilizing a slot transmission line as the feeder line, and in the present paper we have proposed a method utilizing coupling between the transverse magnetic field of a unbalanced strip line and slot. As reports of this type of theoretical and experimental study have apparently not been published to date, we have performed a few experiments on the feeding method. As a result, it was noted that this method extremely enhanced the matching between a slot antenna and a strip feeder line. Therefore in this report we described our detailed experimental results on the input impedance of a printed slot antenna.

We are of the opinion that our experimental results may be applied extensively in the designing of a printed slot antenna array in the future.

A Consideration on the Image Resolution of Wavelength-Order Objects in Long-Wavelength Holography

Yoshinao AOKI

Abstract

A consideration on the image resolution of wavelength-order objects was conducted in

long-wavelength holography using sound-waves and radio-waves. A general consideration was conducted with reference to the experimental results of sound-wave holography and in addition an ideal hologram with an infinite aperture was analyzed theoretically. The analysis was done by estimating the spatial frequency components which propagate through free space between the object and the hologram plane and are recorded on the hologram. The obtained result shows that a free space can be considered as a filter which cuts off the spatial frequency components higher than the inverse of a wavelength. A transfer function of the free space was obtained and a discussion on the image resolution based on this transfer function was conducted. The relation between the image resolution and reactive energy stored by the object is also discussed.

Minimum Fluidization Velocity at Room and High Temperature and an Estimation of Terminal Velocity from said Velocity

Osamu UEMAKI, Satoru KATO and Masao KUGO

Abstract

An equation was derived to represent the relationship between the terminal velocity (U_t) and the minimum fluidizing velocity (U_{mf}) in an intermediate flow region, correlating the force acting on a particle in suspension with that of each constituent particle in the fluidized bed which includes the voidage function as well as the segregation factor. In order to confirm the validity of this equation Bourgeois' experimental equation and data were used from the literatures.

The effect of the fluidizing gas temperature on the U_{mf} was investigated and a modified theoretical equation was proposed for estimating U_{mf} at a temperature as high as 800°C.

It was shown that U_t can be predicted readily by application of this equation for U_{mf} and the above mentioned equation represents the correlation of U_t with U_{mf} .

Softening and Fluidifying Properties of Glasses in the System R_2O - PbO - SiO_2

Toru MATSUSHITA

Abstract

It is the purpose of this paper to investigate the suitable chemical composition of glass binder for the use of glass bonded fluorphlogopite mica in the system R_2O - PbO - SiO_2 .

Softening temperature T_1 (viscosity about 5×10^7 poise) and fluidifying temperature T_2 (viscosity about 3×10^2 poise) of glass were measured using a simple method. B , a closely related value to the activation energy of glass viscosity, was calculated by the following equation:

$$\eta = A \exp(B/T)$$

where η is viscosity, T is the absolute temperature, and A is constant.

It was found that glass with a composition of $\text{PbO} \cdot \text{SiO}_2$ had low values of T_1 and T_2 , and low devitrifying properties in the system $\text{PbO} \cdot \text{SiO}_2$, hence the relations of T_1 , T_2 and B with glass composition in the system $x\text{R}_2\text{O} \cdot (1-x)\text{PbO} \cdot \text{SiO}_2$ were examined.

In the system $x\text{Li}_2\text{O} \cdot (1-x)\text{PbO} \cdot \text{SiO}_2$, $x\text{Na}_2\text{O} \cdot (1-x)\text{PbO} \cdot \text{SiO}_2$ or $x\text{K}_2\text{O} \cdot (1-x)\text{PbO} \cdot \text{SiO}_2$, T_1 , T_2 and B were decreased with increase of x up to x value of 0.1, 0.4 or 0.15 and were increased above that value with the deposition of Li_2SiO_3 , Na_2SiO_3 or $\text{K}_2\text{O} \cdot 2\text{PbO} \cdot 2\text{SiO}_2$ in glass, respectively.

From the experimental result described above, it is conjectured that a suitable composition range for binder glass is within 0.1, 0.4 or 0.15 of x in the Li_2O -, Na_2O - or K_2O -system, respectively.

Rate of Chlorination Reaction of MgO

Tadao ISHII, Ryusaburo FURUICHI, Yoshiyuki KOBAYASHI
and Shiro SHIMADA

Abstract

The chlorination reaction of MgO with Cl_2 -gas was investigated by using an apparatus designed to be applicable to DTA and isothermal measurements. In a temperature range from 25 to 970°C, MgO samples mixed with carbon showed exothermic DTA peaks of chlorination reaction with varying peak temperatures and a change in mixing molar ratio of C/MgO; 530, 485 and 475°C for C/MgO=1, 2 and 3, respectively. No DTA peak was observed in the sample of C/MgO=0. X-ray analysis of this sample showed a very small amount of MgCl_2 formation after heating the sample up to 970°C in Cl_2 , in contrast with the samples containing carbon which showed 45–49% of MgCl_2 formation.

An exact determination of isothermal chlorination of $\text{MgO} \cdot \text{C} \cdot \text{Cl}_2$ system was not possible because of the initial temperature increase arising from the reaction heat. Hence isothermal reaction kinetics were examined by making approximations of the reaction temperatures. From tests of 9 kinetic equations, Jander's equation was found to give the most reliable data and the activation energies estimated were 43.6, 45.8 and 62.2 kcal/mol for C/MgO=0.5, 1 and 2, respectively. The role of carbon in the reaction was assumed to be expressed by $\text{MgO} + \text{C} + \text{Cl}_2 \longrightarrow [\text{MgCl}_2 \cdot \text{O}^*] + \text{C} \longrightarrow \text{MgCl}_2 + \text{CO}$.

The Thermal Decomposition Behavior of Oxalates (MC_2O_4 , $M = Fe, Ni, Cu, Zn$) in the Presence of Potassium Chlorate

Tadao ISHII, Ryusaburo FURUICHI and Chiyokazu OKAWA

Abstract

The thermal decomposition of oxalates ($MC_2O_4 \cdot nH_2O$, $M = Fe, Ni, Cu, Zn$) and their mixtures with $KClO_3$ were investigated by means of gas-flow DTA, x-ray diffraction, IR analysis, and gas-analysis. In flowing N_2 (60 ml/min) and static air, the oxalates decompose to show an endothermic DTA peak arising from the dehydration of crystallization water and another endothermic peak was seen arising from the decomposition of $FeC_2O_4 = FeO + CO_2 + CO$, $NiC_2O_4 = Ni + 2CO_2$, $CuC_2O_4 = Cu + 2CO_2$ and $ZnC_2O_4 = ZnO + CO_2 + CO$. Gas-analysis revealed that a small amount of CO and/or CO_2 were evolved near the end of the dehydration process by partial decomposition of oxalates. In the flowing O_2 (60 ml/min), all DTA curves of oxalates except for Zn-salt show an explosive exothermic peak immediately after the dehydration peak. This exothermic peak results from the oxidation of FeO, Ni and Cu, and the heat of oxidation led to the acceleration of subsequent decomposition.

