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Appendix

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BULLETIN

OF THE

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HOKKAIDO UNIVERSITY

NOTICE

No.140 May 1988

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Three-Dimensional Constitutive Model for Sand —Derivation of Multi-Directional Sliding Model—

Kinya MIURA, Shosuke TOKI and W. D. Liam FINN

(Recieved December 26, 1987)

Abstract

A constitutive model, named Multi-Directional Sliding Model, is developed for sand under three-dimensional stress conditions. The basic concept of the model is that a particulate, discrete medium such as soil has innumerable potential sliding planes at all locations and in all directions, and its deformation characteristics are governed by sliding mechanisms on each sliding plane.

The stress-strain relationships on each sliding plane are formulated for three types of deformations: consolidation, shear deformation and dilatancy. The consolidation behavior is specified by the linear relationship between void ratio and logarithmic consolidation stress. The shear deftrmation behavior is modeled by the hyperbolic relation between shear loading function and shear strain assisted by Masing's criterion for stress reversal. The dilatancy behavior is specified by the linear relationship between the shear-normal stress ratio and normal-shear strain increment ratio. The strain increments in an auxiliary two-dimensional stress-strain system are calculated as the summation of all sliding deformation increments on potential sliding planes. And the three-dimensional strain increments of a soil element are derived as the linear summation of the strain increments of the three two-dimensional stress-strain systems, based on the Compounded Mobilized Plane Theory.

The proposed model is capable of modeling a nonlinear, inelastic and anisotropic sand deformation response to various loadings involving stress reversals and the rotations of principal stress axes under general stress conditions.

Prediction of Deformation Behavior of Sand under Axisymmetric Stress Conditions —by Multi-Directional Sliding Model—

Kinya MIURA, Shosuke TOKI and W. D. Liam FINN

(Recieved December 26, 1987)

Abstract

Anisotropic stress-strain relationships of sand are predicted using Multi-Directional Sliding Model, which is the constitutive model developed for anisotropic sand under three-

dimensional general stress conditions.

The procedure for determining the model parameters are described; the parameters are determined from consolidation-swelling test, and triaxial compression and extension tests.

A series of comparisons of predicted and measured deformation-strength behavior showed the applicability of the model from the following points: 1) The model can simulate the volume change behavior and the deformation anisotropy due to isotropic consolidation-swelling. 2) Anisotropic deformation-strength characteristics of sand in both compression and extension tests is modeled well and its dependency on confining pressure is explained quantitatively. 3) The effect of overconsolidation on the deformation behavior of sand during shear is estimated adequately by the model.

Stress-Strain Behavior of Clay Consolidated and Rebounded under K_0 Condition

Yukihiro KOHATA, Toshiyuki MITACHI, Mitsugu KAWADA
and Takahiro SAITO

(Recieved December 26, 1987)

Abstract

Recently, research on constitutive model of clays have been developed, and various models have been proposed and discussed. Most of these are derived from experimental data on isotropically consolidated clays, while only a few models focus their attention on anisotropically overconsolidated clays.

In this paper, a series of consolidated drained triaxial tests on a saturated remolded clay was performed. Triaxial test specimens were first consolidated and rebounded under K_0 conditions to the stress states at which OCR are 2, 4 and 10. The drained stress probe tests along six stress paths for each OCR were conducted to investigate the influence of anisotropic stress history and stress path on the stress-strain behavior of overconsolidated clay.

From the test results, it was found that the shear strain developed during drained shear depends not only on the change of stress ratio but also on that of mean effective stress. It was also found that K_0 overconsolidated clay exhibits negative dilatancy at the beginning of loading even on the "dry side", and then significant positive dilatancy is observed on the stress path moving towards the Hvorslev surface on the dry side.

Based on the test results, a constitutive model which describes the stress-strain characteristics of anisotropically overconsolidated clay is proposed. Stress-strain behavior for the stress path moving towards the critical state line can be well predicted by the model. The

model also describes the stress-strain behavior for the stress paths directed from the overconsolidation state to the normal consolidation zone.

Convective Heat Transfer Coefficient for a Man-Equivalent Thermal Cylinder

Tohru MOCHIDA and Toshihiko MORIYAMA

(Recieved December 26, 1986)

Abstract

This paper describes the mean convective heat transfer coefficient for an unclothed man, which is one of the most important factors when the rate of convective heat transfer between the body surface and the air is calculated.

An equation of mixed heat transfer coefficient by convection for an unclothed man was derived based on the heat and mass transfer theory.

First, a general expression to give human body's convective heat transfer coefficient was theoretically obtained from the heat equilibrium between man and his environment. The general expression is the sum total of local convection coefficients weighted with each skin area ratio.

Second, using the expression and the dimensionless equation on forced convective heat transfer, the diameter of a man-equivalent thermal cylinder was set at 15.5 cm.

Third, by leveling vectorially the heat transfer coefficients by forced and natural convections and by formulating it with an approximate equation, the folllwing equation as the mean convective heat transfer coefficient of an unclothed man was proposed.

$hc = 1.14 + 6.28\ V^{0.61}$

The value of this formula, compared with those of earlier workers, agrees well with the values proposed by Nelson et al and Nishi et al, especially in the region of high air velocities. In the low air velocity region, however, the locus of the formula derived here is different from many other ones except for that of Colin et al, that is to say, authors' present formula clearly represents the effect of natural convection coexisting with forced convection. The shape of the locus resembles that of Colin et al, although the values of convection coefficients are different between them. The experiments using a heated cylinder were performed to verify the effect of natural convection on forced convection in a low air movement environment and the natural convection effect was observed from the experimental results.

Studies of the Mechanical Characteristics of Tertiary Sedimentary Rocks (Part II)
—Fracture Mechanism of Tertiary Sedimentary Rocks—

Akira NAKAMURA and Yoji ISHIJIMA

(Recieved December 26, 1987)

Abstract

Laboratory experiments using the triaxial loading apparatus for the Tertiary sedimentary rocks have shown that:

1. Bilinearity of the fracture criteria, that is, the criteria shown as a bent line in the σ_1-σ_3 diagram is valid irrespective of the applied stress path.
2. Volume expansion (Dilatation) occurs under relatively low confining pressure when the applied differential stress is above a critical value. This phenomenon indicates the occurence of fracturing of the open micro-cracks existing in the rock.

