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Appendix
Abstracts & Titles, No. 121~125

BULLETIN
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NOTICE

No. 121 May 1984

Papers and Reports	Author	Page
1. Thermoelastoplastic Stress Analysis of a Steel Bar During Rapid Heating and Rapid Cooling	Y. SUGAWARA, H. ISHIKAWA, and K. HATA	1
2. Combination of Parametric and Nonparametric Primitives in Geometric Modeling	M. KINOSHITA, N. OKINO, and Y. KAKAZU	9
3. Deep Electron Traps in Undoped GaAs Grown by MOCVD	T. HASHIZUME, E. IKEDA, Y. AKATSU, H. OHNO, and H. HASEGAWA	23
4. Calcination of Perlite from Volcanic Ashes in Hokkaido Using a Pneumatic Conveyor Calciner	T. TSUJI, O. UEMAKI and M. KUGO	33
5. Electron Spin-Echo Spectrometer for Structural Studies of Magnetic Nuclei around Paramagnetic Species	T. ICHIKAWA and H. YOSHIDA	41
6. Analysis of Electron Spin-Echo Nuclear Modulation by the Least-Squares Method	T. ICHIKAWA and H. YOSHIDA	51
7. On an Extension of the Parameter Space of the Multinomial Distribution	N. TANEICHI, Y. SATO and M. KAWAGUCHI	59
8. On Some Properties of UNIX Operating System	T. DATE	69
9. Radiation-Induced Segregation in Austenitic and Ferritic Steels	T. TAKEYAMA, H. TAKAHASHI and S. OHNUKI	85
10. Resonant Faraday Rotation and Holography for the Measurement of Spatial Magnetic Field and Atomic Density in a Plasma	S. HIMENO, T. ENOTO, H. MOCHIZUKI K. HIRANO, and Y. OZAWA	101

Thermoelastoplastic Stress Analysis of a Steel Bar During Rapid Heating and Rapid Cooling

YUKIO SUGAWARA, HIROMASA ISHIKAWA, and KIN-ICHI HATA

(Received December 27, 1983)

Abstract

The thermoelastoplastic stress analysis of a carbon steel bar, which is heated rapidly, and starts to be cooled rapidly before the steady state of the temperature distribution is reached, is carried out. The A_1 and A_3 transformations on heating and the martensite, bainite, and pearlite transformations on cooling are considered using a continuous cooling transformation diagram.

It is assumed that only the part which is heated over the A_3 transformation temperature on heating can transform into martensite when the cooling rate is sufficiently large. The numerical calculations are carried out for two typical cases when the heating time is longer or shorter.

The plastic strain in the structure of martensite is larger than that in the other structures. When the heating time is longer, there are structures of martensite, pearlite, and bainite in the quenched steel bar. On the other hand when the heating time is shorter pearlite and martensite are caused, and the surface of the bar has the large amount of tensile stress.

Combination of Parametric and Non-parametric primitives in Geometric Modeling

*Masahiro KINOSHITA,** Norio OKINO,*** Yukinori KAKAZU

(Received December 27, 1983)

Abstract

This paper describes the manner in which the parametric and non-parametric primitives are combined for modeling of 3-D geometry. Theoretically, it is assumed that this combination problem has no solution.

By introducing the concept distance, both spaces can be changed in a kind of Norm Space. Here, the Penalty Function who developed as a Pseudo distance function, and by applying this function, both primitives can be treated in the same Penalty Space. As a result, both primitives can be used for geometric primitives for CSG.

Deep Electron Traps in Undoped GaAs Grown by MOCVD

Tamotsu HASHIZUME, Eiji IKEDA, Yuji AKATSU

Hideo OHNO, Hideki HASEGAWA

(Received December 27, 1983)

Abstract

Deep electron traps in undoped GaAs grown by metalorganic chemical vapor deposition (MOCVD) are investigated. The relationship between the growth parameter and the origin of the traps are discussed. Deep level transient spectroscopy (DLTS) has been used to determine the thermal activation energy, the capture cross section and the density of deep traps.

Seven electron traps are detected. The dominant electron trap in MOCVD GaAs layers is EHI with an activation energy $=0.80 \pm 0.02$ eV, which is most probably the same level as EL2 in conventional vapor phase epitaxial GaAs layers.

Two traps (EH2, EH3) are related to the epitaxial layer substrate interface and the remaining four traps (EH4-7) are determined to be due to impurities in trimethylgallium (TMG) used in MOCVD growth.

Calcination of perlite from volcanic ashes in Hokkaido using a pneumatic conveyor calciner

Toshiro TSUJI, Osamu UEMAKI and Masao KUGO

(Received December 27, 1983)

Abstract

Experimental results are reported related to the calcination of perlite from volcanic ashes in Hokkaido using a pneumatic conveyor calciner. The experiments were conducted under different operating conditions and bulk densities of the products were measured.

Passing time of particles in the conveyor pipe was less than a few seconds but was sufficient for expanding the perlite. The expanding rate of the perlite was strongly dependent on calcining temperature and increased with the temperature. Bulk density of the products could be well controlled by adjusting the excess air of the burner. Minimum bulk density of the products was $0.035(\text{g}/\text{cm}^3)$. Yields of the products were more than 80%. Preheating of raw materials under excessively high temperature caused a reduction of the expanding ratio of the products.

Electron Spin-Echo Spectrometer for Structural Studies of Magnetic Nuclei around Paramagnetic Species

Tsuneki ICHIKAWA and Hiroshi YOSHIDA

(Received December 27, 1983)

Abstract

An x-band electron spin-echo spectrometer for deducing detailed geometrical information of magnetic nuclei around paramagnetic species is described. This spectrometer is used to detect nuclear modulation effects on 2-pulse and 3-pulse electron spin-echo signals. The spectrometer has 2.5 ns time resolution and 200 ns dead time. The minimum width of the microwave pulse applied to the sample in the optimally-designed resonator is 30 ns. Observed electron spin echo signals for Cu^{2+} in frozen aqueous solutions are shown for exhibiting satisfactory characteristics of the spectrometer.

Analysis of Electron Spin-Echo Nuclear Modulation by the Least-Squares Method

Tsuneki ICHIKAWA and Hiroshi YOSHIDA

(Received December 27, 1983)

Abstract

A new analysis for electron spin-echo nuclear modulations is presented which is used for deducing the local structure of paramagnetic species in disordered solids. The experimental spin-echo spectrum is compared with the theoretical one under given electron spin-nuclear spin distances and isotropic couplings to obtain the number of the interacting nuclei and the echo decay function by the least-squares method. The optimal distances and hyperfine couplings are then determined in such a way as to minimize the square errors. The results obtained by applying this new method to the 2-pulse electron spin-echo spectra of Ag atoms in CD_3CN and Mn^{2+} ions in moist strong-acid ion-exchange resin and silica gel are shown.

On an Extension of the Parameter Space of the Multinomial Distribution

Nobuhiro TANEICHI, Yoshiharu SATO and Michiaki KAWAGUCHI

(Received December 27, 1983)

Abstract

The main purpose of this paper is to consider the geometrical properties of the parameter space with the metric based on α -entropy. For any value of α , it is shown that the parameter space of the multinomial distributions can be imbedded as a hypersurface in an Euclidean space. As a Riemannian hypersurface, the differential geometrical structures of the parameter space of the multinomial distributions are investigated.