All oxalates containing $KClO_3$ (10–15mol %) show a sharp exothermic peak (P_M) in flowing N_2 over a temperature range of 330–360°C. Since pure $KClO_3$ does not show any DTA peaks in this temperature range, P_M was assumed to be attributable to the mutual interactions of oxalate and $KClO_3$.

FeO obtained by rapid cooling after the decomposition of FeC_2O_4 in flowing N_2 is ignitable in air, but not when it was cooled slowly over a period of 4–5 hours.

Pulsed Cold Neutron Source in Hokkaido University LINAC

Kazuhiko INOUE, Norio OTOMO and Hirokatsu IWASA

Abstract

A description is given of the design and operation of the pulsed cold neutron source in Hokkaido University LINAC. The cold moderator is solid methane, which is condensed and cooled by cooled helium gas. For the energy region below 1 meV the cold neutron beam flux is increased by a factor of 40. The high cold neutron intensity obtained is at present utilized for cold neutron time-of-flight experiments. An operational stability and safety of the facilities are recognized during operation of about 150 hours.

Studies of the Cracking Reactivity of Organic Sulfur Compounds (Part 1)

—Thermal Cracking Reactivity of Aliphatic Mercaptans
in the Absence of Catalyst—

Masatoshi SUGIOKA and Kazuo AOMURA

Abstract

The thermal cracking reactivity of various aliphatic mercaptans in a helium stream was investigated with a pulse reactor.

The order of the thermal cracking reactivity was as follows:



A linear relationship was observed between the logarithms of the apparent first order rate constants of this reaction of aliphatic mercaptans and the bond dissociation energy of c-s bond in mercaptan molecules as shown in the following equation,

$$\log k = c_1 - c_2 D(c-s) / 2.303 RT$$

where c_1 and c_2 are constants.

From this result, it was concluded that the thermal cracking reactivity of aliphatic mercaptans depend on the bond strength of the c-s bond in mercaptan molecule.

Studies of the Cracking Reactivity of Organic Sulfur Compounds (Part 2)

—Catalytic Cracking Reactivity of Aliphatic Mercaptans and
Sulfides on Solid Acid Catalyst—

Masatoshi SUGIOKA and Kazuo AOMURA

Abstract

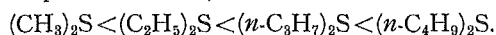
The catalytic cracking reactivity of various aliphatic mercaptans and sulfides on silica-alumina catalyst was investigated with a pulse reactor.

The orders of the cracking reactivity were as follows:

Aliphatic mercaptanes;



Aliphatic sulfides;



These orders were also in parallel with the order of the stability of alkyl carbonium ion. Linear relationships were observed between the logarithms of the apparent first order rate constants of aliphatic mercaptans and sulfides and the enthalpy change in the reaction of the

hydride abstraction from the corresponding paraffins as shown in following equation ;

$$\log k = c_1 - c_2 \Delta H c^+ / 2.303 RT$$

where c_1 and c_2 are constants.

From these results, it was concluded that the cracking reactivity of aliphatic mercaptans and sulfides on silica-alumina catalyst depend on the stability of the carbonium ion which is produced from mercaptan and sulfide molecules.

Studies of the Cracking Reactivity of Organic Sulfur Compounds (Part 3)

—Hydrocracking Reactivity of Organic Sulfur Compounds on Desulfurization Catalysts—

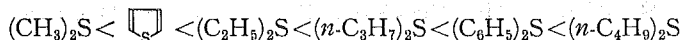
Masatoshi SUGIOKA and Kazuo AOMURA

Abstract

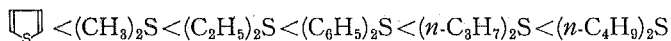
The hydrocracking reactivity of various organic sulfur compounds on the desulfurization catalysts such as Co-Mo-Al and NiS-SA was investigated with a pulse reactor.

The order of the hydrocracking reactivity of organic sulfur compounds on these catalysts in the range of 300°C–400°C were as follows :

on Co-Mo-Al catalyst,



on NiS-SA catalyst,



The order of hydrocracking reactivity of these sulfur compounds on these two catalysts were similar to each other.

Further, linear relationships were observed between the logarithms of the apparent first order rate constants in the hydrocracking of these sulfur compounds on these desulfurization catalysts and the bond dissociation energy of the c-s bond in these molecules as shown in the following equation ;

$$\log k = c_1 - c_2 D(c-s) / 2,303 RT$$

where c_1 and c_2 are constants.

From these results, it was considered that the hydrocracking reactivity of organic sulfur compounds in petroleum on desulfurization catalyst can generally be expressed by the bond dissociation energy of the c-s bond of organic sulfur compounds.

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On Stress Analysis of the Multi-Cell Walled Cylinder by Means of Folded Plate Theory

Sumio. NOMACHI Kouji SAKAI

Abstract

The stress analysis of a cylinder having a wall of multi-trapezoidal cells, which may consist of many long strip elements, is dealt with in this paper. The mode of finding a solution to the problem is based on the displacement shear equation for plane stress and a modified slope deflection equation for the bending of the plate.

Thus the equilibrium of forces at the nodal point are expressed by eight simultaneous finite difference equations with respect to the displacements and the slopes, which are dealt with by finite Fourier transforms in the longwise direction and Fourier finite integration transforms in the circumferential directions.

The above was carried out and the program for the electric computer was found to be simple. The obtained results are illustrated in the last part.

On the Dynamic Response of a Vibro-Impact System to Random Force

Toshihiro IRIE* Gen YAMADA*
and Harumi MATSUZAKI**

Abstract

A method of calculation was established for studying the dynamic response of a mechanical system with a play to arbitrary exciting forces. A computer simulation was carried out on the stationary response of a single degree-of-freedom vibro-impact system to ergodic stationary random input and a harmonic force superimposed by random input.

The following conclusions were obtained from the study. When the stationary random force acts on the system with a play, the power spectral density of the dynamic response is large in the vicinity of the resonance frequency of the vibro-impact system. The colliding velocities and the time intervals between two adjacent collisions become smaller, with the decrease of the play. When a harmonic force superimposed by random force acts on the system, the stationary fundamental and super/sub-impact vibrations are caused at some probabilities in the system. The contour maps made on these probabilities show that the stationary impact vibration of each type is caused at high probability in the system causing a corresponding impact vibration at high stability under the action of a harmonic force.