Interpretation of the bilinear fracture criteria (BFC) were tried here in terms of micro-cracks behavior and the following were deduced.

1. Both the open and closed cracks exist when the confining pressure is lower than the overburden value. In contrast, most of the cracks are in a closed condition in relatively high confining pressure.
2. Rock fracture is preceded by the failure of cracks whose orientations are within a specified region.
3. Bilinearity of the fracture criteria is attributed to the difference of the failure conditions between open and closed cracks.

A Unified Study of Thermally Activated Dislocations Motion with the Dynamic Effect in a Random Distribution of Point Obstacles

Tetsuo MOHRI, Toshihiko GINBAYASHI* and Katsuya WATANABE

(Recieved December 26, 1988)

Abstract

In order to investigate dislocations behavior at cryogenic temperature, a unified study is

attempted to incorporate the thermal activation process, the string model of Granato, Friedel statistics of hardening and Sumino's concept of steady state deformation into a single equation. The deterministic nature of the string model is compromised with the thermal activation process by following Suzuki's concept which considers the average effect during the decay time of a vibrating dislocation. The calculated results not only reproduced experimental tendencies at moderate temperatures but also revealed the peculiar nature caused by the dynamic effect at cryogenic temperatures.

Catalytic Combustion of Lean Methanol Mixture

Kenichi ITO, Osamu FUJITA, Yasunori IWAI,
Byung-Chul CHOI and Kiyotaka YAMANE

(Recieved December 26, 1987)

Abstract

Catalytic combustion of methanol-air mixture was investigated to develop a new type of clean room heater. The experimental research was carried out using a catalytic combustor with a monolith type catalyst loaded with noble metals. The experimental parameters were space velocity, air ratio, and inlet temperature of the catalyst. The axial and radial temperature distribution in the catalysts and the emissions of NO, NO_2, NOx, CO, CH_3OH, and CH_2O were determined. The emission characteristics of a methanol fueled fan-heater was also examined to compare with that of the catalytic combustor.

The results showed that stable combustion was carried out in a catalytic combustor and excellent emission characteristics were obtained over a wide range of air ratios. NOx was reduced to below 1/150 of that from a methanol fueled fan-heater and below 1/10 of the regulation value. The other pollutants were also reduced to a much smaller value than regulation or allowable limits. However, much unburned methanol was emitted during start -up time and the startability of the combustor is the point to be improved for practical use.

Some Considerations on the Basic Mechanical Properties of Carbon Fiber Mono-Filament

Toru NOGUCHI and Ken-ichi AKAGI

(Received December 26, 1987)

Abstract

Some basic problems in measuring the strength characteristics of carbon fiber(CF) mono-filaments were studied. Tensile test was performed on PAN (polyacrylonitrile) type CF mono-filament test pieces with various test lengths. Determination of modulus of elasticity, relationship between fiber strength and cross-sectional area, and the test length dependence of strength were discussed. The results are as follows;

(1) The modulus of elasticity E, differs by 25% at the maximum depending on the load level where the modulus is determined. Excluding this effect, the higher strength fibers still tend to have a higher E value.

(2) In evaluating the tensile strength of fibers, it is desirable to use mean cross sectional areas than individual area of each fibers, because there is no clear relationship between the fiber strength and the fiber diameter.

(3) The mean strength, coefficient of variation and the Weibull modulus are all test length dependent. To estimate the critical strength, it is preferable to use two average strengths from different test lengths than using one average strength and the Weibull modulus for one test length. The estimated value, however, is higher than the actual critical strength in all methods.

On the Heat Resistance of Flake Graphite Cast Iron containing Low Ni

MAKOTO SOHMA, MAKOTO HASEBE

(Received December 26, 1987)

Abstract

The recent tendency to raise power of internal combustion engine strongly points out that the heat resistance of cast iron used mostly in the parts of the system of exhaust is to be increased more.

For the purpose, to add alloying elements is very effective and many heat-resistant cast irons are developed. But they are generally expensive and limited in the point of use industrially because they contain a large amount of alloying element. Thus the development

of comparatively cheap cast iron of low alloying elements is important. So in this paper the heat resistance of cast irons alloyed up to 3% with Ni into the normal flake graphite iron of low strength (10 kgf/mm^2) was investigated by the growth test.

From the test, the following results were obtained. That is, the growth of cast irons containing Ni was larger 2% at most than that of Ni-free iron. But 3%Ni iron had high mechanical properties even after it reached 7% growth when the internal structure became porous, its growth rate decreased from the middle stage of heatings and its falling off of oxide scale was comparatively small. So it was proved that 3%Ni iron was able to be evaluated as the industrially heat-resistant material and also in the point of economy.

An Intelligent Input System for Scientific Article Information Data Base System

Tatsuki SAITO

(Recieved December 26, 1987)

Abstract

It is discribed to develope a scientific article information database system for an highly intellectual utilization of scientific information in this paper. In particular, an importance of an information input system is discussed in detail. Two input system were designed and implemented. The first is an interactive type. The second is an intellectual batch type. The latter input sypstem enables to extract every field from standardized bibliographic format by production system. Those input systems were implemented by NATURAL on DBMS ADABAS. In order to aim at efficient input processing or in order to avoid misinput, a common feature of both information input systems is to input another field data after retrieving an author name of a registered article or after retrieving a title of a registered article. There is a fair prospect to realize a completely automatic data input system for scientific article information by using an printed character type OCR.

Characterization and Mechanism of Drain Current Drift in Hydrogenated Amorphous Silicon Thin Film Transistor

Yuji YOKOYAMA, Hideo OHNO, Hideki HASEGAWA
Mitsuo SHIMOZUMA

(Recieved December 26, 1987)

Abstract

A theoretical and an experimental investigation of drain current drift in hydrogenated amorphous silicon thin film transistors (a-Si : H TFTs) is presented. Detailed measurements of drain current drift showed that the current dirift characteristics are characterized by a very long time constant with time constant dispersion. A model involving interface states distributed energetically and spacially is presented which quantitatively explains the current drift phenomena.