With respect to the trinomial distributions, where the parameter space is regarded as a 2-dimensional hypersurface in 3-dimensional Euclidean space, several illustrations of the hypersurface depending on α are given and their features are considered.

On Some Properties of UNIX Operating System

Tsutomu DATE

(Received December 27, 1983)

Abstract

UNIX is a computer operating system developed first at Bell Laboratories and now used widely for research in operating systems, languages, computer networks, and other topics in computer science, and also for document preparation as utilities for the editing, transformation, analysis, and publication of text of all types.

We discuss in this paper how useful the UNIX system is for English speaking people, or how available or not it is for us Japanese speaking people. By dealing with those which are observed in the first use by the author, we consider non-quantitative measures such as comfortability or satisfactoriness in regard to managing the system, which will differ widely in different levels of knowledges or experiences of users.

Radiation-Induced Segregation in Austenitic and Ferritic Steels

Taro TAKEYAMA, Heishichiro TAKAHASHI and Soumei OHNUKI

(Received December 27, 1983)

Abstract

Void formation and radiation-induced segregation in modified 316 austenitic stainless steels and ferritic steels were investigated by electron and ion irradiations. In austenitic steels modified by Ti and Nb, void swelling was effectively suppressed, particularly the growth rate of voids was remarkably retarded in Nb contained steel. Local composition of solute elements near voids and grain boundaries changed during irradiation. In ferritic steels, significant resistance to void swelling was observed. Radiation-induced segregation and precipitation were confirmed on voids, dislocation loops and grain boundaries. From these results, it was indicated that void formation could be affected due to an effect of solute segregation.

Resonant Faraday Rotation and Holography for the Measurement of Spatial Magnetic Field and Atomic Density in a Plasma

Shun-ichi HIMENO*, Takeaki ENOTO**, Hitoshi MOCHIZUKI*,

Kei-ichi HIRANO***, and Yasutomo OZAWA****

(Received December 27, 1983)

Abstract

This paper describes a method of measuring spatial distributions of magnetic field by resonant Faraday rotation in combination with resonant holographic interferometry using a tunable dye laser.

The sensitivity and selectivity of these resonant methods are high in comparison with conventional Faraday rotation and holographic interferometry.

NOTICE

No. 122 July 1984

Papers and Reports	Author	Page
1. Removal of Arsenic from Lead anode Slime	S. TASAI and T. TANAKA	1
2. Numerical Simulation of a Light-Illuminated Gunn Device	A. TAKAHASHI and Y. OGAWA	9
3. A Split-Band Delay Equalizer for a Sound Transmission Line	Y. KONNO and Y. OGAWA	17
4. A Method to obtain the Shortest Hamilton-Line on a Traveling Salesman problem	K. SAKAKIBARA	23
5. Heat Transfer in Condensation of Steam Containing Noncondensable Gas	Y. NISHINO, T. TSUJI, T. SHIBATA and O. UEMAKI	29
6. Effects of Additives on the Growth of SnO ₂ Crystals by Vapor Phase Reaction Method	T. MATSUSHITA, I. YAMAI, K. KODAIRA, J. SAITO and R. YOSHIDA	41
7. Neutron Scattering Studies by Using Quasielastic Spectrometers Based upon a Pulsed Cold Neutron Source	K. INOUE and K. KAJI	49
8. Pulverizing and Its Prevention of Hydrogen-storage Iron-titanium Alloy	T. MOROZUMI, T. MIZUNO, N. SATO and T. TABUCHI	61
9. Quantitative Analysis of Uranium by Controlled-Potential Coulometry	H. OHASHI, U. WATANABE and T. MOROZUMI	73
10. Automatic Recognition of Continuously Spoken Vowels	M. ITASAKA, M. MIYAKOSHI and M. SHIMBO	83

Removal of Arsenic from Lead anode Slime

Shigeo TASAI, Tokiaki TANAKA
(Received March 31, 1984)

Abstract

The following four methods were investigated to remove As in lead anode slime and the data obtained from these experiments were compared and discussed.

- 1) Roasting in air, Ar, and under reduced pressure.
- 2) Water and caustic leaching.
- 3) Pressure leaching.
- 4) Roasting with soda ash.

Roasting in air, Ar, and under reduced pressure are unattractive because of the insufficient removal of As due to the ease in sintering which inhibits the removal of As.

Higher removal of As is expected in caustic leaching, but the compound β -Cu₃As present in the anode slime is not attacked during caustic dissolution.

In the pressure leaching tests made using an autoclave, a difficulty is encountered in the filtration of the leached solution. Solid particles are in colloidal suspension which pass through the filter. This results in the incomplete removal of As.

Roasting with soda ash gives the highest removal of As among the four treatments described above. Partial substitution of NaNO₃ for soda ash is effective in removing As.

Numerical Simulation of a Light-Illuminated Gunn Device

Akihiko TAKAHASHI and Yoshihiko OGAWA
(Received March 31, 1984)

Abstract

The Gunn device operates at a low voltage and yields high-power outputs in the microwave band. The device is desired to be controlled by light for the application to an optical communication system. In this paper, the controllability of light is inves-

tigated by a numerical simulation based on a one-dimensional Gunn device model. As a result of the simulation, it is shown that dc to microwave conversion efficiency increases linearly in proportion to the amount of light. It seems that holes generated by the illumination plays as donors in the device.

A Split-Band Delay Equalizer for a Sound Transmission Line

Yasuhide KONNO and Yoshihiko OGAWA
(Received March 31, 1984)

Abstract

Group delay distortion in a sound transmission line for MF radio broadcasting serviced by Nippon Telegraph & Telephone Public Corporation cannot be ignored. In this paper, an equalizer which compensates for the distortion is described in detail. It is not conceivable to design an equalizer with the inverse characteristics of the transmission line. Therefore the actual inverse characteristics is replaced by a staircase form. And to realize the characteristics, we split the band into several sections and design an equalizer with a constant delay in a each section. Each basic section of the equalizer consists of an analog delay element, a highpass filter and a lowpass filter.

Using higher-order Butterworth filters and adjusting cross-over frequencies, the amplitude characteristics become flat and the phase characteristics are connected continuously at each cross-over frequency. Thus the equalizer proposed here provides an adequate compensation for the distortion.

A Method to obtain the Shortest Hamilton—Line on a Traveling Salesman problem

Katsuaki SAKAKIBARA
(Received March 31, 1984)

Abstract

A method to obtain all Hamilton—lines which are shorter than a Hamilton—line for a given example is presented in this work. In an example composed of various points, we can obtain the shortest Hamilton—line with less loss by repeatedly using this method.

Heat Transfer in Condensation of Steam Containing Noncondensable Gas

Yoshitaka NISHINO, Toshiro TSUJI
Toshiharu SHIBATA, Osamu UEMAKI
(Received March 31, 1984)

Abstract

The rate of heat transfer in condensation of steam containing noncondensable gas was experimentally investigated to analyze the heat transfer phenomena in a liquid—film type evaporator heated with high humid waste gas from a dryer of filtrated stock. The heat transfer coefficients were measured in a vertical heat exchanger by the use of steam containing a large amount of air, such as 0~2.28 (kg-H₂O/kg-air), as the heating medium. The effects of Reynolds number and concentration of steam on heat transfer coefficients were determined, and the mechanism of heat transfer was elucidated. The results indicated that the heat transfer coefficients increased with the increasing flow rate of the mixed gas and the presence of appreciable quantities of air markedly reduced the rate of heat transfer. It is suggested that the main resistance for heat transfer exists in the boundary layer of the mixed gas so that the condensate film exerts less influence on the rate of heat transfer. Correlations for the heat transfer coefficients based on the experimental data are proposed.