Experimental Consideration for "Sensing Zone" of Bistatic Radar Sensor

Hidenobu HONDA, Kiyohiko ITOH,
Takao SAITOH, Tadashi MATSUMOTO

Abstract

Various memoirs on the application of Bistatic Radar to a radar sensor for automobiles have been reported.

In designing such a system, two important problems appear, namely (1) the method of determination of the service area and (2) clarification of what type of information is required for the judgement of unavoidable collisions. Originally, it is more feasible to analyze the subject of region on a road surface experimentally.

In this paper, a system with two pairs of Bistatic Radars is discussed and the former was especially considered.

Two pairs of horn antennas are required in this system, thus patterns of the "highly sensitive sensing zone" are optically represented.

This optical representation may also be applied to the measurements of other antenna patterns with respect to dependence on range and angle.

Statistical Consideration of Some Signal Reception Systems in Mobile Radio Communication

Kiyohiko ITOH

Abstract

In mobile radio communication a three-element energy density antenna responding to the total electromagnetic energy density offers a means of coping with fading in a standing-wave environment caused by multiple reflections from surrounding objects. Statistical analyses provides evidence indicating that the energy density antenna works well as an anti-fading antenna.

This report statistically considers some signal reception systems analogous to the energy density antenna, all of which have only two square law detectors hence making it economical.

System Diagnosis Under a Given Set of Observable Vertices

Yoneki TAHARA* Masakazu SENGOKU**

Abstract

Some systems (for example, computer structures, computer programs and control systems) can be represented by blocks and links where a block performs a certain function and a link transmits information between two blocks. Linear graphs corresponding to a system are obtained by using vertices for blocks and edges for links. The purpose of system diagnosis is to find the fault vertices in the graph. In some systems, the output signal of all vertices in the graph cannot be always monitored. For a set T of observable vertices, some subsets of T give the same D -partition as T . In this paper, an algorithm giving the optimum internal test terminals T_0 , which is a subset of T giving the same D -partition as T in which the number of elements is minimal is presented.

The Properties of Vacuum Deposited CdSe Films

Osamu SAKAI Yoshihiko OGAWA Teiichi KUROBE

Abstract

This paper presents the crystallographic and electrical properties of CdSe films prepared by a vacuum evaporation.

we employed electron diffraction and x-ray diffraction patterns to analyze the structure of the CdSe films.

The Hall effect and resistivity measurements were carried out for these films at various substrate temperatures. Furthermore, temperature dependence of resistivity from room temperature to liquid nitrogen temperature and photoconductivity characteristics were investigated for the samples under different conditions of evaporation and heat treatment processes. From the result of these measurements, we have discussed the conduction mechanism of CdSe films using a band model.

Two-Dimensional Fast Fourier Transform with Data of Arbitrary Sampling Number (3)

— Its Application for Chinese-Character Recognition —

Hajime NAKATANI Yoshinao AOKI

Abstract

An application of a two-dimensional fast Fourier transform for Chinese-character recognition is discussed. The character recognition is done by a cross-correlation operation with two sampled and quantized Chinese-character patterns. The cross-correlation is calculated by a two-dimensional fast Fourier transform algorithm to shorten the execution time. It is shown that the mode of the sampling of original patterns has a great influence on the recognition process. By taking a suitable sampling number, the recognition time is shortened without decreasing the recognition accuracy, resulting in an increase of the recognition efficiency.

Softening and Fluidifying Properties of Glasses in the System (MgO, ZnO, CdO or CaO)-PbO-SiO₂

Toru MATSUSHITA

Abstract

Softening temperature T_1 (viscosity approx. 5×10^7 poise), fluidifying temperature T_2 (viscosity approx. 3×10^2 poise) and B (an exponent in the equation of viscosity: $\eta = A \exp. (B/T)$) of glasses in the system R_2O -PbO-SiO₂ have been previously reported by the author. In the present experiments, the relation of T_1 , T_2 and B with glass composition in the system $xRO \cdot (1-x) PbO \cdot SiO_2$ were examined.

It was observed within the limits of the present experiments that glasses in the system $xCaO \cdot (1-x) PbO \cdot SiO_2$ had the highest devitrifying properties and those in the system $xZnO \cdot (1-x) PbO \cdot SiO_2$ did not devitrify, and in the system $xMgO \cdot (1-x) PbO \cdot SiO_2$, some of MgO remained in glasses as dispersed fine particles.

In the MgO- and ZnO-system, T_1 , T_2 were gradually increased with the increase of x , and B linearly decreased. In the CdO-system, T_1 , T_2 and B increased with the increase of x ,

The results of the calculation from the experimental data showed that changing rates of B with x were $-0.76_0 \times 10^4$ in the MgO-system, $-0.42_4 \times 10^4$ in the ZnO-system, and $+0.45_6 \times 10^4$ in the CdO-system. Because the value of B is proportional to the activation energy of glass viscosity, it is assumed that Mg ion ranks first in the destructive ability

to the glass network, and is followed by Zn ion and Cd ion in the inverse order of their electro negativities.

From the facts described above, it was concluded that the ZnO-system was the most suitable composition for use as binder glass among the above mentioned systems.

Untersuchung über Triazin-derivaten (IV)

Die Reaktion von Benzoguanamin mit Salpetrigersäure

Yoshiyuki TAKATA Kazuo TAN Eiji SATO

Zusammenfassung

Wir haben beobachtet, daß Benzoguanamin (1 mol) bei der Einwirkung von Natriumnitrit (1–1.3 mol) in verdünnter Salzsäure bei 70°C als Hauptentstehungsprodukt 2-Amino-4-hydroxy-6-phenyl-s-triazin, geringe Menge von Molekul-verbindung des Benzoguanamin mit 2, 4-Dihydroxy-6-phenyl-s-triazin (Molekularverhältnis 1 : 1), Fp. 264°C, und eine Verbindung von Fp. 220°C, die chemische Struktur noch nicht erkannt wird, liefert.

Das Hauptentstehungsprodukt der Reaktion von 1 mol Benzoguanamin mit 2.3 mol Natriumnitrit in verdünnter Salzsäure bei etwa 70°C war 2-Amino-4-hydroxy-6-phenyl-s-triazin und die Ausbeute von 2, 4-Dihydroxy-6-phenyl-s-triazin war schlecht.

Die Reaktion von 2-Amino-4-hydroxy-6-phenyl-s-triazin mit Salpetrigersäure verlief mit Schwierigkeit; daher war die Ausbeute von 2, 4-Dihydroxy-6-phenyl-s-triazin gering.

Synthese von Carbonsäurechloriden durch Reaktion der Carbonsäuren mit Schwefelmonochlorid IV

Synthese von Iso- und Terephthalsäuredichlorid

Toshio MATSUDA Shoichi NARUSE
Ikko HAYASHI, Yoshiyuki TAKATA

Zusammenfassung

Wir untersuchten die Reaktionsbedingungen für Synthese von Säurechloriden durch Reaktion von Iso- und Terephthalsäure mit Schwefelmonochlorid.

