Appendix

Abstracts & Titles, No. 94~97

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No. 94 June 1979

Convective and Radiative Heat Transfer Coefficients for a Clothed Man

Tohru MOCHIDA

(Received December 28, 1978)

Abstract

The convective and the radiative heat transfer coefficients for the human body have been proposed by physiologists and biological engineers. But considerable differences are seen among these obtained values and proposed equations, which were obtained by experiments using human subjects or derived by theoretical analyses. The main reason appears to arise from the fact that a human subject is a thermal body with a complicated form and that it is quite difficult to obtain "precise" data from experiments using the human body.

The convective and the radiative heat transfer coefficients for an unclothed man were previously derived by the author from an engineering method based on the heat transfer theory taking into consideration the physiological properties of the human body.

The present paper deals with the convection and the radiation coefficients for a clothed man and the concrete values, a convective heat transfer coefficient for a clothed man $h_c=\sqrt[3]{270\,V^2+23}$ and a linear radiation exchange coefficient $h_r=5$ Kcal/m^{2}h°C, which are extended for those of an unclothed man derived in the previous study, are proposed.

Aerodynamic Characteristics of Inclined Flat Plates Immersed in a Turbulent Free Mixing Layer

M. ARIE, M. KIYA, H. TAMURA and M. FURUKAWA

(Received December 28, 1978)

Abstract

Pressure distributions along the surface of inclined flat plates immersed in a turbulent plane mixing layer, which resulted from the mixing of a uniform flow with the same fluid at rest, were measured in order to clarify the time-averaged aerodynamic forces acting on the plates together with the flow pattern around them. The Reynolds number based on the height h of the plate and the main-stream velocity U outside the mixing layer was in the range $(3.31\sim5.71)\times10^4$. The stagnation-pressure coefficient and the normal force coefficient were found to be well correlated with a parameter h/δ, where δ is the width of the mixing layer, for assigned values of the angle of attack and the ratio u_c/U, u_c being the velocity of the otherwise undisturbed mixing layer.

Stability of Turbulent Diffusion Wake Flames behind Bluff-Bodies with Fuel Injection

Kenichi ITO Masami KOYAMA and Mitsuo KAJI

(Received December 28, 1978)

Abstract

Stability of wake flames formed behind a cylindrical bluff-body with two fuel injection slits was investigated experimentally in three kinds of bluff-bodies with 10, 15 and 20 mm diameter fitted in an air stream. The range of air flow velocities were 5-60 m/s. Fuels used here were propane, methane, ethylene and butane, and were injected upward into the air stream from the slits at the surface of the flame holder with an angle of 30° against the air flow direction. Flame stability limits, length of the recirculation zone and excess air ratio in the zone were measured for various fuels and air velocities.

The results show that the recirculation zone length depends on the flame holder dimension and is independent of the chemical properties. The excess air ratio in the recirculation zone is influenced only by the approaching air velocity at blow-off. Further it is suggested that the stability curves for each fuel and flame holder dimension are generallized by use of $U_f \cdot A_{st.}$ and $U^* \sqrt{d}/Su$ where U^* is a corrected approaching air velocity, d the flame holder diameter, Su the laminar burning velocity, U_f the fuel flow rate and $A_{st.}$ the stoichiometric air-fuel ratio.

Minimum Ignition Energies and Quenching Distances of Methanol blends

Toshiaki YANO and Kenichi ITO

(Received December 28, 1978)

Abstract

The purpose of this study is to present data on minimum ignition energies and quenching distances for methanol, iso-octane and iso-octane/methanol blends over a temperature range of 100–150°C and at 1 atm pressure.

Minimum ignition energies were measured by means of a conventional automobile ignition system and expressed by the primary current of the ignition coil. The measure-

ment methods of the quenching distances employed the teflon-flanged electrodes technique.

Experiments were performed with methanol, iso-octane and iso-octane/methanol blends over a range of equivalence ratios for several mixture. Quenching distances measured for methane were used to check reliability of the present apparatus and these values practically agreed with other data.

The experimental results indicated that the minimal value of the minimum ignition energies and the minimum quenching distances of methanol and iso-octane air mixtures were attained with a slightly rich mixture. The iso-octane/methanol blend yields larger flammability ranges than those of each in air. The quenching distances of iso-octane/methanol blend depend on that of iso-octane and never become larger than that of either fuel.

*F*irmware *D*evelopment *S*upport *S*oftware *S*ystem for the multi-microprocessor HARPS

Kunio ONDA and Takao TSUDA

(Received December 28, 1978)

Abstract

A *F*irmware *D*evelopment *S*upport *S*oftware *S*ystem, FDS^3, for HARPS was implemented on the host minicomputer system.

HARPS is a new type of multi-microprocessor system with hierarchical and flexible control structures. This system consists of 9 microprocessors. Each processor has user-writable control memory, called WCS (Writable Control Storage), and executes the control sequences of microprograms in WCS.

FDS^3 supports users to develop microprograms. This software system consists of Command Interpreter and five main subsystems: Editor, Micro/Nano-Assembler, Relocatable Loader, Mapping Array Loader, and Micro-Octal-Editor. Micro/Nano-Assembler allows users to interactively correct their programs. Micro-Octal-Editor can directly check and correct microprograms in WCS.

In the implementations of a general purpose firmware system for parallel processing MOSES, FDS^3 was used as a firmware development tool and the effectiveness and the usability of this system was proved in this process.

Transmission Loss and Capacity of Mode-Coupled Optical Fibers

Kohichi TATEKURA, Kiyohiko ITOH and Tadashi MATSUMOTO

(Received December 28, 1978)

Abstract

Properties of optical fibers are characterized mainly by the transmission loss and bandwidth, and these fundamental factors are dependent upon Rayleigh scattering and near-infrared absorption, and refractive-index profile and material dispersion, respectively, if optical fibers are with perfect configurations.

However, realistic optical fibers suffer geometrical distortions in the processes of manufacturing, cabling and installation, and transmission characteristics change in a complicated way. The phenomena due to geometrical or material distortions in the characteristics of optical fibers are referred to as mode-coupling effect in the wave theory.