Effects of Additives on the Growth of SnO₂ Crystals by Vapor Phase Reaction Method

Toru MATSUSHITA, Iwao YAMAI, Kohei KODAIRA,
Junji SAITO and Ryoichi YOSHIDA
(Received March 31, 1984)

Abstract

SnO₂ needle crystals doped with Cr, V and Sb were successfully grown from the mixture of SnO₂ and tin metal powders by vapor phase reaction method. When doping additives are not reduced by tin metal, crystal growth occurred as well as in the case without additives, because the formation of SnO vapor can not be disturbed by the additives. The colors of crystals with Sb, V and Cr were grayish blue, yellow and light purple, respectively. The growth direction of these SnO₂ crystals was along the a-axis. The crystals with Sb showed a metallic conduction, while that with V showed a semiconductive conduction.

Neutron Scattering Studies by Using Quasielastic Spectrometers Based upon a Pulsed Cold Neutron Source

Kazuhiko INOUE and Keisuke KAJI
(Received March 31, 1984)

Abstract

Two spectrometers installed at National Laboratory for High Energy Physics, LAM-40 and LAM-80, are useful apparatuses for the investigation of the molecular motions in polymers. These spectrometers utilize the know-how of the pulsed cold neutron source and the quasielastic spectrometer which have been developed at Hokkaido University. By using two spectrometers we can conduct measurements and analyses regarding the fluctuational motions in polymers.

Pulverizing and Its Prevention of Hydrogen-storage Iron-titanium Alloy

Takashi MOROZUMI, Tadahiko MIZUNO,
Noriaki SATO and Toshiya TABUCHI
(Received March 31, 1984)

Abstract

A study was presented on the pulverizing behaviors of nonstoichiometric iron-titanium alloy, in which hydrogen was repeatedly absorbed and desorbed. The characterization was made as a function of absorption-desorption cycle by measuring various physical and chemical properties: the hydrogen absorption rate and isotherm, the BET area, the particle size distribution, the X-ray diffraction and the Mössbauer spectrum. From the results of these measurements, it was concluded that major changes occurred in micro-structures of alloy within fifty cycles of the initial absorption and desorption of hydrogen. Scanning electron-microscopic observation revealed, however, a delayed fragmentation due to the bond remaining on the tips of cleavages in alloy particles. Zinc coating was not quite inhibitive for the destruction of microstructure, but it effectively prevented the fragmentation. The effect was explained by assuming a capsulation of pulverized alloy with an envelope of zinc film.

Quantitative Analysis of Uranium by Controlled-Potential Coulometry

Hiroshi OHASHI, Urara WATANABE, and Takashi MOROZUMI
(Received March 31, 1984)

Abstract

A modification of controlled-potential coulometry is proposed to determine uranium amounts in solution. The method involves a reduction of uranium(VI) to uranium(IV) with iron(II) in concentrated phosphoric acid, a selective oxidation of excess iron(II) with nitric acid in the presence of molybdenum(VI) catalyst, and an electrochemical titration of uranium(IV) under controlled-potential conditions. The analysis of the transient current gave the rate constant for the uranium(IV) oxidation and the amount

of uranium. The first order rate constant for the uranium(IV) oxidation was nearly unchanged irrespective of the electrode potential between 700 and 900 mV vs. SCE, and the activation energy for the reaction was 15.7 kcal/mol. The amount of uranium was determined by three methods: by the maximum current, numerical integration and extrapolation. Measuring the maximum current was the most convenient, since it required only a short time and was sufficiently accurate and precise. For the electrolysis, we recommend a potential between 750 and 850 mV vs. SCE and a temperature around 40 °C.

Automatic Recognition of Continuously Spoken Vowels

Masaaki ITASAKA, Masaaki MIYAKOSHI and Masaru SHIMBO
(Received March 31, 1984)

Abstract

An automatic speech recognition system of continuously spoken vowels is proposed based on the mathematical phonetical theory. In order to identify vowel phonemes in speech sounds, parameters on a projective vowel plane are calculated from their local peak frequencies. Some experiments are carried out for consecutive vowels, consonant-vowel utterances, etc.

NOTICE

No. 123 October 1984

Papers and Reports	Author	Page
1. Estimation of Dynamic Stresses around the Shot Point by Scale Model Experiment	M. UJIHIRA and H. SHIMAUCHI	1
2. Determination of Faradaic Current through a Bipolar Electrode in Acidic Bichromate	T. SASAKI and T. ISHIKAWA	15
3. Experimental Study on the Glow Plug Aided Alcohol Driven Diesel Engine	T. MURAYAMA, N. MIYAMOTO, T. CHIKAHISA and H. OGAWA	27
4. Implication structures for generalized Implication matrix in ISM	S. KASE, A. OHUCHI, M. KURIHARA and I. KAJI	43
5. Automatic Homonym Selection Using Character Chain Matching in a Japanese Word-Processing System	T. ITOH, K. TOCHINAI and K. NAGATA	55
6. A Mathematical Model of Visual Perception Regarding Peripheral Vision and Its Application to the Hermann's Illusion	T. OYAMA, T. YAMANOI, T. YAMAZAKI and M. KAWAGUCHI	67
7. Analysis Based on Reissner Theory for Rectangular Plates With all Edges Built-in	S. OTSU, T. UCHIYAMA and Y. DOBASHI	77

Estimation of Dynamic Stresses around the Shot Point by Scale Model Experiment

Masuyuki UJIHIRA and Hiroshi SHIMAUCHI

(Received June 30, 1984)

Abstract

In order to evaluate the adaptability of the Similar Law to the problems of dynamic stresses within soft material caused by detonation of explosives, two types of blasting experiments were carried out. One of them was the small scale laboratory experiment and the other one was the actual scale shotfiring test in an underground drift. In every experiment, dynamic strain waves were measured, from which dynamic stresses were calculated by the elastic theory. As a result of analyses, it was found that the Similar Law could be applied in these blasting stress problems and the stresses could be estimated around the actual scale blasting from small scale model experiments.

Furthermore, it is considered that in the case where the direction of dynamic stress of blasting σ_{max} corresponds to that of maximum principle burden stress σ_1 , shearing yield condition of the coal seam is apt to be satisfied. So, in driving in the steep dip coal seam, additional stresses by blasting could act most effectively and widely in the upper zone of the working face.

Determination of Faradaic Current through a Bipolar Electrode in Acidic Bichromate

Takeshi SASAKI* and Tatsuo ISHIKAWA*

(Received June 30, 1984)

Abstract

In order to elucidate the factors determining the proportion of the Faradaic current to the applied one, the Faradaic current through a bipolar electrode was measured under various conditions in acidic bichromate solutions.

A modified electrode was adopted for measurement of the Faradaic current in a compactly packed cell. The bipolar electrodes consisted of graphite disks with many drilled holes. The by-pass resistance, the electric resistance of the electrolyte filling the holes, widely varied with functions of the diameter and the number of the holes and the thickness of the electrodes. The interelectrode gaps were also varied.