Isophthalsäuredichlorid wurde mit 90%iger Ausbeute erhalten, wenn man 0,1 mol Isophthalsäure, 0,3 mol Schwefelmonochlorid und 0,2 g Eisen(II)-chlorid als katalysator 3 Stunden auf 130–140°C erwärmte.

Beider Synthese von Terephthalsäuredichlorid wirkte Eisen (III)-acetat-katalysator stärker als Eisen (II)-chlorid-Katalysator. 0.1 mol Terephthalsäure, 0,3 mol Schwefelmonochlorid und 0,2 g Eisen (III)-acetat wurde 5 Stunden auf 120–130°C erwärmt. Terephthalsäuredichlorid wurde mit 90%iger Ausbeute erhielt.

Wir fanden, daß Eisenpulver, Eisen (II)-sulfat, Eisen (III)-sulfat, Eisen (II)-oxalat, Eisen (II)-format und Eisen (III)-chlorid die katalytische Wirkung für Entstehung von Säurechlorid durch Reaktion der Terephthalsäure mit Schwefelmonochlorid.

Computer Programmes for Calculation of the Nuclear Magnetic Double Resonance Spectra

Hiroiyuki FUKUI* Junkichi SOHMA**

Abstract

A theory of nuclear magnetic double resonanre was developed in the present paper with the time-dependent Schrödinger equation in a form convenient for digital computation. It was shown that the two signals can arise by transition between the two states.

A computer programme "NMDR" based on the theory was written. The flow chart of this programme is given in Fig. 1 in the text. The programme NMDR is available for double resonance spectra of the all types of spin systems up to six spins having $I = 1/2$. This programme was applied to the calculation of the double resonance spectrum of 3-methyl-pyrrole and shown to be of high utility. The observed and calculated spectra of the N-H proton of 3-methyl-pyrrole are given in Fig. 2, in which the ^{14}N nucleus and methyl protons were decoupled and the 5th proton was perturbed. The theoretical spectrum (b) is in good agreement with the observed spectrum (a).

A Study of Hindered Rotations in Methylbenzenes by Total Cross Sections of Cold Neutrons

Kazuhiko INOUE

Abstract

The hindrance of internal rotation of methyl-groups in methylbenzenes was investigated in this paper by the total scattering cross sections of cold neutrons. The height of the methyl-group potential in the case of C_6 point groups is lower than that in the case of C_3 point groups.

A Numerical Method for the Time-dependent Neutron Transport Equation

Norio OTOMO* Kazuhiko INOUE*

Abstract

It was once suggested that the time-dependent multi-group neutron transport equation in finite, non-multiplying, isotropic homogeneous media can be solved analytically in a given small time interval and that the solution at any time can be obtained by the iterative procedure. This paper describes a more general formulation. The accuracy of the present method is higher, and we have shown here that the well-known direct integration method, in approximation can be obtained from our formulation.

Decay of Slow Neutron Pulses in Cold Moderators

Tadashi AKIMOTO* Yuichi OGAWA* Takashi SAITO**

Abstract

The decay constants of neutrons in methane, ethane and light water at various low temperatures were obtained by experimentation and calculation. A simple method for estimating the cooling limited temperature of neutrons using the decay constant was set forth. The investigation showed that solid methane is a favorable moderating material for a pulsed cold neutron source, judging from the decay constant and the cooling limited temperature of neutrons.

Dissolution of Zirconium in Aqueous Solutions of Ammonium Fluoride and Hydrofluoric Acid

Takashi MOROZUMI Makoto MORIYA Toru KUBO

Abstract

The dissolution rate and the corrosion potential of zirconium were measured in aqueous solutions of ammonium fluoride and hydrofluoric acid at 30°C. The dissolution was rapid and uniform in both solutions, and the rate increased remarkably with the increase in concentrations of the solutions. In the case of ammonium fluoride solution, the pH of the solution also showed an influence on the dissolution rate. The dissolution

rate may be closely connected with the concentration of hydrogen fluoride existing in the form of neutral molecules in the solutions. In a thermodynamical sense, the depassivation by fluorides may be attributed to the formation of soluble fluoro-zirconium complexes. However, in order to explain the highly aggressive attack of fluorides on zirconium, certain dissolution mechanisms, in which the molecular HF or other fluoro-compounds can take a share of their contribution, must be assumed.

Study on Oxidation of Iron by the Mössbauer Spectroscopy

Hiroshi OHASHI Masanori KOIZUMI Takashi MOROZUMI

Abstract

Iron foil of $9.3\ \mu\text{m}$ in thickness was oxidized in an oxygen atmosphere of 680 Torr at temperatures between 300 and 600°C. The Mössbauer spectra of oxidized specimens were observed as a function of the duration of oxidation. At temperatures higher than 400°C, Fe_3O_4 and $\alpha\text{-Fe}_2\text{O}_3$ were mainly identified as the oxidation products, but no change of the spectrum was observed by heating for 20 days at 300°C. As a result of analysis of the spectra, it was clarified that the oxidation occurred from Fe to $\alpha\text{-Fe}_2\text{O}_3$ through an intermediate Fe_3O_4 as a typical successive reaction at 500 and 600°C. The parabolic rate law fairly well satisfies the oxidation from Fe to Fe_3O_4 at 400°C and that from Fe_3O_4 to $\alpha\text{-Fe}_2\text{O}_3$ at 500°C. The temporary appearance of $\alpha\text{-Fe}_2\text{O}_3$ peaks in the initial stage of oxidation at 400°C was explained by assuming two competitive diffusion processes of Fe^{2+} through the Fe_3O_4 phase and O^{2-} through the $\alpha\text{-Fe}_2\text{O}_3$ phase.

Studies on Density Current (4)

— On the Relationship between the Coefficients of the
Entrainment and the Interfacial Resistance —

Masakazu KASHIWAMURA

Abstract

The mechanism of mixing seems to be one of the most important problems, in connection with the studies on problems of buoyant jet or forced plumes, and numerous work have been made on this subject, from a viewpoint of entrainment current. Here the main stream is considered to set the surrounding fluid in motion, and to entrain it, under the assumption that the velocity of the mainstream is proportional to the velocity

of the induced current which mixes into the stream. The coefficient of this proportionality is referred to as the entrainment coefficient, which has proved to be quite useful in the solving of such problems.

On the other hand, there is another approach, particularly on the problems of a two-layer flow, from a viewpoint of balance of forces. For example, the shape of a salt-wedge or its length has been discussed with the shear stress acting on the interface in fresh water and salt water. The coefficient of the interfacial resistance gives the proportionality between the shear stress and the square of the velocity difference of the two layers.