This report calculates the transmission loss and bandwidth of mode-coupled optical fibers assuming that random bends of the fiber axis are the mostly dominant among the possible sources of mode coupling, and investigates mode-coupling phenomena in detail.

On the Fluctuation of Field Strength Caused by Upheaval of Mountain "USU"

—— The Effect of Reflected Waves ——

Yoshihiko OGAWA

(Received December 28, 1978)

Abstract

The upheaval of volcanic Mt. Usu leads to the fluctuation of V. H. F. field strength at the Tōya receiving station. This problem has been analysed by diffraction theory, and calculated reults were in good agreement with observed values. The fluctuation was caused by both Fresnel's diffraction passing over several mountains and the existence of reflected waves. In this paper it is mainly discussed how the fluctuation of receiving field strength are affected by the variation of the reflection coefficient.

Array-Type Holographic Sonar System Controlled by Microcomputer

Yohinao AOKI and Tsuyoshi YAMAMOTO

(Received December 28, 1978)

Abstract

A sonar technique is discussed, where two techniques, holographic and pulse-echo techniques are used to detect targets along the azimuth and range directions respectively. This holographic sonar system was constructed using a receiver array and microcomputer and an experiment was conducted, resulting in a quasi-real time sonar system. In this system an 8-bits microprocessor controls the transmission of burst signals from an ultrasonic transducer and collects holographic data by switching 32 receiving transducers. The collected data are processed by microcomputer with FFT and phase rotation algorithms and sonar images are displayed on a CRT scope. In the experiment an ultrasonic wave of 700 kHz was used and a limited number of targets made of air-contained sponge-like material in a water tank were displayed as sonar images. The speed of obtaining one frame of sonar image is about a few minutes.

Uber ein modifiziertes Verfahren zur Darstellung von 2-Alkyl- und 2-Arylimidazolinen

Yoshiyuki TAKATA und Kazuaki YOKOTA

(Empfing, Dezember 28, 1978)

Zusammenfassung

2-Alkyimidazoline haben technisches Interesse als Arzneimittel, Pflanzenschützmittel und Oberflächenaktive Stoff.

2-Alkylimidazoline werden synthetisch hauptsächlich durch Kondensation von Karbonsäuren mit Äthylendiamin-monohydrochlorid bei 300° oder durch Kondensation von Nitrilen mit Äthylendiamin-mono-o-toluolsulfonat bei 160–200° gewonnen.

Wir fanden, daß die Karbonsäure mit Äthylendiamin-mono-p-toluolsulfonat bei 200–210° unter Entstehung von 2-Alkyl-oder 2-Arylimidazolinen reagieren glatt. Die Ausbeute beträgt 80–90% der Theorie.

Die Umsetzung von Karbonsäuren mit Äthylendiamin-mono-p-toluolsulfonat eignet sich zur Darstellung von 2-Alkyl-oder 2-Arylimidazolinen.

Beschreibung der Versuche

Das Gemisch von 20 mMol Monokarbonsäure und 22 mMol Äthylendiamin-mono-p-toluolsulfonat erhitzt man langsam auf 200–210° und hält während 3 Stunden bei dieser Temperatur. Nach die Reaktion beendet ist, versetzt man in der Wärme mit Äthanol, filtriert heiß, dampft das Filtrat, saugt beim Abkühlen ausgeschiedenen Kristalle ab. Man kristallisiert aus Äthanol bzw. Äthanol/Aceton um.

Design and Optimization of Neutron Analyser Mirror (I)

Kazuhiko INOUE

(Received December 28, 1978)

Abstract

A high sensitivity and high resolution neutron analyser mirror was designed and fabricated for the pulsed cold neutron source analyser mirror neutron spectrometer (LANDAM spectrometer) at the Hokkaido University 45 MeV LINAC. Design philosophy and optimization procedure for the perfomance of analyser mirror are described.

Accelerator neutron source moderator assembly

Yoshiaki KIYANAGI, Hirokatsu IWASA and Kazuhiko INOUE

(Received December 28, 1978)

Abstract

The measurements to obtain data for optimization of an accelerator neutron source moderator assembly which generates thermal and cold neutrons were performed by using 45 MeV electron LINAC. The neutron energy is determined by the TOF method and the crystal monochromator. The correlation for neutron intensity and area of moderator assembly emission surface, the fast neutron reflector effect, cold neutron energy spectra, and pulse time spectra of thermal and cold neutrons and its variation by reflector were studied. These results give some aspects for optimum design of an accelerator neutron source moderator assembly.

A Study of the Growth Process of Altered Layer during Ion-bombardment on Clean Surfaces of Cu-Ni Alloys

Hiroshi KAKIBAYASHI Mamoru MOHRI Kuniaki WATANABE
and Toshiro YAMASHINA

(Received December 28, 1978)

Abstract

The growth process of an altered layer was investigated for a Cu-Ni alloy at various temperatures by means of AES measurement in both a lower energy Auger electron spectrum (LEAES) and a higher energy Auger spectrum (HEAES). Surface composition estimated from the LEAES differed in general from that estimated from the HEAES. The LEAES data showed a more rapid decrease in Cu-concentration during argon ion-bombardment than the HEAES data. Based on the difference in the escape depth in the different energy regions, a changing process of the depth profile of the altered layer was postulated. The changing process of the surface composition was found to vary with sample temperatures; namely, the rate of the change decreased with the increase of sample temperature. At sufficiently high temperatures (above 500°C) the surface composition did not change any more from the initially equilibrated value by the ion-bombardment. This fact indicates that the diffusion phenomenon plays an important role in the growth process of the altered layer and that the process is greatly influenced by balancing conditions between the selective sputtering which gives rise to enrichment of Ni-atoms at the surface and the diffusion which gives rise to enrichment of Cu-atoms at the surface.