Signal Propagation Characteristics of Interconnect in GaAs Ultra High Speed Integrated Circuits —Effect of Interconnect Resistance—

Jun-ichi KUDOU, Hideki HASEGAWA, Hideo OHNO
Kouichi IIZUKA

(Recieved December 26, 1987)

Abstract

Using an MIS (metal-insulator-semiconductor) paralled stripline model of interconnects and its equivalent circuit representation, on-chip interconnection delay in a very high-speed GaAs LSI/VLSI's is analyzed in the time domain taking into account DC interconnect resistance and its skin effect.

The results show that 1) interconnect resistance limits the high speed performance of an integrated circuit when the interconnect is miniaturized for high level of integration, and that 2) the drive capability and effective sheet resistance must be optimized for realizing ultra high-speed performance. (t_d of below 100 psec)

An Implementation of Strategies for Generating Topic Expressions in Japanese Text by Generalized Text Generator

Akira TAKAHASHI, Yoshio MOMOUCHI and Eiichi MIYAMOTO

(Recieved December 26, 1987)

Abstrast

The need for good text generation is rapidly increasing in man-machine interface through natural language in various systems such as database systems, expert systems and machine translation systems. A sequence of sentences must exhibit cohesion to be considered a well-formed text. Ellipsis of topic expressions is one of the most important devices to create cohesive Japanese texts. To decide how to eliminate a topic expression, key factors such as focus, coherence, perspective and text style must be considered effectively through the process of generation. In this paper, we argue about strategies for generating topic expressions using these factors. We also describe the implementation of a computer text generation system Hi-GTG (Hokkaido University Information Engineering-Generalized Text Generator), designed to incorporate our strategies for controlling the generation of the topic expressions.

Computational Experience with Improving on Efficiency of Implicit Enumeration Method with Surrogate Constraints

Jun ANEZAKI, Toshio OHYANAGI and Ikuo KAJI

(Recieved December 26, 1987)

Abstract

In this paper an implicit enumeration method with surrogate constraints namely an algorithm for solving linear integer programming problems with zero-one variables is introduced and two heuristics for this algorithm are proposed. One heuristic suggests the opportunity of making surrogats constraints and the other suggests the selection of variables during branching operation.

Then a way of testing such heuristics is presented and its computational experience is given with consideration.

Computer Simulation of Amorphous Structure of Aluminium

Masao MAEDA, Akira OGURI
and Katsuyasu FUJITA, Masafumi TANIWAKI
(Recieved December 26, 1987)

Abstract

The structure of amorphous aluminium was simulated in a computer using Ichikawa's method. The splitting of the second peak in the radial distribution function of the amorphous aluminium structure disappeared by increasing the hard spheres used in the simulation. From this fact it is considered that the structure of amorphous aluminium is not an ideal dense random packing of hard spheres. The relaxation of the amorphous aluminium made by Ichikawa's method was performed by molecular dynamics using Morse potential. By this relaxation, the amorphous structure with the splitting of the second peak in its radial distribution function was obtained. The present result was compared with the amorphous structure models simulated by other researchers and it was concluded that the amorphous structure consisting of an element does not depend on its kind.

Surface Area and Outgassing Behaviors of Various Isotropic Graphites as Nuclear Fusion Material

Y. HIROHATA, S. FUKUDA, T. HINO and T. YAMASHINA
(Recieved December 26, 1987)
Department of Nuclear Engineering, Hokkaido University, Sapporo Japan

Abstract

Surface areas and outgassing behaviors of various isotropic graphites were investigated by using the physisorption of xenon at 77 K and a thermal desorption spectroscopy (TDS), respectively. The specific surface areas ranged from 0.4 to 1.34 m^2/g and hand a tendency to increase with the apparent density. The main gases desorbed from graphites were H_2, H_2O, CH_4, CO, CO_2, and hydrocarbons. The total amount of desorbed gases increased with the specific surface area. The purification after graphitization was effective for the reduction of the outgassing.

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The Effects of Inherent and Induced Anisotropies on Sand Deformation-Strength Characteristics

Kinya MIURA, Shosuke TOKI and Susumu SHIMAYA

(Received March 31, 1988)

Abstract

Usual sand in the ground often acquires significant anisotropic deformation-strength characteristics. The anisotropies of sand can be classified into two types, based on their sources: inherent anisotropy and induced anisotropy. The former is due to original anisotropic sand fabric, and the latter is due to the shear deformation history. The aim of this paper is to show the effects of the two types of anisotropies on sand deformation behaviors experimentally and analytically.

Two series of stress probe tests were performed on medium dense sand specimens with an anisotropic fabric by means of hollow cylinder torsional shear apparatus. In the first test series isotropically consolidated specimens were sheared in different principal stress axes directions to investigate the inherent anisotropic effects. The second test series was carried out for induced anisotropy effects, where specimens were fist subjected to one cycle of loading and reloading of shear stress in a prescribed principal stress axes direction, and then sheared in different directions. Examining the observed deformation behaviors clarified some experimental facts of anisotropy effects on strength, dilatancy and shear deformation behaviors and principal strain axes direction.

In order to explain some aspects of anisotropic deformation behaviors, the concept of the three-dimensional constitutive model for sand referred to as Multi-Directional Sliding Model is applied. The model assumes that the soil element has innumerable potential sliding planes and its deformation behavior is governed by the sliding deformation mechanisms on the planes. It is shown that varying the shear resistance on the plane depending on its relative direction with respect to the bedding plane and incorporating Masing's criteria into the hyperbolic shear-normal stress ratio vs. shear strain relationship on the plunes, are useful to evaluate the inherent and induced anisotropy effects, respectively.

Force balance equations for particles in binary-solid liquid fluidized beds

Naoyuki FUNAMIZU, Tetsuo TAKAKUWA

(Received March 31, 1988)

Abstract

The grains of binary media water filters are cleansed by upward backwashing with water at a rate sufficient to fluidize the entire bed without mixing two kinds filter media. In a binary-solid liquid fluidized bed complete segregation of two kinds of particles differing in size and density is observed at a liquid velocity less than the critical velocity. However beyond the critical velocity mixing of particles occurs. When calculating the critical velocity, a model to predict particle concentrations in a mixed bed is required.