As a result of the theoretical considerations on the loss of the energy head, this paper reveals that those two coefficients, which have been developed in different ways, are essentially of the same character with each other. This conclusion seems to play a very important part to unify the two groups of the different means of studies on effluent problems of the density current.

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Removal of Mn(II) Ions by the Flotation Method

Masami TSUNEKAWA Takakatsu TAKAMORI

Abstract

In water treatment recently ion flotation is introduced for the removal of heavy metal ions, dyestuffs, radioelements and other matter in waste water.

However, it was difficult to remove Mn(II) ions even by the flotation method, especially if its concentration is low. Therefore, some fundamental characteristics of the ion flotation of Mn(II) ions in dilute aqueous solution, 0.1 mM/l were studied.

In this research, ion flotation in a narrow sense, foam fractionation and precipitate flotation, which are the three types in "so-called ion flotation", were chosen for the rejection of Mn(II) ions, because of their usefulness as a separation method in waste water treatment.

In ion flotation, sodium stearate (NaSt) acted as the most effective collector followed by sodium palmitate (NaPa) and sodium oleate (NaOl). Suitable amounts of addition at natural pH were 3-4 molar ratio to Mn(II) when NaSt and NaPa were used as the collector, on the other hand when NaOl was used the molar ratio was 2. An excessive addition of the collector however led to a low rejection rate. The most suitable pH range was found to be pH 8-9 in each case.

In the foam fractionation, sodium dodecyl sulfate (SDS) was used as the collector. While the rate of rejection in this case is mainly dependent on the rate of foam formation the rate of rejection suffered depression by the ionic strength of the solution and other cations.

In the precipitate flotation, anionic collectors had no effect on the rejection of Mn(II), but cationic collectors, octadecyl dimethyl benzyl ammonium chloride (ODBAC) acted effectively. The fact that Mn hydroxide was rejected by cationic collector, but not by anionic collectors may be due to the fact that Mn hydroxide carries a negative charge.

In the other experiments, an ordinary flotation testing machine was used for ion flotation, and the results were excellent.

It was confirmed that under suitable conditions more than 99% of Mn(II) ions could be rejected by the ion flotation.

A Performance Analysis of the Gas and Steam Combined Cycle

— A Consideration of Combination in the Exhaust Heat Recovery Cycle —

Takeshi SAITO Hiroshi TANIGUCHI Takashi SONODA
Masayoshi KOBIYAMA Kazuyuki ITO

Abstract

A performance was analyzed for the exhaust heat recovery cycle namely in one of the gas and steam combined cycles as an electric power generating cycle was studied and certain effects were checked for thermal efficiency or combination of both cycles through the factors of pressure ratio or reheating process on the gas side and steam conditions.

From the above results, it was recognized that the reheating process could be utilized to improve the steam condition, broaden the working area on the gas side and obtain higher thermal efficiency. And, it was also recognized that a higher steam pressure could be utilized for broadening the working area and obtaining higher efficiency. Thus, a considerably higher thermal efficiency may be supported by the use of this combined cycle even when a sub-critical steam pressure is applied.

A Study on Heat Transfer in a Furnace

— A Digital Simulation of a Furnace Model
using an Electronic Computer —

Hiroshi TANIGUCHI Ken-ichiro SUGIYAMA Ko TANIGUCHI
Masayoshi KOBAYAMA Hiroshi HAYASAKA Kazuyuki ITO

Abstract

It was recognized that heat transfer in a furnace is a complex phenomenon and that considerations must be made on the furnace model which uses flame as the heat generating medium, combustion gas as the surrounding medium, refractory wall as the insulating wall and heating surface as the absorbing wall. The heat is mainly transferred by radiation between them, but it is also desirable to apply convective transfer or flow effect of these media.

The authors have proposed a digital simulation using an electronic computer for the above complex heat transfer system under some actual conditions. These numerical results of temperature distribution and heat absorbing rate are comparatively in good agreement with the experimental results in a rectangular solid or a cylindrical type furnace. The analysis was supported by the above mentioned facts.

On Computer Program Generating the Liapunov Function by Means of Zubov's Method

Terumi ITOH, Ken-ichi NISHIYA,
Jun HASEGAWA, Toichiro KOIKE

Abstract

Liapunov's direct method is highly useful for stability analyses in non-linear systems, and Zubov's systematic construction procedure of the Liapunov function is also quite useful.

In this paper, computational programs generating the Liapunov function by means of Zubov's method as the system equation given in a form of power series, are discussed.

An ordering scheme, which gives a one to one correspondence between a series number of a homogeneous polynomial (L) and its exponents (K_i) by means of new parameters (J_i), was introduced and used by the authors.

In this paper, computational programs to determine an asymptotic stability region were also discussed.

As examples, model systems of two and three state variables, modeling simple power systems, were considered, and Liapunov functions and stability regions are shown.

Electric Power System Static State Estimation

— An Attempt of "Two-Node State Estimation" —

Kyosuke KOMATSU Ken-ichi NISHIYA
Jun HASEGAWA Toichiro KOIKE

Abstract

Recently many studies have been carried out regarding the state estimation problem in an electrical power system. As a result, it has been pointed out that a hierarchical structure is necessary for a large scale system.

In this paper, from this point of view, an idea tentatively called "two-node state estimation" was introduced and cooperation between local estimators and a central estimator was considered. Measurement variables are divided into the those concerned with nodes and the others with lines. The former is processed by local estimators, the latter by a central estimator. The system is assumed to be a steady state and static state estimation technique was used.

High Speed MOSFET Current Sense Amplifier

Tomohisa MIKAMI Teiichi KUROBE Yoshihiko OGAWA

Abstract

A current sensing makes it possible to read the state of a MOSFET six device memory at high speeds, thus a low input impedance sense amplifier which usually is

a bipolar amplifier was used where performance is a requirement.

If a MOSFET current sense amplifier can be built on a memory chip, it would be possible to simplify peripheral circuits and decrease their power dissipation and large occupied areas.

This paper describes the design of a high speed MOSFET current sense amplifier for these purposes. Low input impedance is attained by grounded gate stage, and long transients of the output stage are avoided by driving a load device with high source voltage.

Studies of writing a FORTRAN compiler using FORTRAN language

Shigeki YAMADA Mitsuru SUDO Hiroaki TAKAJO
Koji TOCHINAI Kuniichi NAGATA

Abstract

An experiment with the intent of writing a FORTRAN compiler using FORTRAN language along with the assembly language is reported.

Although it is known to be desirable to use high level languages, such as FORTRAN, in compiler writing for good programming productivity, it has been pointed out that the compilers written in such a manner are generally inefficient.