A New One-Parameter Family of Generalized Variable-Metric Method in Accordance with Fletcher's Duality

Toshihisa HONMA and Ikuo KAJI

(Received December 28, 1978)

Abstract

We have developed a new one-parameter family of generalized variable-metric method which is reduced to Fletcher's one-parameter family for certain values of parameters. The process of the development is as follows. First, from the application of the generalized inverse of matrices, we derive the general solution of a matrix equation on which variable-metric methods are based, and we consider only the generalized variable-metric method including the Broyden-Fletcher-Goldfarb-Shanno algorithm. Next, we develop a dual generalized variable-metric method in accordance with both the Sherman and Morrison formula, and Fletcher's idea of *dual*, so that we construct a new one-parameter family which consists of the generalized variable-metric algorithms which are dual with each other. The situation of known variable-metric methods is made more clear by the new one-parameter family of generalized variable-metric method.

The Vacuum Poloidal Flux Functions Satisfying the Grad-Shafranov Equation in the Flat-Ring Cyclide Coordinate System

Toshihisa HONMA Masafumi KITO Ikuo KAJI
and Masaharu SEKI

(Received December 28, 1978)

Abstract

The Wangerin functions, which are solutions of Laplace's equation in the flat-ring cyclide coordinate system, are derived as series solutions about regular singular points $\mu=0$ and $\mu=K'$ which correspond respectively to the external and internal points of plasmas, where the curve $\mu=$const denotes the flattened cross section of plasmas and K' is the complete elliptic integral of the first kind with the modulus k'. Since the

argument of the Wangerin functions is expressed as the aspect and elongation ratios of plasmas, so we can accurately treat the equilibrium problem of axisymmetric toroidal plasmas without an expansion in the aspect ratio. The Grad-Shafranov equation, which governs magnetohydrodynamic plasma equilibria, is analytically solved in the vacuum region by using the flat-ring cyclide coordinates, so that the poloidal flux function is expressed as the Wangerin functions with the toroidal mode number being equal to one.

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No. 95 August 1979

Characteristics of Impulse Transmission in the Structure of Internal Combustion Engines

Nobuyuki YAMAZAKI Noboru MIYAMOTO Tadashi MURAYAMA

(Received March 31, 1979)

Abstract

In this paper, the characteristics of impulse transmission in engine structure were analyzed inattempt to reduce the vibration and noise in internal combustion engines.

The stress response, which was caused by input impulse given to the piston, was measured at each component in the test-engine by strain gauge and accelometer.

As result, the impulse forces were found to be gradually transmitted from the piston to the main bearings with a slow reduction, and the largest reduction of transmitted forces was obtained between connecting rod and crank shaft.

The influences of the material and dimension of the components on the transmission characteristics were found to be comparatively small.

Syntheses of Linkage Mechanisms by Geometric Method with Vector Equations

Osamu DOI Takayoshi UKAI Masando KODERA

(Received March 31, 1979)

Abstract

The authors developed a method of synthesis on four-bar linkages by geometric method with vector equations. As mechanisms are analyzed by solving vector equations, the authors analyzed four-bar linkages with vector analysis. Four-bar linkages are classified into nine models according to the type of motion of the driver and follower.

In this paper, vector equations are applied to synthesis of mechanisms and relations are introduced at the accuracy points for function generator and path generator of four-bar linkage. Numerical results may be drawn on a X–Y plotter, then efficiency and accuracy of synthesis are improved and parameters may be changed easily.

The Analysis of Thyristor circuit using "the method of equivalent source"

Yuzoh ITOH Mitsugwu KIMURA Hajime FUJIWARA

(Received March 31, 1979)

Abstract

The thyristor switching has been applied to the electrical circuit in order to control the power input. In this paper the analytical technique named "the method of equivalent source", which is an application of the Low of superposition, is proposed to solve the circuit including thyristor or mechanical switch.

It is shown that the simple circuit models including the mechanical switch can be analysed by means of this technique, and that the solution is the same as the results of the conventional transient analysis. Also this method is applied to the ac circuit consisting thyristors for deciding the extinct angle and circuit currents. The calculated values are in good agreement with the measured.

It is significant to find the component of the residual voltage of load on the period of blocking mode of thyristor. Therfore, the manner of deciding the component is described in detail.

An Analytic Method of the No Spark Zone of DC Machines

Yoshitaro MATSUSHIMA Hajime FUJIWARA

(Received March 31, 1979)

Abstract

The no spark zone appreciating the commutation performance of D-C machines is calculated by the numerical method. An analytical method of the no spark zone is proposed in this paper.

In this analytical method, the no spark zone can be analyzed by the use of the linear commutation conditions. The effective inductance for the commutation coil inductance is then used in the commutation equations. The effective inductance is calculated through Richter's calculating formula.

The validity of the proposed analytical method of the no spark zone is confirmed by running a comparison between the calculated values and the tested values.

The features of this analytical method are summarized as follows:

(1) The theory of the no spark zone is analytically developed in the case of β (brush covering number)>1.

(2) The calculating procedure deciding the no spark zone can be simplified in this method.

(3) The characteristics of the brush contact voltage vs. current are thoroughly considered in the theory.

Effect of Negative Ions on the Breakdown Process in Air (I)

— Experimental study —

Nobuyasu SATŌ and Saburō SAKAMOTO

(Received March 31, 1979)

Abstract

The effect of negative ions on the breakdown process in air is investigated by the comparison between the experiments of breakdown in air and those in nitrogen gas where negative ions are not formed. It is shown that the effect of negative ions cannot be detected from the measurements of sparking potential between parallel plates. The measurements of current growths in air and nitrogen started at undervoltages by supplying a large number of initial electrons at the cathode of parallel plates are carried out for various discharge conditions. The effects of negative ions on the current growth curves in air discharges are observed and become more evident at higher pressures of the sample gas. It is shown that the development of the discharge is suppressed by the attachment of electrons which forms negative ions but the electrons detached from the negative ions contribute to the space charge accumulation and decrease the formative time of breakdown.