The model is developed on the basis of the force balance equations of each particle (gravitational, buoyant and drag forces) and the assumption that the drag force acting on the particle 1 in the bed consisting of particle 1 and 2 is equal to that in the equivalent mono component bed of particle 1. The validity of the present model is tested against experimental data.

Chemical Properties of N-Oleoylsarcosine in an Aqueous Solution

Masami TSUNEKAWA, Zhang Zhi Yuan and Takakatsu TAKAMORI

(Received March 31, 1988)

Abstract

The critical micelle concentration (cmc) of n-oleoylsarcosine (OLSA) determined by conductivity measurement was 8.5×10^{-4}mol/l at 25°C. The effects of potassium concentration (C_K) on cmc was studied by the dye method with pinacyanol chloride, and the following experimental equation was obtained.

$$\log \text{cmc} = -5.55 - 0.66 \log C_K$$

The values of pH in partially acidified OLSA aqueous solutions were measured as a function of total OLSA concentration, and based on the thermodynamic consideration the results were quantitatively analyzed. The results showed that OLSA formed acid soap in which the solubility product at 25°C was $C_K \times C_H^{1.39} \times C_Z^{2.39} = 2.2\times10^{-23}$, where C_H and C_Z are the concentration of hydrogen ions and OLSA anions, respectively. The solubility and dissociation constant of OLSA at 25°C were 3.32×10^{-4} mol/l and 7.9×10^{-6}.

The Influence of Micelles and Precipitates on the Titration Curves of Aqueous N-Oleoylsarcosine Solutions

Masami TSUNEKAWA, Zhang Zhi Yuan and Takakatsu TAKAMORI

(Received March 31, 1988)

Abstract

Saponified n-oleoylsarcosine (OLSA) solutions below and above the critical micelle concentration were titrated with HNO_3. The titration curves depended on the OLSA concentration, and at the same time showed influences of micelles, and the formation and precipitation of the acid soap and OLSA. Based on thermodynamic considerations the titration curves can be calculated under various conditions. The calculated curves were in rough accord with the experimental curves in lower concentration of OLSA, and with the increasing OLSA concentration the deviation of the former from the later became large. The reason for the deviation was discussed in terms of micelle properties.

On the characteristic phenomena that occurs in the process of lateral stress pressurization in a scale model study on coal and gas outburst

Yoshihiro TEJIMA and Masuyuki UJIHIRA

(Received March 31, 1988)

Abstrct

In the present paper, the results of a scale model study on coal and gas outburst in which both pore gas presure and mechanical stress were applied to the model material that consisted of wood rosin are described. In the experiment, even when pore gas pressure was insufficient to bring about outbursts by its pressure, gas outbursts could occur by applying lateral stress. It has been observed that outbursts can occur only when the crak gas pressure gradient appears in the neighbouring range of the exposed surface of the confined test piece by its internal brittle destruction.

Development of High Efficiency and Low NO_x Engines for Heat Pump Systems Operated with Gasified Methanol

Tadashi MURAYAMA, Takemi CHIKAHISA and Naohiko OIKAWA

(Received March 31, 1988)

Abstract

Methanol is one of the most promising alternative fuels for conventional petroleum fuels. The paper describes the performance and characteristics of a heat pump engine operated using gasified methanol fuel.

In a methanol-gas engine, the vaporization heat is taken from the cooling water, resulting in an increased available energy. In addition it is advantageaus because of the reduction of the cooling system capacity, clean emission potential, and less lubricating oil deterioration, which is one of the major concern in the heat pump engines.

As a result of the experiment, very lean combustion was possible with gasified methanol, and good thermal efficiency and low NO_x emission was obtained. It emitted a large amount of unburnt methanol and formaldehyde, which can be removed completely with the aid of oxidation catalysts such as Rh and Pd. It was also found that the NO_x level increases significantly when the mixture is close to stoichiometric conditions. This suggested that the rated power of an engine should be designed smaller than normal in order to cope with lean combustion.

Numerical and Experimental Evaluation of Energy Storage Systems with CaO-CaS-$Ca(OH)_2$ Chemical Reactions

Takemi CHIKAHISA, Tadashi MURAYAMA and Futoshi MIHASHI

(Received March 31, 1988)

Abstract

This paper describes the possibility of heat storage systems with CaO-CaS-$Ca(OH)_2$ chemical reactions. The cycle consists of three chemical reactions; one is a endothermic reaction in a storage mode, and two is a exothermic reaction in a heating mode. The analysis is performed by numerical simulation with an assumption of chemical equilibrium in each vessel.

As a result, the possibility of a very high temperature extraction was seen in the

numerical analysis. However, the experiment showed a difficulty in one of the three reactions. The promotion of the reaction is the major problem of this system.

The Action of Oxygen in The Atmosphere on The Growth of Cast Iron

Makoto SOHMA

(Received March 31, 1988)

Abstract

Formerly the present author proposed that the oxygen in atmosphere not only oxidized the matrix of cast iron but also produced the carburizing atmosphere in the interior, or inhibited the diffusion of carbon and increased the growth in the austenitic region. In this paper the dilatometric test of flake graphite cast iron in various oxygen concentrations was performed in order to investigate the above suggestion.

The results obtained were summarized as follows.

1) The growth of cast iron increased with oxygen concentrations in the atmosphere by both cyclic and isothermal heatings, although the growth by the isothermal was greater by 60% on the average than that of the cyclic.

2) The tendency of growth in lower oxygen concentrations (up to 6%O_2) was greater than in higher concentrations where the oxidization became severe.

3) The growth phenomena in all oxgen concentrations were found to be explained unifiedly by the mechanism of selfcarburizing phenomenon.

4) It was also found that the remarkable growth tendency in dilute oxgen concentrations (up to about 2%O_2) was due to the inbibiting action of oxygen on the diffusion of carbon to add to the above mechanism.