In this experiment, an attempt has been made to utilize the FORTRAN as much as possible, wherever it is proper, and the assembly language was used only where a high efficiency is required.

As result of our experiment, a good productivity was obtained, and some approaches to develop high level languages for writing system programs such as compilers were also proposed.

Microwave Holography in a Uniaxial Anisotropic Plasma

Keinosuke NAGAI Michio SUZUKI

Abstract

Properties of a hologram constructed in a uniaxial anisotropic medium, namely in a gyro-plasma were investigated theoretically. We considered the interference patterns of ordinary waves and extraordinary waves from a source such as a hologram. An element of permittivity tensor can be measured by the reconstruction process from this hologram.

Computer-Generated Holograms and their Some Applications

Youichi SUZUKI Yoshinao AOKI

Abstract

There has been considerable interest recently in the field of digital holography¹⁾, i.e. computer generation and reconstruction of holograms. We discussed the computer reconstruction of acoustical and microwave holograms previously^{2),3)}. In this paper we discuss computer-generated holograms of the Lohmann-type and some applications. The basic principle in generating a Lohmann-type hologram displayed by a plotter was described first, then this ingenious method was applied to the technique that generates holograms by a line printer. In this technique the phase information of a calculated hologram controls the position of the output symbols of the line printer, while a multiple printing technique is adopted to display the amplitude of the hologram. Examples of a three-dimensional sectioned hologram displayed by a plotter and by a line printer are also discussed. A hologram conversion technique by computer-generated holograms was proposed and an experiment for converting Fresnel-transform holograms into Fourier-transform holograms was conducted.

On the Study of the Time Behaviour of the Cold Neutron Pulses in the Cold Moderators

Norio OTOMO* Kozuhiko INOUE*

Abstract

Theoretical calculations of a time-dependent neutron spectra were carried out in detail in water at room temperature, in ice and condensed methane at extremely low temperatures and a comparison of the results of several experiments was run; pulsed neutron method, measurement of the monochromatic neutron pulses by the neutron reflections of a single crystal and all experiment of the time-dependent neutron spectra. The neutron pulse width can be obtained from the monochromatic neutron pulse characteristics and the mean emission time of the cold neutron at 0.001 eV was more than 200 micro-sec. in ice and solid methane at 20°K. The effect of the time resolution in the experiment of the cold neutron spectroscopy can not be disregarded.

Electron Leakage from a LINAC at its "BEAM OFF" Condition

Sadashi SAWAMURA Yoshiki MIYAGIMA Takashi SUMIYOSHI
Ikuo MURAI Hiroaki TANIDA Meiseki KATAYAMA*¹
Saburo SAKAMOTO Yasutomo OZAWA

Abstract

Characteristics of leakage electrons from a 4 MeV LINAC which have been observed recently without applied anode voltage and in the absence of the heater current of the electron gun were presented.

Under these conditions of the LINAC, the measured maximum energy of leakage electrons was about 2 MeV which amounts to one half of the maximum energy of its full powered normal operation and the maximum dose rate was as high as one thousandth of that at the full powered normal operation.

The space distribution and time dependence of the dose rate are also measured.

Anharmonic Damping of Surface Elastic Waves (II)

— General Theory —

Tsuneyoshi NAKAYAMA Tetsuro SAKUMA
Department of Engineering Science, Faculty of Engineering,
Hokkaido University, Sapporo

Abstract

Based on the theory of surfons, we present a formalism to calculate the attenuation rate of elastic surface waves at low temperatures in a high frequency region. A general formula for the attenuation rate due to the cubic anharmonic terms in the elastic energy of an isotropic elastic continuum is given by means of a temperature-dependent Green's function. In a frequency region between 20 and 40 GHz at $T=1^\circ\text{K}$, our results show quite different frequency and temperature dependence $\omega^{1+n} T^{4-n}$ ($1.9 \lesssim n \lesssim 2.2$) from that obtained in a low frequency region.

Ethylation of Phenol (I)

— Reaction between Phenol and Ethylene with γ -Alumina Catalyst —

Kazuo AOMURA, Masahiro NITTA, Muneo MATSUMOTO

Abstract

A vapor-phase ethylation of phenol with ethylene was carried out in the presence of γ -alumina catalyst at 280~400°C under atmospheric pressure. The products obtained are o-, m- and p-ethylphenol, 2,6-diethylphenol and a small amount of unidentified compounds of which the major part is suggested to be diethylphenols. Among them, o-ethylphenol is obtained in the largest yield. All products are formed from the beginning of the reaction. The absence of phenetol in the products suggests that it is not involved as an intermediate in the ethylation reaction. The conversion of phenol increases with the rise in the temperature, molar ratio of the feed (ethylene/phenol) or the contact time (W/F). The dependence of the initial reaction rate upon the molar ratio shows that the surface reaction between phenol and ethylene both adsorbed on the catalyst is the rate-determining step in the reaction.

Based on the results above, a reaction mechanism of selective ortho ethylation is also discussed.

A Generalization of the Crossed Extensor

Yoshiharu SATO* and Michiaki KAWAGUCHI*

Abstract

Extensor analysis, a generalization of tensor analysis, offers many mathematical models designed to meet requirement of application to physical science and/or engineering. Since extensor analysis is concerned with the calculation of higher order differentials, it also plays an important role in the study of higher order space.

The purpose of this paper is to show the existence of a new extensor, referred to as a hybrid extensor, and to investigate its properties. It is a possible generalization of the crossed extensor which has been studied elsewhere.

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Defect Structures in Mercury Selenide Crystals

Kenji KUMAZAKI* Takashi FUKUI Hideo KOSEKI
and Akira ODAJIMA

Abstract

Large HgSe single crystals of a few cm in length were prepared by the modified Bridgman method. Hall coefficients and lattice parameters of HgSe were measured in both Hg and Se atmospheres. Thermodynamical considerations indicate that the native lattice defects in HgSe are composed of doubly ionized Hg interstitials or Se vacancies produced under nonstoichiometric conditions due to high mercury pressure. The electron concentration is varied from 2.5×10^{17} to $7.0 \times 10^{18} \text{ cm}^{-3}$ by thermal treatment in Hg atmosphere.

The dominant ultrasound dissipations are the Akhieser loss and loss due to motion of dislocation. The low value of the Peierls stress calculated from the experimental data casts some doubt on the applicability of the Seeger model to compounds in interpreting the observed peaks in HgSe, but they may be associated with sideways motion of kinks as well as with point defects. The ultrasonic parameters of HgSe obtained in these experiments are compared with those of HgTe.