Effect of Negative Ions on the Breakdown Process in Air (II)

—Theoretical study—

Nobuyasu SATŌ and Saburō SAKAMOTO

(Received March 31, 1979)

Abstract

As a continuation of Part I, the effect of negative ions on the breakdown process in air is investigated by a computer simulation of transient discharges in air and nitrogen gas which corresponds to the experiments in Part I. The spatiotemporal developments of electron, positive ion and negative ion densities are calculated by numerically solving continuity equations together with the Poisson's equation. The calculated current curves are in good agreement with the experimentally observed current growths, which indicate the validity of the simulation. The formation and accumulation of negative ions are

much smaller than those of positive ions throughout the gap so that the electric fields are not affected by the distribution of negative ions. However, the attachment process which forms the negative ions decreases the ionization amplification of the gap, while the electrons detached from negative ions contribute to the accumulation of the space charge which decreases the formative time lag. The extent of the detachment effect and γ_p effect on the development of the discharges are estimated and the relations between these effects are discussed.

Applied Linear Programming System ALPS-1

Toshiyasu KASHIHARA Azuma OUCHI Ikuo KAJI

(Received March 31, 1979)

Abstract

The authors are designing and developing an Applied Linear Programming System (ALPS) which is applicable to large scale engineering problems.

This report gives an outline of ALPS, i.e., characteristics, construction and two application examples. In order to solve L.P. effectively, we use those techniques in ALPS such as the revised simplex method using the product form of inverse, the upper-bound technique, the composite primal algorithm, the dual simplex algorithm, the sparsity technique and the reinversion technique by the triangularization method. The first version of ALPS is implemented in FACOM 230-75 in FORTRAN.

Consideration on Restoration of Linear Motion Degraded Images

— Inverse Filtering —

Tatsuya ISHIKAWA Tetsuo SHIMONO
Hideo KITAJIMA Teiichi KUROBE

(Received March 31, 1979)

Abstract

This paper is concerned with the inverse filtering technique for restoration of motion degraded images. Consideration is restricted to degradations arising from a uniform relative translation between the camera and the object being photographed.

We show that the inverse filtering by Discrete Fourier Transform DFT is, in general, impossible without the limitation to the object size. However, when the recorded image extends over an infinite interval in space, inverse filtering by (DFT) is applicable. The importance of the infinite interval condition is demonstrated by computer simulated examples.

Synthese von 2-Phenylbenzimidazolderivaten III. Mitteil

—Kondensation von o-Phenylendiamin mit aromatischen Carbonsäuren in p-Toluolsufonsäure—

Yoshiyuki TAKATA Masateru TAO Kazuaki YOKOTA

(Received March 31, 1979)

Zusammenfassung

Wir untersuchten die synthetische Verfahren zur Darstellung von 2-Phenylbenzimidazolderivaten durch Kondensation von aromatischen Carbonsäuren mit o-Phenylendiamin in p-Toluolsulfonsäure.

Man erhitztete das Gemisch von 1 Mol aromatischen Carbonsäuren, 1 Mol o-Phenylendiamin und 1 1/2 bis 2 Mol p-Toluolsulfonsäure auf 205–220° während 1 1/2 bis Stunden, löstete die entstandenen Produck in warmem Wasser, machtete alkalisch mit Ammoniak und filtriertete die freie 2-Phenylbenzimidazolderivaten.

Mit guters Ausbeute erhieltete wir 2-Phenylbenzimidazolderivaten aus Benzeosäure, o- und p-Chlor-, o-Brom-, 2, 4-Dichlorbenzoesäure, o-Toluylsäure, o- und p-Oxybenzoesäure nach diesem p-Toluolsulfonsäure-Verfahren.

Über synthetische Verfahren von Säurechloriden durch Umsetzung von Karbonsäuren mit Schwefelmonochlorid IV.

— Synthese von Säurechloriden durch die direkten Reaktion von Karbonsäuren mit Chlor und Schwefel —

Toshio MATSUDA Kazuaki YOKOTA Yoshiyuki TAKATA

(Received March 31, 1979)

Zusammenfassung

Wir untersuchten die Darstellungsverfahren von Karbonsäurechloriden durch direkte Reaktion von Carbonsäuren mit Schwefel und Chlor in Gegenwart von Eisen (III)-acetat-Katalysator.

Mit guter Ausbeute erhielten wir Carbonsäurechloride aus aromatischen Mono- und Dicarbonsäuren (Benzoesäure, p-Nitrobenzoesäure, Iso- und Terephthalsäure) und niederen Fettsäuren (Essigsäure und Propionsäure).

Im Falle von aromatischen Carbonsäuren leitet man langsam Chlor in einem Gemische von Carbonsäure, Schwefel, Eisen (III)-acetat-Katalysator und Tetrachloräthan als Lösungsmittel bei 125–130°C, filtriert das Reaktionsgemisch, wäscht mit wenig Lösungsmittel, destilliert das Lösungsmittel ab und destilliert das Ruckstand im Vakuum.

Im Falle von niederen Fettsäuren leitet man Chlor langsam in einem Gemisch von Carbonsäure, Schwefel und Eisen (III)-acetat, und gleichzeitig destilliert das entstehende Säurechlorid ab.

Photo-induced Resistive State and Effective Quasiparticle Lifetime in Nonequilibrium Superconducting Sn Films Near Transition Temperature

Shigehiro ISHIZUKA Kazuhiko YAMAYA and Yutaka ABE

(Received March 31, 1979)

Abstract

The photoinduced resistive state in superconducting Sn films was measured by means of conventional dc-method, and the effective quasiparticle lifetime was deduced from the experimentally observed decay time of quasiparticles. Near transition temperature, T_c, the mean lifetime of phonon for creating quasiparticles, τ_{pq}, is dominant in quasiparticle relaxation. It shows that τ_{pq} increases with the decreasing temperature. The current-voltage characteristics are shown to be nonlinear under illumination. These are not explained in terms of simple lattice heating or the modified heating theory and suggest that a spatially inhomogeneous state would be established in the optically excited superconducting Sn films.