A study on How to Introduce PC to a Mechanical Design and Drawing Class —— An Approach Colaborting CAD System Development ——

Yukinori KAKAZU

(Received March 31, 1988)

Abstract

How to introduce PC (: Personal Computer) to a class of mechanical design and drawing which is still an unsolved problem when we set several objectives such as having an expectation of providing the maximum available educational effect.

This paper proposes a new approach on how to introduce PC to a class with a case study. The proposed approach is based on the idea of producing the expecting the maximum educational effects through colaborating development of a CAD system.

To realize the idea, the concept of SADT (: Structure Analysis and Design Technique) is introduced and following the SADT, the class members are divided into several groups, each group has a group leader and the class has a supervisor. And the design object is also analyzed and divided into several subparts, each subpart is assigned to a group. In order to clarify the effectiveness of the proposed approach, the experiment was performed. And reasonable results was obtained.

Deformation Mode Change in D-T Neutron Irradiated Ni and Au^{+}

Akira OKADA*, Keiji KANAO**, Toshimasa YOSHIIE*
Satoshi KOJIMA** and Michio KIRITANI***

(Received March 31, 1988)

Abstract

The process of the deformation structure development in D-T neutron irradiated Ni and Au was investigated. In Ni irradiated to fluences ranging from 1×10^{21} to 10×10^{21} n/m^2, and in Au from 0.5×10^{21} to 5×10^{21} n/m^2, the transition in the deformation process from dislocation channeling to that by cell formation was observed with an increase in the deformation amount. This transition took place with larger deformation in specimens irradiated to higher fluences. In the specimens for a fluence lower than the minimum fluence of these ranges, the deformation by cell formation was observed to be continued until the specimen broke, whereas the deformation by dislocation channeling

for a fluence higher than the maximum fluence, respectively. The deformation mode transition is illustrated in a diagram as a function of both irradiation fluence and deformation amount.

The difference in the deformation structures can be understood to have resulted from the difference in the stacking fault energy. The shape of the stress-strain curves and material ductility were also discussed correlating the deformation structures.

SPECIMEN SIZE EFFECTS ON D-T NEUTRON-IRRADIATED METALS+

Akira OKADA*, Keiji KANAO** and Michio KIRITANI***

(Received March 31, 1988)

Abstract

The specimen size effects were investigated on small sized tensile specimens of D-T neutron-irradiated Au, Cu, Ni and Fe. The size effects depend on the irradiation dose and type of metal. The mechanical properties relevant to small deformation such as yield stress can be obtained from small specimens, however, the other parameters for larger deformation amounts, viz., tensile strength and uniform elongation limit, strongly depend on the specimen size factors. The difference of size effects observed for various irradiation doses were discussed from a simple scheme. It was concluded that the prediction of size effects in highly irradiated materials is difficult from the data obtained from nonirradiated specimens.

$In_{0.53}Ga_{0.47}As$ metal-semiconductor-metal photodiode using Schottky contact

Tsuyoshi KIKUCHI, Hideo OHNO, Hideki HASEGAWA

(Received March 31, 1988)

Abstract

Metal-semiconductor-metal photodiodes (MSM PDs) with $In_{0.53}Ga_{0.47}As$ active layers were realized. Low Schottky barrier height of InGaAs was overcome by the insertion of lattice mismatched AlGaAs intermediary layer between metal and InGaAs

active layer. Fabricated photodiodes utilizing interdigitated metal electrodes formed by self-alignment technique showed a fast rise and fall time of 650 ps which was limited by the capacitance of the device. The gain of the device was less than 1. Theoretical analysis showed that photocurrent consists of drift current due to the photogenerated carriers in the depletion layer and the diffusion current from the region surrounding the depletion layer.

Fabrication Process of Self-Aligned InP MISFETs Using Refractory Metal Gates

Toshihiro TANAKA, Atsushi ISHII, Kouichi HAGITA,
Hideo OHNO and Hideki HASEGAWA

(Received March 31, 1988)

Abstract

A successful fabrication process of self-alinged InP MISFETs using refractory metal gates is presented. A tungsten gate which was formed by electron beam evaporation on to a heated substrate, was used for the self-aligned formation of n^+ contact regions by Si ion implantation. SiN films formed either by the plasma CVD process or by the photo CVD process, were used as gate insulators.

Optimum conditions for the gate metal formation, gate insulator formation and activation annealing were entablished. Contact resistance of Au/Ge/Ni seurce and drain contacts was determined by the TLM method and was found to be sufficient.

InP MISFETs were successfully fabricated on Fe-doped semi-insulating InP substrates, using the new self-alignment process. Superiority of the photo-CVD SiN film over the plasma CVD film for gate insulator was shown. The best mobility value in the devices with photo-CVD SiN films was 1,100$cm^2/V \cdot sec$ for $L=10\mu m$.

Research on Regional Extraction of Three-Dimensional Image Data

Takafumi KIKUCHI, Yuji SAKAMOTO and Yoshinao AOKI

(Received March 31, 1988)

Summary

Recently with the development of CT scanner and MRI technique three-dimensional image data have become increasingly available. With the development of 'under' snow radar technique, it has become possible to aquire three-dimensional data of targets in accumulated snow. However, we are lacking in systems by which we can display three-dimensional data accurately. We have been conducting research work which may enhance the display of three-dimensional imaging. We have attempted to extend FIR filter for three-dimensional imaging. We are working on a three-dimensional image processing including edge extraction. Following edge extraction, the processing of three-dimensional segmentation is greatly enhanced. The selection of outstanding data from the source will make it possible to display a three-dimensional image more readily. Three-dimensional FIR filtering is reported in the first section. In the second section three-dimension domain partition and a method by which compression of three-dimensional image data are reported.

An Implementation of Personal Computer Network Using a Public Telephone Line Network System

Ban GUO, Yoshinao AOKI and Peikai ZENG

(Received March 31, 1988)

Abstract

This paper describes the design and implementation of a local network between the same level of personal computers through a universal modem equipment linked to public telephone lines. The software of the Personal Computer Communication System (PCCS) is written in MS-C for the efficiency and convenience of running different computers. Now, the test system is run on a general purpose personal computer of PC -9801.