Anomalous attenuation of the ultrasonic waves in *n*-InSb in a pinched plasma state

Yoshihiko TAKASE Yukinobu MURAO Nobuo YAMADA
Masanao KITAMURA Akira ODAJIMA

Abstract

A few years ago Tanaka and others of our group reported that the longitudinal ultrasonic waves travelling along the $\langle 110 \rangle$ direction in *n*-InSb sample were anomalously attenuated when it was in a pinched plasma state under a strong electric field applied along this direction (K. Tanaka et al.: Phys. Letters **39 A** (1972) 43). They examined various possible causes of dumping qualitatively and concluded that this might be the Akhieser loss due to the raise in temperature of the sample caused by the pinch effects.

We applied the DAJ theory to this problem and calculated the radial variations of the carrier density and the temperature in the InSb sample. It was found that there is no such large temperature raise over a wide region of the sample to cause Akhieser loss as large as the observed attenuation. We further measured the frequency dependence of the attenuation and found that it seems to be of the form ω^n with $n=4$ in the low frequency region and with $n \approx 1$ in the high frequency region, when the dc pulse was

over 60 Å. Taking into account these theoretical and experimental findings we must look for some causes for this dumping other than the Akhieser loss, such as diffraction loss due to inhomogeneity in elastic properties due to the thermal gradient in the sample.

Crystallization of Amorphous Selenium and Effects of Illumination on Its Growth

Tokihiro UENO Shozo MURAOKA*
Tatsuro SHIMADA** Akira ODAJIMA

Abstract

Morphologies and growth rates of spherulites grown on amorphous selenium in a temperature range of 33 to 189°C, in bulk and in thin film, were examined under a photo- and electron-microscope. Electron diffraction reveals that the *c*-axis of the crystallites is in parallel with the substrate and perpendicular to the radial direction, which indicates no twisting lamella texture. Abrupt thickening of the lamella formed in the spherulite is observed above 120°C in the bulk samples. The growth rate along the radius, however, increases monotonically up to 170°C and then decreases, which is explained satisfactorily from a view-point of nucleation theory. For the bulk samples growth rates under illumination are at least one order of magnitude higher than in dark conditions. While the spherulite on the surface of bulk samples grows in three dimensions in dark, under illumination it grows in two dimensions with a thickness of about 1 μm. The thickness 1 μm corresponds to one absorption depth of amorphous selenium at 2 eV, which is close to the dissociation energy of the Se-Se bond. At the substrate-film interface the growth rates are higher than those of the bulk samples. However, the former is not affected by illumination under the present conditions.

Statistical Properties of Speckle Intensity in Relation to Rough Surfaces

Nobukatsu TAKAI

Abstract

Statistical properties of rough surfaces were studied in connection with the first-order probability density distribution with respect to speckle intensity. First, it was shown that the first-order probability density is given by the negative exponential distribution

with a first-order approximation for the results derived from the rigorous mathematical analysis. Second, the relation between the averaged intensity of speckles and the statistical quantities of rough surfaces was investigated in the Fraunhofer diffraction field. It was finally shown by experiments that the averaged slopes of surface roughness for various ground glasses were determined by using the averaged intensities calculated from the first-order probability density of the speckle intensity. The experimental results obtained here agree fairly well with the data measured directly by employing a mechanical profilometer.

Errors and Response-Time of Vehicular Speed Measurement by Cross-Correlation Techniques

Masahiro WATARI** Toru IDOGAWA*

Abstract

The speed of a vehicle may be determined from the cross-correlation function of random signals which are obtained from a road surface by simple optical detectors. This paper presents an experimental method to estimate errors of the speed measurement. The error depends on (1) the aperture diameters of the signal detectors, (2) the averaging length of the cross-correlation functions, and (3) the S/N ratio of the random signals whose cross-correlation function is to be determined. An expression of the S/N ratio is also introduced. This evaluation can be performed from the random signals given by the detectors. Generally speaking, an extremely long averaging length is required to estimate the correlation functions; on the basis of the experimental results, however, it was shown that short averaging lengths are sufficient to determine the speed accurately. It is expected from the experimental results that the speed can be determined to an accuracy of 0.5%, using for instance a rectangular aperture of 6×30 mm and an averaging length of 2.5 m.

Transfer Characteristics Estimation for Vocal Tracts under Utterance

Ryoji OHBA Hideaki DOHI Tohoru IDOGAWA

Abstract

A new method to estimate transfer characteristics of vocal tracts in utterance is presented. The method is based on a simple model of the voicing process and a new fact that the known vocal cord waveform may be approximated with a mean waveform of those of five vowel sounds from the same subject. The accuracy of estimation is also discussed in detail. It is a special feature of the present method that very short observations of a voice waveform, namely only a single pitch period, is required. This is applied to determine formant-patterns of the Japanese vowels and it was shown to work as well as conventional methods. Using several features of the estimated transfer characteristics, a voice recognition test was carried out on 500 samples of five Japanese vowels from 100 male adults and the recognition rate of 94.4% is obtained by the test.

Input- and Output-Device for Digital Image Processing and Some Applications

KAZUMI MURATA Junji MAEDA Hideo ITAYA

Abstract

Input- and output-device for digital image processing by electronic computer was constructed. A flying spot scanner for digitizing the input image and for displaying the output image is connected with the large computer (FACOM 230-60) in an off-line mode through the mediation of a magnetic recording tape. The constitution and the functions of the device are described. In order to test the device constructed, some experiments are performed and the results are presented. Several applications of the device to image analyzing, image synthesizing and image processing are also reported.

Effects of Spatical Coherence on Holographies

Hirofumi FUJIWARA

Abstract

Coherence effects on holography are considered for faithful storages of an interference pattern produced by the superposition of the reference and object beam and for the reconstruction of a high quality image. In the analysis, the effects of partially coherent illumination on typical holographies (Fourier transform holography, in-line Fraunhofer holography, image holography and Fresnel holography) were systematically investigated by making a comparison between two cases of the stationarity and non-stationarity in space of the coherence function. It is understood that the reconstructed image is seriously degraded by the decrease of the spatial coherence and that a well-known uncertainty relation exists between the spread of the spatial coherence and that of the point image by assuming the spatial stationarity of the coherence function.

Plastic Torsion Deformations of Ice Single Crystals

Akeharu FUKUDA

Abstract

Creep test under alternating torsion stress was used to investigate fatigue of single crystals of ice. Results show that the deformation is controlled by both the generation rate of dislocations and the velocities of dislocations inherently present in the crystal. The generation rate of dislocations is proportional to the density of dislocations in the crystal. The velocities of dislocations are proportional to the stresses exerted on the crystal.

Almost all dislocations can be casily moved by sheer stresses at the basal planes, and work hardening did not occur. This is due to the fact that the dislocations in the crystal were rearranged in such a way that the resistance to its movement was minimal.