In-depth profiles of oxide films on GaAs studied by ESCA

Masanori NISHINO Masao HASHIBA Kuniaki WATANABE
Toshiro YAMASHINA Katsumasa YABE

(Received March 31, 1979)

Abstract

In-depth profiles of plasma oxides and anodic oxides on GaAs were studied by ESCA (Electron Spectroscopy for Chemical Analysis) in conjunction with sputter-etching by argon ions. Chemical composition and bonding state of the constituents were analyzed by use of As3d, Ga3d and Ols photoelectrons and Ga-$L_3M_{4,5}M_{4,5}$ and As-$L_3M_{4,5}M_{4,5}$ Auger electrons. Kinetic energies of these electrons were gradually increased with sputter-etching of the oxide films. It was found that this energy shift was predominantly due to the charge-up effect of the sample surfaces. Correction of the charge-up shift for each

photoelectron was carried out with use of Ols and the two Auger peaks and revealed that both the plasma and anodic oxides consisted of As_2O_3, Ga_2O_3 and un-oxidized elemental As. However, the content of Ga_2O_3 in the plasma oxide was higher than that in the anodic oxide. In addition, the content of oxygen in the former was lower than that in the latter and hence the fraction of the elemental As to the total amount of As in the former was higher than that in the latter.

Irreversible Circulation of Fluctuation in Coupled Nuclear Reactors

—Application to a Non-Markoffian system far from equilibrium—

Hidetoshi KONNO Keiichi SAITO Masanao KITAMURA

(Received March 31, 1979)

Abstract

A generalized Brownian motion theory is applied to the coupled core nuclear reactors, which is an example of the non-Markoffian system far from equilibrium. Then we calculate analytically the irreversible circulation of fluctuation between cores in the steady state.

Since neutron fluctuation in the coupled cores generally obeys non-Markoffian stochastic process, the definition of irreversible circulation cannot be directly applied. When the memory function takes the form of an exponential type, the Markoffianization procedure becomes possible by introducing new variables. We set up an equivalent Markoffian model and evaluate the irreversible circulation of fluctuation.

In the cource of model building associated with the introduction of additive variables, we discuss the fluctuation-dissipation theorem and the causality condition in relation to the orthogonality between the additive variables and the macrovariables interested. Furthermore, we treat a perturbational approach in order to clarify not only the relation of macroscopic circulation to the irreversible circulation of fluctuation but the irreversible properties of the model introduced.

Finally, the relations among the non-Markoffianity, the nonlinearity and the non-stationarity are shown schematically in connection with the coarse-graining procedures

On the Preparation of Large Single Crystals of Ferrous Sulfide

Keizo NISHIDA Toshio NARITA
and Motoyuki YAMADA

(Received March 31, 1979)

Abstract

Some experiments for the formation of single ferrous sulfide crystals (about 1.5 cm × 1.0 cm ϕ) having stoichiometric and congrent compositions (FeS and $Fe_{0.934}S$) were carried out by the Bridgeman method. The crystals obtained were examined by X-ray diffraction, optical and polarized light microscopy, and their orientations were determined by the pole figure method. The best sound crystal can be obtained by the sulfide having a congruent composition with a lowering rate of 0.33 cm/h produced in a vertical electric furnace and maintained at the highest-temperature part ($\geq$1200°C). Its crystal orientation had a (100) plane perpendicular to the crystal growth direction.

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Free Vibration of a Quadrangular Membrane with an Arbitrary Shape

Toshihiro IRIE, Gen YAMADA and Kaneo YODA

(Received June 30, 1979)

Abstract

The free vibration of a quadrangular membrane with an arbitrary shape is analyzed by use of the Galerkin method. For this purpose, a quadrangular membrane is transformed into a square membrane with edges of unit length by the transformation of variables. By applying the Galerkin method to the equation of motion of the membrane, the frequency equation is derived analytically, where a double Fourier series is used as an admissible function expressing the transverse deflection of the membrane.

The present method is applied to quadrangular membranes symmetrical with respect to one of the diagonals; the natural frequencies (the eigenvalues) and the mode shapes of the membranes are calculated numerically and the effects of the shape of the membrane are studied.

Pressure Exerted on a Domain Wall by Dislocations

Iwao ISHIDA and Hitoshi NAKAE

(Received June 30, 1979)

Abstract

A distribution of pressure exerted on a domain wall by dislocations is studied theoretically. Magnto-elastic interaction between a planer rigid wall and a straight dislocation line is treated on the basis of the relation of Peach-Koehler. A force exerted on the wall by a dislocation line is obtained. Assuming a distribution of dislocation lines, the mean values and variances of the force are calculated. As the dislocation density is ρ, the distribution of pressure on the wall is estimated applying the center limiting theorem to the forces. As a result, the mean pressure becomes zero and the pressure solely depends on the variance. And the variance depends on the distribution and morphology of dislocation lines as well as the λ_{100}, $C_{11}-C_{12}$, $\sqrt{A/K_1}$ and ρ.

Initial Susceptibility and Coercive Force due to Dislocations

Iwao ISHIDA and Hitoshi NAKAE

(Received June 30, 1979)

Abstract

Taking the flexibility into account of a domain wall, the theories of coercive force and initial susceptibility under the influence of dislocations are developed on the basis of the previous paper[1].

Using the distribution function of forces, a coercive force in a mechanism in which the statistical fluctuations of forces are incorporated is evaluated. As compared with the experimental coercive force in Fe-3%Si, an area S_0 approximated by rigid walls becomes 197 (μm^2). It is estimated that the number of ways dividing a total wall area S into n partial area S_i is about $(S_0N_0)^{n/4}$. When $\rho=10^{10}$ (cm/cm^3), $S=1$ (mm^2) and $S_0=197$ (μm^2), the number is about 10^{5000}, which is approximately infinite. In a division when the free energy of wall is minimized,

$$\sum_{i=1}^{n}(S_i\Delta E_{wi}+E_w\Delta S_i) \ll \sum_{i=1}^{n}\Delta V_i\,.$$