The system provides almost all of the commands provided in typical MS-DOS operating systems and allows users to use them for operating local computers and the remote computers linked through public telephone lines. The program facilitates the users to render access to remote hardware and software resources between the same

level personal computers, instead of having access to a high level host computer. Using the system, the user can easily control their application programs within remote machines and obtain results in the same way as using neighboring ones. Certainly, it also provides those functions supported in commercial communication systems such as autodialing, data or file transfer and mail messages.

Also, the design of automatic main power on-off circuit for a computer system, the procedure of display data transfer by X parameter control and the control of modem equipment on telephone line are discussed.

Hybrid Image Coding which Combines Block Truncation Coding and Predictive Coding

Hiroshi SATO, Tetsuo SHIMONO, Hideo KITAJIMA,
and Yoshihiko OGAWA

(Received March 31, 1988)

Abstract

This paper presents a high compression coding of still pictures which combines block truncation coding (BTC) and predictive coding. In case of BTC the intensity components of each block have a statistical dependency on its adjective blocks. Therefore predictive coding is utilized for the compression of the intensity sequence of each block. The compression rate of the new hybrid coding technique is superior to that of BTC, but the complexity of the coding process is almost the same as that of BTC.

Consideration on IIR digital filter with equal ripple characteristics

Shigenori KATSUMI and Yoshihiko OGAWA

(Received March 31, 1988)

Abstract

It is known that a filter with equal-ripple characteristics both on the passband and on the stopband has the greatest stopband attenuation. This report considers an equal-

ripple IIR digital filter under the condition of a fixed sum of a denominator and numerator degree in the transfer function. Under this condition the number of multipliers in the digital filter system is constant. In this report a new filter design method is proposed. In this method denominator and numerator of the transfer function can be independently determined.

Structural Analysis of Hydrothermally Synthesized Nickel Ferrite

Takashi MOROZUMI, Tatsuhiro FUJII, Tamotsu KOZAKI
and Hiroshi OHASHI

(Received March 31, 1988)

Abstract

Nickel ferrite was prepared by hydrothermal treatment of hydrolysis products of mixture of nickel chloride and ferric chloride solutions, and characterized by X-ray diffraction, SEM observation, and Mössbauer spectroscopy.

The samples, treated at 75℃ for 96 hours, showed only a weak indication of a peak at the strongest position in the X-ray diffraction pattern of nickel ferrite. X-ray diffraction patterns showed nickel ferrite formation above 100℃.

Formation and growth of nickel ferrite particles was virtually complete within 24 hours at temperatures between 100 and 250℃.The average particle size was from 15 to 35 μm with a maximum from 100 to 200μm. Below 150℃ the particles were angular, after 72h at 200℃ they were spherical, and after preparation for prolonged duration at higher temperatures they were platelike, due to cleavage. Since the patterns were quite similar to those of magnetite, nickel ferrite could not clearly identified by X-ray diffraction. Mössbauer spectroscopy, however, gave clear evidence of nickel ferrite at all temperatures above 100℃. This suggests the possibility of nickel ferrite formation through corrosion of Ni-containing steels in the environment of water coolant circuits of nuclear reactors.

Pulverization Process and Its Preventation by Copper Plating of Fe-Ti Hydrogen Storage Alloy

Tadahiko MIZUNO, Junichi KITABUKI, Yoshiaki HAYASHI
and Takashi MOROZUMI

(Received March 31, 1988)

Abtract

Pulverization of Fe-Ti hydrogen storage alloys was studied by using an acoustic emission method, as well as the BET surface area measurement including scanning electron microscopic observation.

The acoustic emission occurred remarkably in the first cycle of hydrogen absorption into virgin alloy, but practically disappeared during and after the second cycle of hydrogen absorption and desorption. The SEM image indicated the occurance and the growth of micro fissure network that was almost completed all over the alloy grains during the first cycles of hydrogen absorption in correspondence with the increase in the BET surface areas. The electroless copper plating was effective for preventing the pulverization when it was applied for the alloy which had already absorbed hydrogen, but was not effective for virgin alloy. The necessary thickness of copper plating layer was determined to be about 0.2% of mean alloy particle diameter.

This technic seems to be advantageous since it is low cost and does not markedly effect the hydrogen storage performances.

A method for fixing laser diode temperatures

Shizuo YOSHIDA

(Received March 31, 1988)

Abstract

A newly developed LD (laser diode) temperature fixing method is described. In contrast to the presently used Pertier element, the LD is maintained at a higher temperature than the ambient temperature. The electric forward current is monitored for changes due to ambient temperature fluctuations. The current through a fine metal wire is adjusted to maintain the LD temperature.

Tests showed the LD temperature changes 0.0091℃ for each one-degree C change in the temperature of the surroundings, which compares quite well with the Peltier element.

In addition, by using this method, it is possible to avoid longitudinal mode hopping and to control the LD temperature within a more confined space than now possible with the Peltier element.

Generalized Principal Components Analysis and an Improvement in it

Masahiro MIZUTA

(Received March 31, 1988)

Abstract

Generalized Principal Components Analysis (GPCA) is explained briefly and an improvement in GPCA is proposed in this paper. GPCA is one of the methods that determine non-linear structures of the data. Most of the properties of 'non-linear' modes are not dependent on a coordinate system, but the results of GPCA are not always invariant under orthogonal transformations, parallel translations and similarities of the coordinate system. An improvement in GPCA is proposed in order to cope with this defect. The proposed method is invariant under these transformations of the coordinate system.

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Corrosion Inhibition of Copper Alloys in Ball-Point Pen Vehicles

Takenori NOTOYA

(Received June 30, 1988)

Abstract

Corrosion products prevent a continuous flow of ink by clogging within ink-flowing paths in copper alloy ball-point pen tips, particularly after a long time of non-use under adverse conditions. Microscopic observation of the ink-path surfaces were roughened by heterogeneous dissolution, deposition of insoluble corrosion products, and a number of microcracks perpendicular to the drilling direction in oxide stripped substrates. In order to improve the performance and extend the service life of ball-point pens by preventing the formation of the ink-blocking corrosion products, screening tests of suitable organic inhibitors such as ink additives were conducted to mitigate corrosion of three copper alloys as the tip materials in a simulated solvent in the presence of inhibitors. Effectiveness of the inhibitors were evaluated by visual observation of the immersed surfaces of nickel silver, 60/40 brass and bronze and 30 day weight loss measurements in a mixture of benzyl alcohol (4 parts by volume) and oleic acid (1 part) containing inhibitors under stagnant conditions at 60° C.