The proportion of the Faradaic current to the applied one was substantially determined by the by-pass resistance independent of the diameter and the number of holes, and the thickness of the electrode. As continuous electrolysis was carried out in the acidic bichromate solutions, the proportion of the Faradaic current remarkably decreased in low concentrations of Cr(VI) and this was responsible for the decrease in the gross current efficiency in the bipolar electrode cell.

Experimental Study on the Glow Plug Aided Alcohol Driven Diesel Engine

Tadashi MURAYAMA, Noboru MIYAMOTO,
Takemi CHIKAHISA and Hideyuki OGAWA

(Received June 30, 1984)

Abstract

Forced ignition with glow plugs has a great potential for the utilization of alcohol fuels in diesel engines. However, the installation of glow plugs may cause misfiring or knocking in parts of the operating range. This paper presents an analysis of the factors influencing the ignition characteristics of ethanol in a glow plug-assisted diesel engine; these factors may be classified into two categories: the factors related to the temperature history of the droplets before contact with the glow plug, and those related to the probability of contact. By optimizing these factors, the combustion difficulties were successfully eliminated over the whole operating range, and engine performance comparable with conventional diesel operation was achieved.

Implication structures for generalized Implication matrix in ISM

Satoshi KASE, Azuma OHUCHI, Masahito KURIHARA and Ikuo KAJI

(Received June 30, 1984)

Abstract

In this paper, the theory of generalized complete implication matrix is described which expresses the implication structures of interpretive structural modeling (ISM).

Explicit expression of the complete implication matrix is obtained by analyzing the implication relations. A simple three-step algorithm is proposed for generating the complete implication matrix by using this result. The theory makes it possible to do transitive embedding process of ISM flexibly. The results obtained in this paper includes a Warfield' interconnection theory as a special case.

Automatic Homonym Selection Using Character Chain Matching In a Japanese Word-Processing System

Taisuke ITOH, Koji TOCHINAI and Kuniichi NAGATA

(Received June 30, 1984)

Abstract

In the Kana-Kanji translation system for the Japanese word processing, the manner in which to select homonyms is an important factor for the performance of the system.

We have developed a method for the automatic homonym selection by the use of the character chain matching.

Letters which appear just before and after a word are considered to be determined by the grammatical relation such as conjugation, the context of the sentence and the personal style of the writer, etc. Therefore, comparing a set of a word and letters just before and after it with those registered in the dictionary, homonyms can be selected as a suitable one.

In this paper we describe the construction of the homonym dictionary and selection algorithms used in the prototype system developed. Results of input experiments are also described, and it is concluded that about 50% of homonyms are automatically selected.

**A Mathematical Model of Visual Perception Regarding
Peripheral Vision and Its Application
to the Hermann's Illusion**

Takamasa OYAMA, Takahiro YAMANOI, Toshimasa YAMAZAKI
and Michiaki KAWAGUCHI

(Received June 30, 1984)

Abstract

Human visual perception is treated on the basis of the concepts of receptive field in physiology and in psychology.

The distribution of receptive field on the retina is assumed by the fact that the central vision differs from the peripheral one. A function is introduced so that it fits the assumption.

A mathematical model of visual output function is determined by the function introduced and by the model of the lateral inhibition.

The deeper understanding of the mechanism of the Hermann's illusion is acquired by this model.

**Analysis Based on Reissner Theory for Rectangular
Plates With all Edges Built-in**

Satoshi OTSU, Takeshi UCHIYAMA and Yoshizo DOBASHI

(Received June 30, 1984)

Abstract

Taking into account the shear effect for differently loaded, all-edge-built in rectangular plates of a system of series solution of Reissner type is obtained where the numerical results are comparable with those of the classic thin plate analysis.

Preliminary groundwork to its elasto-plastic development presenting the above results are intended to furnish a means of checking such an effort potentially due to finite element or other analysis, this may be supplementary to the currently available knowledge of pertinent elastic solutions since it seems insufficient other than for simply supported cases.

NOTICE

No. 124 January 1985

Papers and Reports	Author	Page
1. Development of a Robot Simulator	Y. KAKAZU, N. OKINO, H. YOSHIMURA and H. NAKAMURA	1
2. Development of CAD System for a Dieset of Mold Base	M. KINOSHITA, N. OKINO, Y. KAKAZU and S. SAWAI	13
3. The Waiting Time of Vehicles in a PRT Merging Section with the Restriction of Both the Number of Waiting Vehicles and the Waiting Time	Y. HAMAMATSU, M. KURIHARA and I. KAJI	25
4. Epitaxial Growth of GaAs, InAs, $Ga_xIn_{1-x}As$ and GaAs/InAs Strained Layer Superlattice by Molecular Beam Epitaxy	R. KATSUMI, H. OHNO, T. TAKAMA and H. HASEGAWA	37
5. Multiple Scattering of a Cylindrical Sample in Quasielastic Neutron Scattering	K. INOUE	49
6. Radiation induced change in the affinity of a plastic resin to chlorine contained in artificial tap water	R. FUJIYOSHI, S. SAWAMURA and M. KATAYAMA	59
7. On the variances of estimators based on an α -entropy	Y. SATO, N. TANEICHI and M. KAWAGUCHI	69

Development of a Robot Simulator by

Yukinori KAKAZU, Norio OKINO,
Hitoshi YOSHIMURA and Hitoya NAKAMURA

(Received September 29, 1984)

Abstract

In the present days, industrial robots are playing key roles in highly automated factories. Various types of robots have been developed and used for a variety of purposes. To incorporate these robots into highly organized production systems, e. g. FMS, an approach was introduced to solve some typical problems: how to avoid dangerous collisions, how to use robots effectively and how to develop new robots some special purposes are our main objectives. The approach made here is based on a virtual robot, i. e. robot simulator: based on Geometric Modeling.

This paper describes how the new type of robot simulator was developed and the fact that the simulator consists of the following parts.

- (1) Geometric Modeling part of the virtual robot world.
- (2) Robot mechanism modeling part.
- (3) Output part of synthetic solution of robot motion.
- (4) Robot Language part.
- (5) Transformation part of the robot world geometry.
- (6) Graphic output part.

In addition, with respect to Geometric Modeling, 3D Solid Modeling method is adopted. Therefore, this robot simulator can easily be connected to 3D CAD systems.

Development of CAD System for a Dieset of Mold Base

Masahiro KINOSHITA, Norio OKINO, Yukinori KAKAZU
and Suguru SAWAI

(Received September 29, 1984)

Abstract

Making a dieset requires a set of complex procedures to complete it and further requires

routine work at work shops.

This paper describes an approach to replace this routine work by a computer. First, a problem oriented data base is constructed. In this data base, geometry of the dieset and their dimensions are stored, and then they are retrieved and modified through a design process. Second, when the modification is finished, 3D Solid model is constructed from 2D drawing and is stored in the data base for CAD applications. Experiments are conducted by using TIPS-1 Solid Modeler and three orthographic views, oblique figures (shaded picture etc.) are obtained as well as necessary technical information.

The Waiting Time of Vehicles in a PRT Merging Section with the Restriction of Both the Number of Waiting Vehicles and the Waiting Time

Yoshio HAMAMATSU, Masahito KURIHARA and Ikuo KAJI

(Received September 29, 1984)

Abstract

We consider a merging section of the personal rapid transit (PRT) system. The merging section is composed of overpasses and underpasses and the traffic flow goes from the subline to the mainline through an offline. The vehicles going from the subline into the mainline must form a queue in order to avoid colliding with other vehicles of the mainline, but we assume that the length of the queue is finite.