Under these conditions, the initial susceptibility χ_a and coercive force H_c are

$$\chi_a=\frac{\sqrt{2}\,I_s^2\cos^2\phi V\sqrt{S_0}}{\sigma_{p0}\sqrt{\pi}}, \qquad H_c=\frac{\lambda\sigma_{p0}}{2I_s\cos\phi\sqrt{S_0}}\,.$$

Influence of a magnetic field on the ionization current at low pressures

—— Application to CH_4 gas ——

Hitoshi HIRAYAMA, Mitsuo SHIMOZUMA, Tsutomu KOBAYASHI and Hiroaki TAGASHIRA

(Received June 30, 1979)

Abstract

The behaviour of electrons in CH_4 gas under crossed electric E and magnetic B fields is studied experimentally and theoritically for $E/p_0 \leq 300$ V cm^{-1} Torr^{-1} and $B/p_0 \leq 400$ G Torr^{-1}. The ionization coefficient α/p_0 is determined from measurement of the ionization current growth, and it is found that α/p_0 at a constant E/p_0 decreases monotonically as B/p_0 is increased. A Monte Carlo simulation method is adopted for the theoritical analysis and the results show that the deviation of the center of mass of an electron avalanche from the

center of the electrodes increases as the electrode separation X and/or B/p_0 are increased. The results also show that as B/p_0 is increased the electron mean energy $\bar{\varepsilon}$ and the ionization coefficient α/p_0 decrease monotonically because the decrease of gyration radius of electrons increases the number of collisions which the electrons undergo in a 1 cm drift in the E field direction. Decrease of the component in the E field direction and increase with saturation in the $E \times B$ direction, of the electron drift velocity with increasing B field at a constant E field are also suggested from the simulation.

Synthetic Studies of Heterocyclic Compounds I

Alkylation and Acylation of 1, 2, 4, 5-Tetrahydro-3-methyl-3H-3-benzazepin-2-one

Kazuhiko ORITO and Tsutomu MATSUZAKI

(Received June 30, 1979)

Abstract

Alkylation of the title azepinone **1** with alkyl halides was studied using a combination of sodium hydride and tetrahydrofuran-N, N-dimethylformamide solvent system. This resulted in the efficient formation of monoalkyl derivatives **2** as well as spiro compounds **3**. Ester condensation type reaction of **1** was also achieved to give 1-acylbenzazepinones **4**.

Über Kolbe-Elektrolyse von ω-Acetylaminocapronsäure 1.

—— Synthese von 1,10-Diacetylaminodecan ——

Yuji KOBAYASI, Toshiro CHIBA, Kazuaki YOKOTA and Yoshiyuki TAKATA

(Received June 30, 1979)

Zusammenfassung

Wir untersuchten die Bedingungen zur Synthese von 1, 10-Diacetylaminodecan nach Kolbe-Elektrolyse der ω-Acetylaminocapronsäure.

Als Lösungsmittel eignet sich Methanol. In Äthanollösung wird 1, 10-Diacetylaminodecan durch Elektrolyse von ω-Acetylaminocapronsäure nicht gebildet.

Als Base zur Neutralisierung von ω-Acetylaminocapronsäure ist das Ätznatron dem Natriummethylat und Ätzkali an Ausbeute von 1, 10-Diacetylaminodecan überlegen.

Elektrolysiertet man bei einem Neutralisierungsgrad von 12% mit Ätznatron, einer Stromdichte von 1.25 A/cm^2, einer Strommenge von 1.8 F/Mol und einer Zimmertemperatur in Methanol, so erhältet man 1, 10-Diacetylaminodecan mit Ausbeute von 39% der Theorie.

A New Microwave Cavity, Cell Assembly and Electronic Attachment for Liquid Phase ENDOR Spectroscopy

Keiichi OHNO

(Received June 30, 1979)

Abstract

A rectangular cavity for the *X*-band is described, in which radio frequency (RF) coils made of flexible printed circuit sheets are attached to the wall of a flat sample cell. The microwave *Q* of the cavity is about 4000. To obtain large RF magnetic fields and observe negative ENDOR signals, a tracking system, a second derivative phase sensitive detector (PSD) system and a magnetic field lock system were constructed. The cavity with the flat sample cell has been tested by ENDOR spectroscopy with a low power RF amplifier (20 W) using 2, 2, 6, 6-tetramethyl-4-oxopiperidinooxy (TANONE) in *n*-heptane and 9, 10-anthraquinone in alkaline ethanol at 20°C.

A Simple Method to Estimate Transfer Characteristics of Vocal Tracts under Utterance

Naoki MIKAMI, Ryoji OHBA and Tohru IDOGAWA

(Received June 30, 1979)

Abstract

The present paper proposes a simple method to estimate the transfer characteristic of a vocal tract under utterance based on only one pitch period of vowel waveform. A vowel waveform generally contains some triangular dips. They correspond to time intervals in which the vocal tract is forced to oscillate by glottal wave. We regarded them approximately

as glottal waveforms. It is ascertained by a computer simulation that the transfer characteristic can be estimated by our method. A data processing system was constructed employing a minicomputer to estimate the transfer characteristic in real-time. Estimation tests were carried out by the system on Japanese vowels from male adults. Using several features of the estimated transfer characteristics, a vowel recognition experiment was also performed on 500 vowel samples from 100 male adults. A vowel classifier was designed and trained by a half of the samples, then its performance was tested on the others. The recognition rate of 93.6% was obtained for the test samples.

On a Graphical Representation of Multidimensional Data

Masaru SHIMBO and Masaaki MIYAKOSHI

(Received June 30, 1979)

Abstract

A reduction technique of plotting multidimensional data on a plane is proposed with reference to Fourier series expansion technique by D. F. Andrews, where the data represent the sampled components of the frequency spectrum. Based on the duality between time and frequency, the same components are regarded here as sampled values of a curve in time domain and the plotted points are connected by applying the wellknown *sampling theorem*. This enables us to read the components of multidimensional data more easily on the plane as well as to cluster the corresponding curves into several groups interactively. The trajectories of project vectors in these reduction techniques are also shown.