The inhibitors tested were benzotriazole and three benzotriazole derivatives, two benzimidazoles, mercaptobenzothiazole, phenyl thiourea, dimercaptothiadiazole and dimethyldithiocarbamic acid.

It was found that benzotriazole, together with its methyl-and carboxylic derivatives, and dimercaptothiadiazole were effective for the copper alloys in preventing dissolution and formation of clogging masses of the metallic soap in the solvents.

Optimal Generation Expansion Planning based on the Dynamic Programming

Keiichiro YASUDA, Ken-ichi NISHIYA and Jun HASEGAWA

(Received June 30, 1988)

Abstract

The fundamental problem of generation expansion planning in electric power systems is to decide the type and number of generation technologies that should be added to power system, and the appropriate time to add them, so that future load demands can be met at the least cost. In this paper, an efficient method based on the dynamic programming is develop-

ed to determine the optimal generation mix and addition process. The dynamic programming, whose states are the cumulative capacity of generators and whose stages are generator technologies, is developed to determine the optimal generation mix. The dynamic programming method, whose states are the number of addition generators and whose stages are time periods, is applied to obtain the optimal addition process. A feasible computation time is required to obtain the optimal solution and the obtained generation mix can satisfy specified discrete capacities for all generators exactly. The feasibility of the proposed method is demonstrated on a typical power system model.

Determination of a Robot Position in a Corridor by a Visual System

Kunio ONDA, Rokurou MATSUSHIMA and Yoshinao AOKI

(Received June 30, 1988)

Abstract

This paper gives a method for determining a robot position in a straight corridor. In the method 3-dimensional image of the corridor is reconstructed from a perspective scene and the robot position is estimated by a pattern matching between the reconstructed image and an environmental map. For the reconstruction the method detects a vanishing point in the scene, determines a section of the corridor and calculates the distance to both sides of the wall surface. For the matching we used an arrangement of objects on the wall such as doors, windows and so on. These objects are expressed as compressed pattern data in the map for the fast matching and memory saving. And the reconstructed image is also compressed in the same manner as the map data. Experimental results shown in the paper gave satisfying precision for navigation of the robot.

An On-Line Input and Generation System of Calligraphic Characters Using a Pressure Sensing Pen

Chong-Ming SHI, Kunio ONDA and Yoshinao AOKI

(Received June 30, 1988)

Abstract

This report presents an on-line input and generation system of calligraphic characters,

which is realized on a personal computer. An input device named "pressure sensing pen" is developed by installing an infrared sensor inside the stylus pen of a tablet digitizer. We can use this pen instead of a writing bruch to write calligraphic characters and on-line input them into a computer. In writing characters, the vertical movement of the pen, which is proportional to the pressure concentrated on the pen, is measured by the infrared sensor so that not only the X-Y but also the Z information can be meanwhile obtained. In a computer, character strokes are generated from these three dimentional data. A stroke generation method is proposed in which the shape and the size of a brush touch pattern are modified based on the moving direction of the pen and the pressure imposed on the pen, respectively. Because the sensor works under the condition of no touching, writing brushes having different softness can be eaily simulated just by changing the softness of spring. Generated characters can also be actually written out on paper by a brush writing system.

Fourier Transformed Coupled Wave-Equation of Four-Wave Parametric Image Upconverter

Atsushi OKAMOTO, Teruhito MISHIMA and Ichiro SAKURABA

(Received June 30, 1988)

Abstract

The Fourier transformed coupled wave-equations of parametric image upconverters are derived from Maxwell's equations.

These nonlinear second-order differential equations are reduced to the first-order ones by using SVEA (slowly varying envelope approximation) on the assumption that the parametric interaction is sufficiently weak. If the pump intensity is so large that its depletion can be ignored, the linear coupled-mode formulations are obtained by a two-wave approximation. And if the nonlinear medium is sufficiently thin, the general solution of the differential equations is derived assuming the one-wave approximation in which only the sum-frequency wave is affected by the parametric interaction. This solution shows the optical transfer relation between the infrared and the sum-frequency Fourier spectrum.

By using these results, the image transfer performances of the devices, e. g., the image formations, aberrations, diffractions and phase matching properties can be analyzed in the spatial frequency domain.

The temperature dependence of ^{151}Eu Mössbauer effect in the high temperature superconductor $Ba_2EuCu_3O_y$

Masafumi TANIWAKI and Hiroyuki SASAKI

(Received June 30, 1988)

Abstract

^{151}Eu Mössbauer spectra for the superconducting $Ba_2EuCu_3O_y$ were observed at temperatures ranging from 4.2 K to 350 K. The europium in the superconductor was trivalent. The magnetic splitting was not observed at temperatures between 4.2 K and 350 K. The Debye temperature was obtained considering that the Mössbauer effective thickness was 240 K, which was lower than those obtained by other reseachers. The temperature dependences of the line intensity and line shift showed a clear deviation from the Debye approximation.

A Shape Comparison of Particulates and Descriptions of Thermally Deformed Ones by their Morphological Characteristics

Toshiharu SHIBATA, Atsushi DENDA, Kenji YAMAGUCHI

(Received June 30, 1988)

Abstract

The Fourier sine method in a half interval was well applied to contour analysis of particulate groups such as sharpedged sand, blocky coal, rounded ash of the coal and crushed acrylic ruptures for classification and characterization of shapes.

Bulk materials of coal and of the acrylic rupture, which were not small and had certain decision points, were thermally deformed and morphologically traced. The result showed in -lined changes along a characteristic axis but rather unexpected deformations such that initial irregularity resulted in complex contours and vice versa.