We restrict both the maximum queue length in the subline and the maximum number of slot slippings to the first vehicle in the queue. In the model, we derive the average number of vehicles in the queue, the average waiting time of vehicles and the rerouting rate using the Markov chain technique.

**Epitaxial Growth of GaAs, InAs, Ga_xIn_{1-x}As
and GaAs/InAs Strained Layer Superlattice
by Molecular Beam Epitaxy**

Ryuichi KATSUMI, Hideo OHNO,
Toshihiko TAKAMA and Hideki HASEGAWA
(Received September 29, 1984)

Abstract

Molecular beam epitaxial (MBE) growths of GaAs, InAs, Ga_xIn_{1-x}As and GaAs/InAs strained layer superlattices are reported. Growth condition for epitaxial growth are determined and the resulting layers are characterized by Van der Pauw Hall measurement, optical absorption and X-ray diffraction. Satellite peaks due to superlattice structure have been observed in X-ray diffraction peaks from GaAs/InAs SLS. This fact indicates that successful growth of superlattice structures with a combination of materials with 7% lattice mismatch can be done by MBE.

**Multiple Scattering of a Cylindrical Sample
in Quasielastic Neutron Scattering**

Kazuhiko INOUE
(Received September 29, 1984)

Abstract

For data analysis of quasielastic neutron scattering, it is essential that multiple scattering corrections, which include energy transfer information, be as accurate as possible. We have proposed an expansion of the integral representation of the scattering operator for neutron transport phenomena which enables us to calculate multiple scattering corrections including energy transfer phenomena, readily and exactly. We have also set forth a method of numerical calculation which is useful for the assessment of multiple scattering in a cylindrical sample. We have also derived a calculation method, i.e. the nest theory to avoid an apparent numerical overflow in the numerical integral representation. In this paper, we have described the expansion for multiple scattering, the numerical method, the nest theory, and the results of their application to some molecular liquid scattering samples.

Radiation induced change in the affinity of a plastic resin to chlorine contained in artificial tap water

Ryoko FUJIYOSHI, Sadashi SAWAMURA and
Meiseki KATAYAMA

(Received September 29, 1984)

Abstract

γ -Radiation curing of a polyacetal resin was attempted in order to eliminate the unsuitable property for the joints of tap water pipes. In the case of non-irradiated resin, almost all available chlorine (AC) contained in usual tap water disappeared.

γ -Irradiation of the resin showed an indirect effect on eliminating such a property; that is, a decrease in the amount of AC from artificial tap water (test solution) showed a decrease to JIS (Japan Industrial Standards) level of requirement at certain absorption doses.

However, it was also found that the decrease in the amount of AC from the test solution increased with time after γ -irradiation.

On the variances of estimators based on an α -entropy

Yoshiharu SATO, Nobuhiro TANEICHI and Michiaki KAWAGUCHI

(Received September 29, 1984)

Abstract

The estimation problem in which the probabilities of multinomial distribution are the functions of unknown parameters is discussed. Three types of estimators are offered using the theory of parameter space of the multinomial distribution based on an α -entropy, reported in the previous paper. These estimators include the maximum likelihood estimator, minimum chi-square and minimum modified chi-square estimator as their special cases. The variances of these estimators are calculated up to the second order and their magnitudes are evaluated for a finite number of samples.

NOTICE

No. 125 March 1985

Papers and Reports	Author	Page
1. Crystallinity and Disorder Parameter in Piezoelectric Polymers	A. ODAJIMA and K. YUASA	1
2. Photodarkening phenomena in amorphous chalcogenide semiconductors.....	K. T ANAKA, T. NAKAGAWA and A. ODAJIMA	9
3. Determination of Dipole Moments in P · VDF _x /TrFE _{1-x} by X-Ray Photoelectron Spectroscopy	T. UENO and A. ODAJIMA	15
4. Structural Changes in an Aromatic Polyimide on Annealing at High Temperatures and Electron Irradiation	T. ISHIBASHI, O. YODA, M. HAGIWARA and A. ODAJIMA	21
5. Transient Characteristics of Ferroelectric Polarization Switching of Polyvinylidene Fluoride.....	Y. TAKASE and A. ODAJIMA	29
6. Preliminary Experiment for Microcomputer Control of a 633 nm He-Ne Laser with an Iodine absorption Cell	K. TANAKA and S. KAWABATA	37
7. Direct Observation of Glottal Waveforms Using Optical Fiber Probe Microphone	R. OHBA, T. SYOZU, A. MACHIDA and N. MIKAMI	47
8. Fast Algorithms to Extract Feature Parameters of Vowels by Digital Filters	N. MIKAMI and R. OHBA	53
9. Automatic Orientation Analysis of Crystallographic Axes of Arbitrary Lattice Using X-ray Laue Photograph	I. UEHIRA, H. YAMADA, H. WATANABE and R. OHBA	61
10. New Approaches for Data Processing in Photogrammetry	R. OHBA, S. KONDO, K. NAKAGAWA, K. TANAKA and K. MURATA	69
11. Measurement of Ray- and Wave-Aberration by Spatial Filtering	K. MURATA and H. MATSUI	77

12. Observation of Binary Stars by Stellar Speckle Interferometry with White LightN. BABA, M. YAMAMOTO and K. MURATA 85
13. Wave and Geometrical Approach in Hologram AberrationY. ISHII 91
14. Image Restoration by a Constrained Iterative MethodJ. MAEDA 97
15. Characteristics of Images Reconstructed from 360° HologramR. SATO and K. MURATA 103
16. Dynamical Processes of Dislocations and Point Defects in Ice CrystalA. HIGASHI, A. FUKUDA, T. HONDOH, K. GOTO and S. AMAKAI 111
17. Periodic Structure of Grain Boundaries and Grain Boundary Dislocations in a Hexagonal CrystalT. HONDOH 123
18. Total Gas Content in Deep Ice CoresM. NAKAWO 135
19. Mechanical Relaxations in Linear Low-Density PolyethyleneM. KAKIZAKI, H. IWASAKI and T. HIDESHIMA 145
20. Relaxation Phenomena in Polyethylene Pulverized at Liquid Nitrogen TemperatureY. ANADA, M. KAKIZAKI and T. HIDESHIMA 155
21. Nuclear Magnetic Relaxation of Polymers Undergoing Multiple Internal RotationsA. TSUTSUMI and T. HIDESHIMA, 169
22. New Experimental Techniques for Accurate Determination of the Structure Factors —Measurements of Pendellösung Beats Using White Radiations—T. TAKAMA, K. KOBAYASHI and S. SATO, 181
23. Strain Compatibility at the Grain Boundary in Cu-Zn-Al Shape Memory AlloysK. TAKEZAWA, H. CHIBA and S. SATO 191
24. Atomic Structure of Twin Boundaries Deduced from Quantitative Analysis of Image Contrast of Electron MicrographsK. MARUKAWA 201

Crystallinity and Disorder Parameter in Piezoelectric Polymers

Akira ODAJIMA and Kimihiro YUASA

(Received November 30, 1984)

Abstract

A new X-ray method of crystallinity determination is developed. This method takes into account the diffuse scattering due to thermal vibrations and lattice imperfections in the crystalline part of a semicrystalline polymer.