The Effect of Temperature on Deformation Structures in Fe-Mn-Cr Austenitic Steel

Heishichiro TAKAHASHI, Taro TAKEYAMA
and Toshiyuki HASEGAWA

(Received June 30, 1979)

Abstract

The influence of temperature on the deformation structures of Fe-Mn-Cr austenitic steel was studied by means of tensile testing and transmission electron microscopy (TEM) in a temperature range from −70 to 360°C.

Yield stress indicated the temperature dependence below 200°C and the dynamical strain aging occurred between 200 and 300°C at which temperatures the higher work hardening was obtained.

Deformation structure also varied with the temperature and ε-phase was formed at −70°C. With increasing in deformation temperature the yield stress decreased and stacking faults and further dislocations occurred. The stacking fault energies were determined by "in situ experiments" using TEM and it was clarified that the stacking fault energy increases with the increasing in temperature.

Thus, the yield stress and the work hardening were affected by the structures which depend on deformation temperature and stacking fault energy. Furthermore, it seems that the increase in stacking fault energy at higher temperatures would cause mobile dislocations to increase and to interact with carbon atoms in solution during deformation.

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The Effect of Work-Hardening and Residual Stress upon the Fatigue Strength

— A Case of Low Temperature Annealing —

Kin-ichi HATA Tōru NAGASAWA

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The purpose of this paper is to examine the effect of work-hardening and residual stress upon the fatigue strength of cold-rolled plate specimens. Material used in this experiment is commercial deoxidized copper. The tension test and bending fatigue test of the cold-rolled specimens are carried out after low temperature annealing in vaccum for 90 min. at 280°C, and then the residual stress in these plate specimens is measured by strain guage method.

In spite of the tensile residual stress in the vicinity of the surface of the plate specimens, the fatigue strength of the cold-rolled specimens increases by 14 to 24% as compared with that of the annealed specimens with an increase of reduction in thickness.

The S–N curves predicted by the equation which has been proposed with consideration of the effect of work-hardening and residual stress are in good agreement with the experimental results. It can be verified from the results that the effect of work-hardening upon the fatigue strength is about 3 times that of residual stress.

Forces and Spatially Distributed Pressure Exerted on Domain Wall by Dislocation Loops in (001) Fe–3% Si Single Crystal

Iwao ISHIDA Hitoshi NAKAE

(Received September 29, 1979)

Abstract

This paper presents a Monte Carlo simulation of the spatial distribution of the pressure exerted on a local rigid wall by dislocation loops in (001) Fe–3% Si single crystal. An expression of a force exerted on a rigid wall by a circular dislocation loops is developed by using the relation of Peach-Koehler. It is assumed that dislocation loops are distributed uniformly and the total force on the wall of area S which is approximated as rigid is the sum of the forces exerted on the wall by the dislocation loops. A distribution of the pressure which is estimated from the spatial distribution of the pressure agrees well with the theoretical results which are obtained by applying the central limit theorem to the forces exerted on the wall by the dislocation loops.

Statistical Analyses of Pressure Exerted on Domain Wall by Dislocation Loops in (001) Fe–3% Si Single Crystal

Iwao ISHIDA Hitoshi NAKAE

(Received September 29, 1979)

Abstract

This paper presents a statistical treatment of the spatial distribution of pressure exerted on a local rigid wall by the dislocation loops in (001) Fe–3% Si single crystal. Assuming that dislocation loops are distributed uniformly, auto-correlation coefficients and power spectrum of the spatially distributed pressure are obtained theoretically and by a Monte Carlo simulation. The theory shows that the auto-correlation coefficient disappears beyond the interaction distance $\xi_0(=2r\cos\gamma+\delta)$, and a peak of power spectrum is at a wave length $\xi_0/2$ or ξ_0 when $2r\cos\gamma$ is within 2δ or beyond 4δ, and beyond δ in $2r\cos\gamma$ tails to wave length δ. These results of the simulation agree well with the theory. Distances ζ between neighbouring stable positions of the wall, absolute values η of the pressure gradients at the positions, and their distributions are obtained from the simulation. The mean distance $\bar{\xi}_f$ become 1.6δ and 4.0δ with $2r\cos\gamma=\delta$ and $2r=240\delta$ respectively. The relation between the mean distance $\bar{\xi}_f$, the mean value $\bar{\eta}$, and the variance of the pressure σ_p^2 is expressed as

$$\sigma_p = \bar{\eta}\bar{\xi}_f/4\sqrt{\pi}$$

Photochemical Reaction of Ethyl 3-Dicyclohexylborylacrylate in Alcohols

Masao TOKUDA Vo Van CHUNG the late Mitsuomi ITOH

(Received September 29, 1979)

Abstract

Irradiations of ethyl 3-dicyclohexylborylacrylate (**1**) in methanol, ethanol, 2-propanol and 1-propanol with a high pressure or a low pressure mercury vapor lamp produced the corresponding 2-cyclohexyl-1, 3, 2-dioxaborolanes (**2a–d**, 20～65%), ethyl 3-cyclohexylpropionate (**3**, ～10%) bicyclohexyl (**4**, ～3%) and 4-alkyl substituted 3-cyclohexyl-γ-butyrolactone (**5**, ～8%). Product **2a–d** was not obtained when irradiated with a Pyrex filtered light (>300 nm). These photochemical reactions proceed *via* a radical process. Dioxaborolanes **2a–d** may be formed by a photochemical reaction of cyclohexyl boron compound with diol, which was produced by a coupling of α-hydroxy alkyl radicals. An interesting photochemical process, in which an excited carbonyl oxygen of **1** attacks a boron atom to induce a migration of cyclohexyl group to β position of **1**, may be involved in the formation reaction of **3**.

Über eine modifizierten synthetischen Verfahren von 2-Alkylbenzimidazolen

—Kondensation von o-Phenylendiamin mit Fettsäuren in p-Toluolsulfonsäure—

Yoshiyuki TAKATA Kazuaki YOKOTA

(Received September 29, 1979)

Zusammenfassung

Wir untersuchten die synthetischen Darstellungsverfahren von 2-Alkylbenzimidazolen durch Kondensation von o-Phenylendiamin mit hoheren Fettsäuren in o-Toluolsulfonsäure.