Growth of Ice Single Crystals from Dilute Aqueous Solutions by the Modified Bridgman Method

— Distribution of Impurities and Structure of Dislocations —

Mitsugu OGURO

Abstract

Single crystals of ice containing various soluble impurities such as NH_3 , NH_4F and NaCl were grown from dilute aqueous solutions of these substances by a modified Bridgman method. The crystals thus formed were examined either by the X-ray diffraction topography method or under a light microscope. It was found that the impurities were distributed inhomogeneously in the crystals even when the solute concentrations are low-segregated as invisible small patches which generate screw dislocations ($b = \frac{1}{3} \langle 11\bar{2}0 \rangle$) and edge dislocation-loops ($b = [0001]$) both lying on the basal plane of the ice crystal. When the concentration increased, the impurities were captured in ice as discoidal or hexagonal-plate shape brine pockets which caused an increase of dislocation density and some characteristic features of dislocation structures, such as helical dislocations, stacking faults and small angle boundaries.

The segregation of impurities in ice crystals during its growth was attributed to the morphological instability of the growing interface. It was calculated that the instability occurs when the concentration of solution exceeded 100~1000 ppm in cases of NH_3 according to the change of the order of the distribution coefficient experimentally obtained. The origin of the circular dislocation-loops appeared in dilute NH_3 -doped ice crystals were found to be the result of the collapse of discoidal aggregates of vacancies which remained after comparatively rapid diffusion of impurities in the grown crystal at a high temperature near the melting point.

Effect of Nitric Acid Treatment on γ Relaxation of Polyethylene

Shiomi FUKUI, Teruo HIDESHIMA

Abstract

In order to examine the effect of fuming nitric acid treatment on the magnitude of the γ -relaxation in polyethylene, the temperature dependence of mechanical loss tangent was measured in the samples of polyethylene treated with fuming nitric acid at 80°C for various periods of time.

As-polymerized powder of high molecular weight linear polyethylene AC-1220 and

single crystals of Sholex-6009 precipitated from 0.1% xylene solution were used as the samples and embedded in polystyrene, which was dynamically inert in the temperature region where γ -relaxation occurred. Loss tangent was obtained from the half width of resonance occurring in bending vibration of such a composite system.

Of the component relaxations γ_1 , γ_2 and γ_3 constituting the γ -relaxation of polyethylene, the magnitudes of γ_1 and γ_2 relaxations were found to decrease, while that of γ_3 -relaxation was found to increase, as the treatment time increased. These results suggest that the three relaxations are all related to the motion of molecules existing on the lamellar surfaces and/or in the interlamellar amorphous regions, since all relaxations were affected by the treatment. Especially γ_3 -relaxation appears to be caused by the motion of cilia on the lamellar surfaces which increase by means of scission of folds in the course of the nitric acid treatment.

NMR Study on Molecular Motions in α - and γ -Relaxation Regions of Linear Polyethylene

Takuo KAKUDATE Teruo HIDESHIMA

Abstract

Broad line NMR behavior of linear polyethylene single crystals which were annealed at 120°C for various periods of time was observed from -160 to 100°C.

The mobile fraction obtained by the straight line decomposition changed stepwise with the temperature in three ranges associated with α -, β - and γ - loss bands. In the γ -loss band, two molecular processes, referred to as γ_1 and γ_2 , were found in two step-like changes in the second moment of the total absorption spectrum (and also in those in the mobile fraction in the case of the high molecular weight sample).

From the correlative changes of the magnitude among the above-mentioned four molecular processes in the course of annealing it was revealed that the γ_1 - and γ_2 -processes were related to the β - and α -processes, respectively. It was suggested that two non-crystalline regions existed and in each of these regions there were two modes of molecular motion which may correspond to the micro-Brownian motion and the local mode motion of amorphous polymers.

In the latter half of this paper a comparative study of the three line decomposition methods, i.e. straight line decomposition, symmetrical decomposition and decomposition as proposed by Bergmann-Nawotki, was made.

Some Fundamental Properties of Crystal Disclinations

Kenzaburo MARUKAWA

Abstract

Properties of crystal disclinations were discussed and some fundamental relations were obtained. The discussion contains (1) conservation laws for disclination-disclination combination and for disclination-dislocation combination, (2) conditions for conservative motion of disclinations, and (3) the force on a disclination exerted by an applied stress. The motion of a disclination line and of the rotation axis associated with the disclination were treated separately. In these discussions the disclination is characterized by a tensor which represents the associated lattice rotation. This representation is in contrast with that of previous works in which the rotation was assumed to be infinitesimal and represented by a vector.

Electron Microscopic Study on the Low Temperature Martensite in β_1 -CuZn Alloy

Kazuyoshi TAKEZAWA Shin'ichi SATO

Abstract

Low temperature martensite, which is the so-called β_1'' , was studied by electron microscopy. The transformation was continuously observed under an electron microscope with a cooling stage. Two different forms of martensite, banded and wide, were clearly recognized during dynamical observation. The crystal structure of the wide martensite was analysed by using various kinds of electron diffraction patterns. The obtained structure was a modified 9R with $A=4.28 \text{ \AA}$, $B=2.60 \text{ \AA}$, $C=19.2 \text{ \AA}$ and $\gamma=92^\circ$. It was revealed that the modification contains a small displacement, $\mathbf{d} = d_1 \mathbf{A} + d_2 \mathbf{B}$, between successive close-packed planes, the values of d_1 and d_2 were about 0.02 and -0.01 , respectively.

An X-Ray Study on the Recovery of Heavily Faulted Regions in Deformed Cu-Ge Crystals

Toshihiko TAKAMA Norikatsu YOKOTA Shin'ichi SATO

Abstract

X-ray diffraction profiles were previously examined for individual crystals in deformed Cu-11 wt % Ge alloy. Diffuse streaks with broad peaks were diffracted from "heavily faulted regions" in the deformed specimen. The faulted state was examined by Kakinoki's theory with "Reichweite" $s=3$, having particular fault probabilities, for example, $\alpha=0.45$, $\beta=0.55$, $\alpha'=0.15$, $\beta'=0.15$.

The work was extended here to study the recovery of the heavily faulted state. At temperatures higher than 300°C, redistributions of peak intensity on the streaks were observed in addition to the decrease in the total diffuse intensity. By analysing the diffuse profile from the above specimen after annealing, for example, for 5 minutes at 350°C, a new stacking state with $\alpha=0.4$, $\beta=0.8$, $\alpha'=0.1$, $\beta'=0.8$, was obtained. This change corresponds to the reaction in which the intrinsic stacking faults combine into successive layers to form the extrinsic stacking fault. Transient stable stackings, such as hcp, d.hcp and twinning, which can be thought as a regular arrangement of stacking fault, are locally formed following longer periods of annealing. It is worthy of note that monotonic decrease in fault density was not observed.