The present method is applied to a ferroelectric polymer, namely, vinylidene fluoride and trifluoroethylene copolymer ($P \cdot VDF_{72}/TrFE_{28}$). The amorphous background of the observed X-ray scattering curve is expressed by the X-ray scattering curve from the perfectly amorphous $P \cdot VDF_{72}/TrFE_{28}$, in which the Ruland method has been used to determine the relative amount of the amorphous background. The result shows that $P \cdot VDF_{72}/TrFE_{28}$ possesses a high degree of crystallinity of about 90 %, on good annealing. This is in good agreement with a recent report that $P \cdot VDF_{72}/TrFE_{28}$ exhibits a large electromechanical coupling factor, since the crystallinity is directly related to the piezoelectric activity in ferroelectric polymers. The disorder parameter is also determined, and shows a much larger value than those in ordinary polymer crystals.

Comparisons of various crystallinity measurements on polyvinylidene fluoride (PVDF) as well as and $P \cdot VDF_x/TrFE_{100-x}$ are described. It is concluded that strong piezoelectricity in $P \cdot VDF_{72}/TrFE_{28}$, as compared with PVDF, may be attributable to its higher crystallinity.

Photodarkening phenomena in amorphous chalcogenide semiconductors

Keiji TANAKA, Tohru NAKAGAWA and Akira ODAJIMA

(Received November 30, 1984)

Abstract

A reversible photodarkening phenomenon induced by band-gap illumination and thermal annealing is widely observed in amorphous chalcogenide semiconductors. A comparative study on the magnitudes of the photodarkening in several chalcogenides reveals that the materials having high glass-transition temperatures and appropriate rigidity exhibit a great photodarkening. These characteristics can be understood through the use of a structural model, in which it is assumed that the shift of chalcogen

atoms from stable to quasistable positions results in strains of the van der Waals bonding. The model can also account for the fact that the rigid materials show considerable photodarkening, because the relaxation of the strains may be suppressed in these rigid chalcogenides.

Determination of Dipole Moments in $P \cdot VDF_x/TrFE_{1-x}$ by X-Ray Photoelectron Spectroscopy

Tokihiro UENO and Akira ODAJIMA

(Received November 30, 1984)

Abstract

X-ray photoelectron spectra of $P \cdot VDF_x/TrFE_{1-x}$ have been observed for $x = 0, 0.52, 0.65, 0.72$ and 1.00 . Charges on C of $-CF_2-$, $-CHF-$ and $-CH_2-$ are obtained from the binding energies of the C 1s spectra using the charge potential model; those on C of $-CF_2-$ are 0.44 in units of electron charge for $x = 0$ and 0.45, 0.65, 0.72 and 0.42 for $x = 1.00$. In contrast to $-CF_2-$, charges on C of $-CHF-$ and $-CH_2-$ are less in quantity. Electric dipole moments of $-CF_2-$ are evaluated at 1.6~1.7D through the data on the C-F distance and the F-C-F bond angle. This new method for evaluation of the dipole moments in solids is discussed.

Structural Changes in an Aromatic Polyimide on Annealing at High Temperatures and Electron Irradiation

Teruo ISHIBASHI*, Osamu YODA**, Miyuki HAGIWARA**, and Akira ODAJIMA*

(Received November 30, 1984)

Abstract

The fine structure and molecular aggregation in the partially oriented state of an aromatic polymer, polyimide(PI) were investigated by means of wide-angle x-ray scattering(WAXS) and small-angle x-ray scattering(SAXS).

By applying the Hosemann's analysis to the line broadenings in the WAXS, it was found that the length of the x-ray coherence region is about 80 Å and that its value remains constant on annealing at high temperatures and/or electron irradiation. It

was also shown on annealing that the second kind of distortion, the so-called g -factor decreases from 3.7~4.0 % of the as-drawn PI to 2.0~2.5 % but holds its value on electron irradiation.

The SAXS curves show that after annealing at high temperatures the molecular aggregation in the as-drawn PI is of a two phase structure, composed of the high and low density regions. On the other hand, molecular aggregation in the as-drawn PI has not been clearly clarified in terms of the SAXS measurement.

Transient Characteristics of Ferroelectric Polarization Switching of Polyvinylidene Fluoride

Yoshihiko TAKASE and Akira ODAJIMA

(Received November 30, 1984)

Abstract

Ferroelectric polarization reversal currents were measured under electric fields; $E=200-100\text{MV/m}$ at 20°C and $E=200\text{MV/m}$ in the temperature region from 20 to -80°C . The measured currents are analysed based on a model which takes into account (i) the initial switching due to the reversal of dipoles, which is not followed by a time dependent growth of the domain, as well as the main switching due to (ii) a random nucleation and (iii) a two-dimensional domain growth. Through the analysis, probability ν_0 of the dipole reorientation in the process (i), probability ν of the random nucleation and the growth rate G of the domain were obtained. Activation energies for ν_0 and ν exhibited different values in the temperature regions above and below the glass transition temperature, while that for G did not in those temperature regions. These findings show that the probabilities of ν_0 and ν are affected by the noncrystalline region and that the domain growth takes place within the crystalline region. These conclusions were supported by the γ -ray irradiation effect.

Preliminary Experiment for Microcomputer Control of a 633 nm He-Ne Laser with an Iodine Absorption Cell

Keiichi TANAKA and Shoichi KAWABATA

(Received November 30, 1984)

Abstract

A new Servocontrol system employing a microcomputer was studied for stabilizing 633 nm helium-neon laser with an iodine absorption cell in the laser resonator. The third derivative of saturated absorption signal appeared by hyperfine structure of iodine 127 absorption line is detected by a phase sensitive detection technique and the laser is locked at a component of the hyperfine structure. The control system shows the ability to find one of the commanded components and automatically locks the frequency on it. The frequency stability of 5×10^{-10} was obtained in a preliminary experiment.

Direct Observation of Glottal Waveforms Using Optical Fiber Probe Microphone

Ryoji OHBA, Toshiaki SYOZU, Akiharu MACHIDA and Naoki MIKAMI

(Received November 30, 1984)

Abstract

The present paper reviews the principle, the structure and performance of the experimental model of the optical fiber probe microphone, which has been developed as one of acoustical sensors applicable to probe a narrow sound field such as in the human glottis. The model is applied to observe the sound pressure waveforms at several points in the human vocal tract including the glottis under utterance. Simultaneous direct observations of both the glottal and the speech-waveforms are successfully performed under utterance. Several new facts obtained by the directly observed glottal waveforms are presented. Transfer characteristics of the vocal tract are determined by using both the simultaneously observed glottal and speech-waveforms. Discussions on the differences between both the transfer characteristics derived by the present and by a conventional-method are also given.

Fast Algorithms to Extract Feature Parameters of Vowels by Digital Filters

Naoki MIKAMI and Ryoji OHBA

(Received November 30, 1984)

Abstract

This paper compares performances of two fast algorithms which were proposed to extract the feature parameters corresponding to the first and the second formant frequencies of vowels. Their principles and recursive forms for practical procedures to calculate the feature parameters are briefly reviewed. A natural Japanese continuous vowel phrase is analyzed by the two algorithms and by a linear prediction. The results of the analyses are compared with each other and it was confirmed that the first and the second formant frequencies obtained by the two algorithms are in good agreement with those by the linear prediction. Furthermore, it was also confirmed that both formant frequencies obtained by them are almost identical.