Die Kondensation von o-Phenylendiamin mit Fettsäuren in p-Toluolsulfonsäure verläuft leicht und liefert 2-Alkylbenzimidazolen mit guter Ausbeute, besonders die reaktionsträgern Fettsäuren, die in α-Stellung Seitenkette besitzen, bilden 2-Alkylbenzimidazolen mit guter Ausbeute.

Die Mischung von 10 m Mol Fettsäure 10 m Mol o-Phenylendiamin und 10 m Mol p-Toluolsulfonsäure-monohydrat werden unter Rühren mit Thermometer auf 170 bis 200° während 1 Stunde in Reagenzglas erhitzt (bei der reaktionsträgern Fettsäuren, Z. B. Pivolinsäure und Di-n-butylessigsäure, 5 Stunden lang erhitzt). Dann gießt man die heißen Mischung in verd. Ammoniak, filtriert das ausgeschiedene Produkt und wascht mit Wasser. Umkristallisiert man aus heißem Äthanol unter Zusatz von Aktivkohle.

Spectral Profile Analysis of Elastically Scattered Neutrons from a Mixture of Bound and Diffusing Nuclei

Yukio SAKAMOTO Kazuhiko INOUE

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Abstract

Neutrons are quasielastically scattered from nuclei performing diffusive motions and are accompanied with small energy change. On the other hand, neutrons are purely elastically scattered from strongly bound and periodically oscillating nuclei and energy change does not occur. These phenomena have an interesting application to the non-destructive and quantitative analysis of the mixture of bound nuclei and diffusing nuclei. The purely elastic scattering spectrum reveals a Gaussian function-like shape due to the resolution of the instrument. The spectral shape of quasielastic scattering has a shape which folds the resolution function into a Lorentzian function having a considerably wide half width at half maximum. The peak positions of these two spectra are in the same energy range, and the experimentally observed spectra are superpositions of these two types of spectra including statistical errors. In the present paper the decomposition procedure will be described in the case of a mixture of bound nuclei and free water.

Spectral Distortion due to Scattered Cold Neutrons in Beryllium Filter

Yukio SAKAMOTO Kazuhiko INOUE

(Received September, 29 1979)

Abstract

Polycrystalline beryllium filters are used to discriminate the cold neutrons from the thermal neutrons with energies above Bragg cut-off energy. The cold neutron scattering cross section is very small, but the remaining cross section is not zero. Then the neutrons scattered once from the filter in the cold neutron energy region have chance of impinging on the outlet of filter. Those neutrons are almost upscattered and develop into thermal neutrons; thus the discriminated cold neutrons include a small spectral distortion due to the thermal neutrons. In the present work we have evaluated the effect on the cold neutron spectrum due to the repeatedly scattered and transmitted neutrons by using a Monte Carlo calculation method.

Intramolecular Structure Study of Liquid Methanol by Neutron Diffraction on Electron LINAC

Haruo FUJIMORI Takaaki MATSUMOTO and Meiseki KATAYAMA

(Received September, 29 1979)

Abstract

A structure study of liquid methanol was performed by means of neutron diffraction using a 45 MeV electron LINAC installed at Hokkaido University. The dynamical effect in the high Q region was succesfully corrected by the method proposed by one of the authors based on the Wick's short time approximation. The structure factor $S(Q)$ of liquid methanol was obtained over a wide range of Q ($1\sim30$Å^{-1}). The intramolecular structure, which can be derived from $S(Q)$ in the high Q region, was examined by comparing with model calculations.

Mössbauer Spectroscopic Determination of Chemical State of Iron in Bauxite

Takashi MOROZUMI Masaharu OTSUKA Hiroshi OHASHI

(Received September 29, 1979)

Abstract

The chemical state of iron contained in several kinds of bauxite, which are utilized as a raw material in the aluminum industry in Japan, were investigated by Mössbauer spectroscopy. The main compounds of iron were identified from the results, which showed variations of the Mössbauer absorption spectra with calcination and measuring temperature. Although the absorption intensities of the spectra differed significantly, major species identified were paramagnetic or superparamagnetic α-Fe_2O_3 in all of these bauxite samples. The superparamagnetic α-Fe_2O_3 was found mainly in the gibbsite-type bauxite, but not in the boehmite/gibbsite-type or the boehmite-type bauxite. The Mössbauer absorption spectra of red mud and its calcined products were also given.

Some Visual Illusions Having Minkowski Space as a Mathematical Information Model

Michiaki KAWAGUCHI Takahiro YAMANOI
Tsukasa KUDO Masaru SHIMBO

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Abstract

Some visual illusions are interpreted Minkowski geometrically. This provides a mathematical information model of human visual systems. In order to derive an equation of indicatrix in visual space, a psychophysical experiment was conducted. The approximated indicatrix determines a metric tensor in visual space. By this tensor Minkowski geometrical aspect of visual space is shown.

On an Error Estimation in the Latent Class Analysis

Yoshiharu SATO Kazuaki SUGAWA Michiaki KAWAGUCHI

(Received September 29, 1979)

Abstract

On the Latent Class Analysis, M. Okamoto pointed out that most of the solutions, e. g. Gibson method, Green method and modified Green method, are unstable in the following sense that the errors of the latent parameters are extremely large in comparison with the observational errors.

In this paper, the errors of the parameters are estimated from the different point of view, that is, from the differential geometrical structure of the statistical parameter space. And it will be shown that this instability is caused by the relative expansion and contraction between the observable parameter space and the latent parameter space rather than the solutions.

A Note on a Self-Excited Vibration Model of Earthquake Process

Masaru SHIMBO

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Abstract

A single mechanical self-excited vibration model, which represents the energy release process of strain energy in earthquakes, is analyzed mathematically and the minute process of crustal disturbance to the earthquake occurrence is clarified. The repetition and/or periodicity of earthquakes are explained and the possibility of earthquake prediction based on a crustal movement in the preseismic stage is discussed here.