Automatic Orientation Analysis of Crystallographic Axes of Arbitrary Lattice Using X-ray Laue Photograph

Ichiroh UEHIRA, Hironori YAMADA, Hidehiro WATANABE and Ryoji OHBA

(Received November 30, 1984)

Abstract

It is possible to determine the orientation of the reciprocal lattice vector (RLV) corresponding to the lattice plane which diffracts the incident X-ray beam to the spot, using the site of the spot in the X-ray Laue photograph. A counterpart can be found for a set of RLVs, whose orientations are determined by observed spots, by using angles between all pairs of the RLVs, in the allowable RLVs which are theoretically possible to diffract the incident X-ray. The reflection index, then, can be assigned to each spot by selecting the optimal allowable RLV that gains a maximum score of coincidence among the angles.

A computer program is developed on the basis of this principle for automatic analysis of the orientations of the crystallographic axes of single-crystals with an arbitrary lattice. The usefulness of the program is illustrated by analyzing several single-crystals with different lattices.

New Approaches for Data Processing in Photogrammetry

Ryoji OHBA, Shin-ichi KONDO, Kaoru NAKAGAWA,

Keiichi TANAKA and Kazumi MURATA

(Received November 30, 1984)

Abstract

A pair of new approaches for data processing in photogrammetry are presented. One is the least square locating method using an adaptive model of the object and the other is a locating method utilizing the cross-correlation function of the stereo pair. The former uses no indices in principle but locates an object by adaptively correcting the model in such a way as to minimize a certain cost function defined by both the observed data and the location of the model. While the latter uses trigonometry in principle, but requires no manual operations unlike in the conventional photogrammetric analyses in order to search for the indices in a stereo pair. The results of experimental applications are presented as well as the basic principle and features of each approach.

Measurement of Ray- and Wave-Aberration by Spatial Filtering

Kazumi MURATA and Hiroshi MATSUI

(Received November 30, 1984)

Abstract

A method for the measuring of the ray- and wave-aberration of an optical system is described, in which the spatial filtering with coherent light and the digital image integration by micro-computer are successively applied. The ray-aberration is optically measured by using a square-root filter and then digitally transformed into the wave-aberration almost in real time. The principle of the method is presented and some experiments are shown.

Observation of Binary Stars by Stellar Speckle Interferometry with White Light

Naoshi BABA, Masafumi YAMAMOTO and Kazumi MURATA

(Received November 30, 1984)

Abstract

The observation of binary stars were carried out by using our developed speckle camera with a white light. A comparison between observational results with a white light and those with narrow bandwidth is described. From this comparison, it is confirmed that the stellar speckle interferometry is feasible even with white light. This fact extends the applicability of the stellar speckle interferometry to the observation of dark stellar objects.

Wave and Geometrical Approach in Hologram Aberration

Yukihiro ISHII

(Received November 30, 1984)

Abstract

The diffraction patterns suffering from hologram aberrations are of considerable interest because these factors permit an assessment of hologram imagery. The aberrated diffraction patterns are approached from two different items; that of the wavefront matching with the diffraction integral and ray tracing. This paper is concerned with the combined influence of diffraction and aberrations by using a holographic technique on a reconstructed image from a hologram. The ray-traced spot diagrams are also shown.

Image Restoration by a Constrained Iterative Method

Junji MAEDA

(Received November 30, 1984)

Abstract

We describe a new digital method for restoring linearly degraded images in the presence of noise. The restoration procedure is an iterative damped least-squares algorithm which has the advantage of the capability of dealing with the wide range of degradations and tolerance to noise. We present some experimental results that demonstrate the effectiveness of the proposed method.

Characteristics of Images Reconstructed from 360° Hologram

Ryuji SATO and Kazumi MURATA

(Received November 30, 1984)

Abstract

Characteristics of images reconstructed from two types of 360° holograms are discussed.

One is a cylindrical holographic stereogram which causes in principle a distortion of a reconstructed image. We analysed the 3-D distortion due to the geometrical set-up in making the stereogram and in observing the reconstructed image. The condition which decreases the distortion is determined. As an example, using a cubic frame as an object, a comparison of the calculated result with the experimental one is also run.

The other is a cylindrical rainbow hologram. We propose a new technique using unique mirror elements. The same as an ordinary rainbow hologram, image blur due to the wavelength spread is discussed. The calculated result is compared with the experimental one regarding the image blur. In the case of the cylindrical rainbow hologram, the object size or visual field is restricted. The effective visual field is also discussed.

Dynamical Processes of Dislocations and Point Defects in Ice Crystal

Akira HIGASHI, Akeharu FUKUDA, Takeo HONDOH, Kumiko GOTO
and Shinya AMAKAI

(Received November 30, 1984)

Abstract

Various processes of dislocations and point defects in ice crystal have been revealed by "in situ" observations using X-ray diffraction topography with powerful sources. Based on a comparatively small value of the stacking-fault energy derived from observed shrinkage rates of faulted and unfaulted dislocation loops, it is concluded that the common dislocations ($B.V. = \frac{1}{3} \langle 11\bar{2}0 \rangle$) on the basal plane in ice crystal are dissociated. Faster movement of dislocations on the non-basal plane than on the basal plane were observed as characteristic features in continuously taken topographs of ice specimens under loading. The well-known easy glide on the basal plane of ice which at a first sight seems to conflict with the above anisotropy of the mobility of dislocations can be attributed to the much less dislocation density on the non-basal plane than on the basal plane.

Observations of the growth process of dislocation loops in quenched-in specimens supplied us with values of both the formation- and migration energy of self-interstitials in ice crystal. Comparing the above values with that of the activation energy of self-diffusion in ice measured by the tracer method, the interstitial mechanism for the self-diffusion in ice is concluded. Observed climb motions of the dislocation loops ($B.V. = \langle 0001 \rangle$) under uniaxial stress parallel to the c-axis clarified directly that the dislocation loops generated in quenched-in specimens are the interstitial type and the climb has a superior importance than Nabarro-Herring mechanism in diffusional creep in ice.

Periodic Structure of Grain Boundaries and Grain Boundary Dislocations in a Hexagonal Crystal

Takeo HONDOH

(Received November 30, 1984)

Abstract

This paper describes a basic concept of the coincidence site lattice (CSL) theory, which is a useful tool for studying a periodic structure of a grain boundary (GB), and its application to a hexagonal crystal. A relationship between the rotation angle θ_0 and the reciprocal density of coincident sites Σ for the ideal hexagonal crystal, in which the axial ratio $c/a = \sqrt{8/3}$, were calculated for two rotation axes $\langle 11\bar{2}0 \rangle$ and $\langle 10\bar{1}0 \rangle$. For determining the Burgers vectors of grain boundary dislocations (GBDs), the displacement shift complete (DSC) lattices were also calculated for the above cases. Results of calculations in the range of $\Sigma < 50$ were tabulated in Tables 1 and 2. Near-CSL concept was applied to ice lattice, the axial ratio of which slightly deviates from the ideal value, for determining GBD arrangements on GBs in ice and for calculating GBD energies.

Total Gas Content in Deep Ice Cores

Masayoshi NAKAWO

(Received November 30, 1984)

Abstract

Polar ice sheets have undergone evolutions responding to the climatic change. Their variations in height can potentially be revealed by studying the total gas content in deep ice cores from the ice sheets. One can estimate, for a given ice, the elevation of its forming place, which represents the previous surface of the ice sheets. For the calculation, the pore close-off density, ρ_c is to be given as a known parameter. The value for ρ_c was determined by careful measurements on density and total gas content of shallow core samples recovered at three sites, extending over a range from 1200m to 2300m in elevation, in Mizuho Plateau, East Antarctica. The experimental results indicated that ρ_c increased with decreasing temperature at close-off, which accounted for almost half of the dependence of the total gas content on elevation. Future problems on the total gas content have also been discussed.

Mechanical Relaxations in Linear Low-Density Polyethylene

Maeko KAKIZAKI, Hajime IWASAKI and Teruo HIDESHIMA

(Received November 30, 1984)

Abstract

Storage and loss moduli for two samples of linear low-density polyethylene, LLDPE, and a sample of branched polyethylene, which have 14.6 ethyl branches, 13.4 hexyl branches and 13.1 short-chain branches per 1000 carbon atoms respectively, are measured and compared with each other and with those for linear polyethylene in the temperature range from ca. -170°C to ca. 80°C .

Four relaxations are observed in temperature dependence of storage and loss moduli for LLDPE as in that for branched polyethylene and named α , β , γ_1 and γ_2 in the order of the descending temperature. The frequency-temperature positions and activation energies for these processes and relaxation spectra for α , β and γ_1 processes are determined and compared with those for branched polyethylene and found to be in good agreement with the latter.

The intensity of relaxation for the β process increases in parallel with that for the γ_1 process as the length of branch and (1-crystallinity) increase in all the samples investigated. This fact suggests that these two processes are caused by the same amorphous molecular chains and the amount of such chains increases with the increase in the length of branches and (1-crystallinity).

Relaxation Phenomena in Polyethylene Pulverized at Liquid Nitrogen Temperature

Yuichi ANADA, Maeko KAKIZAKI and Teruo HIDESHIMA

(Received November 30, 1984)

Abstract

NMR second moment, mobile fraction, Yong's loss modulus and loss permittivity were measured from -180°C to 120°C for the polyethylene pulverized at liquid nitrogen temperature and kept in air at room temperature for a sufficiently long time. Intrinsic viscosity and melting temperature of this sample were also measured. Change in second moment vs. temperature curve was hardly observed for the γ_3 -process in the pulverized sample, and intrinsic viscosity in that sample was also not changed. As the strength of the γ_3 -process represented by the change in second moment was related to the number of ciliary chains and intrinsic viscosity was

proportional to a power function of molecular weight, it seemed that scission of molecular chains scarcely occurred, if any, in the pulverized sample. On the other hand, the strength of the NMR γ_2 - and α' -processes, which was related to the number of folded chains in the surface layer of lamella, increased.

Corresponding change in the relaxation strength was observed for the mechanical and dielectric relaxations. The DSC thermogram shows that fusion of lamellae in the pulverized sample started from lower temperature than in the unpulverized sample.

Nuclear Magnetic Relaxation of Polymers Undergoing Multiple Internal Rotations

Akihiro TSUTSUMI and Teruo HIDESHIMA

(Received November 30, 1984)

Abstract

In order to study the molecular dynamics in polymer systems, the nuclear magnetic relaxation is investigated theoretically. The spectral densities of fluctuating dipolar interactions are calculated for a spin-pair undergoing multiple internal rotations superimposed on the isotropic or anisotropic overall motion. Six types of internal rotations including the stochastic rotational diffusion and the rotational jump among unequivalent two or three sites are taken into account. Applications of these calculations are made using three synthetic polypeptides in solution, and the segmental motion of the main chain and the internal rotation in the side chain are discussed in detail.

**New Experimental Techniques for Accurate
Determination of the Structure Factors
—Measurements of Pendellösung Beats
Using White Radiations—**

Toshihiko TAKAMA, Kazuyoshi KOBAYASHI and Shin'ichi SATO

(Received November 30, 1984)

Abstract

Two experimental techniques for measuring the X-ray Pendellösung intensity beats of white radiation were developed in the authors' laboratory. The intensity variations are directly measured with respect to the wavelength by using a solid-state detector and the energy-dispersive diffraction method. The accurate values of the structure factors can be determined with their wavelength dependence from the extremum positions of the measured beats.

In the first method, the integrated intensity diffracted from the whole exit surface is successively measured with changing the Bragg angle. Accurate values of the atomic scattering factors have so far been determined for several pure elements by this method. In this note the result on Al is described as an example.

The intensity diffracted only from the central part of the Borrmann fan at the exit surface is measured in the second method. Since the measured beats consist not only of a large amplitude but also of a high frequency in the second method, the error in atomic scattering factors of Si, f_{220} and f_{111} , is found to be reduced to about one tenth of that in the first method.

**Strain Compatibility at the Grain Boundary
in Cu-Zn-Al Shape Memory Alloys**

Kazuyoshi TAKEZAWA, Hidetaka CHIBA and Shin'ichi SATO

(Received November 30, 1984)

Abstract

The mechanical behavior associated with the shape memory effect and pseudoelasticity in Cu-Zn-Al martensitic alloy is remarkably affected by the size and crystallographic orientations. This is because the grain boundary has a life-and-death power over the reversibility of the two-step transformations, i. e., $\beta_1 \rightarrow \beta'_1$ and $\beta'_1 \rightarrow \alpha'_1$, stress-induced in this alloy.

In the present study a detailed morphological examination was performed during

the extension of various Cu-Zn-Al alloys with different compositions. Attention was paid to the compatibility of transformation strains at the grain boundary in polycrystalline specimens and also in two types of bicrystals, one with the boundary parallel and the other perpendicular to the tensile direction.

The conclusions derived are summarized as follows:

- (1) In alloys with low Al contents, the second martensite α'_1 is easily induced and the slip in α'_1 prevents the initiation of crack at the boundary. However, the slip produces an irreversible shape change.
- (2) In alloys with high Al contents, α'_1 is hardly produced and the fracture occurs easily at the boundary.
- (3) The optimum content of Al for practical use of the shape memory alloy is to be about 6 at %.

Atomic Structure of Twin Boundaries Deduced from Quantitative Analysis of Image Contrast of Electron Micrographs

Kenzaburo MARUKAWA

(Received November 30, 1984)

Abstract

Atomic structure of (112) twin boundaries in b.c.c Fe-Si alloy crystals was investigated by quantitative analysis of electron micrographs. Observations were made by utilizing common reflections to the matrix and twins. These common reflections should reveal lattice displacement, if any, accompanied by twin boundaries as fringe patterns, similar to those in the case of stacking faults. In order to separate components of the displacement from each other, several common reflections, mutually independent, were used. It was found that the displacement component along the twin boundary is null. Faint fringe patterns corresponding to the displacement component normal to the boundary was observed. This indicates that there is a dilatation associated with the boundary. Profiles of these fringes were measured and compared with the theoretical ones, which were calculated on the basis of the many beam theory of electron diffraction. From this comparison, the amount of the dilatation was deduced to be 0.07 d, where d is the spacing of (112) planes. The results are discussed in comparison with recent theoretical work on the defect structure.