Effects of Oxygen Stoichiometry on the Anisotropic Structural Change of Oriented $YBa_2Cu_3O_x$

Teruo ISHIBASHI and Tsuneyoshi NAKAYAMA

(Received June 30, 1988)

Abstract

The effects of oxygen content on the structural change of highly oriented $YBa_2Cu_3O_x$ were studied in terms of x-ray diffraction in a temperature range from 77K to room temperature. It is found that the temperature dependence of the lattice constant c is severely affected by the oxygen content from $x=6.83$ to 7.00. However, the temperature dependences of the lattice constants a and b are not influenced by the oxygen content in contrast to that of c. The interpretation of these results are that oxygens are introduced as defects in the range $x=6.83$-7.00. Discussion is given for a role of the anisotropic structural change to the formation of anisotropic wave-function.

Numerical Simulations of Temperature and Turbidity in Reservoir

—— Effect of the Reservoir Scale and Level of Outlet on Vertical —— Distribution of Temperature and Turbidity

Morimasa OHTANI and Isao YAKUWA

(Received June 30, 1988)

Abstract

In this study, we performed a numerical simulation and compared the vertical distribution of water temperature and turbidity of Takisato and Kanayama Reservoir, whose scales and outlet levels are different from each other.

Their distribution depends strongly on the outlet levels even in the same reservoir. The distributions of temperature and turbidity of the discharged water depends weakly on the levels since the discharge causes a mixing of the upper and lower layers. It was shown that scale and water depth do not explicitly influence the temperature and turbidity of the discharge water.

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Observation of Interfaces of Compound Semiconductors by High Resolution Electron Microscope

Heishichiro TAKAHASHI, Tamaki SHIBAYAMA
Hideki HASEGAWA and Hideo OHNO

(Received June 30, 1988)

Abstract

Interfaces of Si, GaAs, InP compound semiconductor/native oxide insulator were studied using a high resolution transmission electron microscope (HRTEM).

The lattice images observed by HRTEM on semiconductor were compared with theoretically calculated images on the basis of Multi Slice method. The undulational interfaces between Si and native oxide were observed. In GaAs/native oxide interface, the interface after annealing in hydrogen became more flat than as grown.

On the other hand the interface between InP and native oxide showed a very flat lattice image, although 1~2 atomic layer steps were formed along (001) plane. As a result, the roughness of the interfaces were in the order of Si/native oxide, InP/native oxide, GaAs/native oxide (as grown), and GaAs/native oxide (annealed).

Formation of Silisides at Low Temperature by means of Ion-Beam Mixing Method

S. OHNUKI, K. KIMURA, H. TAKAHASHI
and R. NAGASAKI

(Received June 30, 1988)

Abstract

Ar^+ ion-beam mixing method was applied to the formation of Ni-silisides. Ni/Si samples irradiated with 200 keV Ar^+ were observed by a high resolution analyticalmicroscope. At low temperature (<200℃), the ion-beam mixing was enhanced effectively to form the objective material of $NiSi_2$ phase which showed the epitaxial relation for the Si matrix. The process is probably caused by the direct collision of ions and target atoms. At medium temperature (>300℃), the effect of ion-beam mixing was limted, and only the NiSi phase was formed. The suppression arises from the formation of the defect-free zone around the interface between the siliside and Si. From these results it is indicated that low temperature ion-beam mixing is useful for the formation of the siliside with a good epitaxitial relation to Si matrix.

Precipitation Behavior and Compositional Change during the Aging Process on Type 316 Stainless Steels

H. KINOSHITA, H. TAKAHASHI, R. NAGASAKI
S. OHNUKI, Y. SATO and S. MOCHIZUKI

(Received June 30, 1988)

Abstract

The precipitation behavior of two species of the thermally aged SUS316 stainless steels (A and B) were examined. After solution treatment followed by 20% cold work, the materials were aged at 500~700℃ for 1000~18000 hrs. The structures of the aged materials were investigated by means of Transmission Electron Microscope (TEM) and the mean size, the number density and morphology of precipitates were measured.

According to these measurements, the mean size increased with the increase in temperature but the number density was only slightly changed above 600℃.

Furthermore the precipitates were identified by using a Energy Dispersive X-ray Spectroscopy (EDS) and electron diffraction technique. From these analysis, the effects of thermal aging conditions on precipitation behaivior were discussed, and finally Time-Temperature-Precipitation (TTP) curve was constructed.

According to measurements of concentration on Laves phase compared to 600℃ and 700℃, it was claryfied that the concentration of Mo increased and that of Cr, Ni, Si decreased with the increase in temperature.

Joining of Alumina to Alloys with Chromia Coatings

Koji ATARASHIYA, Ryukichi NAGASAKI and Tadayoshi TAKAHASHI

(Received June 30, 1988)

Abstract

The diffusion bondings of alumina to nichel-chromium alloys at 1573~1623 K for 172.8~950.4 ks were examined.

An alloy plate was placed between two alumina blocks, and this set was annealed under null pressure in air. Chromium in nickel-chromium alloy reacts predominantly with gaseous oxygen in air into chromia on the surface of alloys. Because alumina and chromia are completely soluble with each other, the bonding parts are made of the alumina-chromia solid solution and excess chromia layers.

To improve the interfacial structure of bonding parts, nickel-metal foils were used as fillers. In this case, the initial oxidization of chromium was prevented, thus, the bonding parts consisted of the alumina-chromia solid solution alone. The nickel-

metal foils diffused into the bulk of alloys and did not remain in the bonding parts.

The fracture strength up to 12MPa was achieved by three-point bending tests. The cross-sectional structure were observed by SEM and the concentration distribution of bonding parts were determined by EDX.

Diffusion Bonding of Two Blocks of MgO Using Ni-filler

Yuji HATANAKA, Koji ATARASHIYA, Ryukichi NAGASAKI
and Tadayoshi TAKAHASHI

(Received June 30, 1988)

Abstract

In this joining technique a nickel-metal foil was placed between two magnesia blocks and this set was annealed in air. Nickel metal reacted entirely with gaseous oxygen into nickelous oxide. Then, the joining was accomplished to form the solid-solution of magnesia and nickelous oxide at the joining part of magnesia.

The couple of a 7mm × 10mm × 20mm block of magnesia was prepared. A 10μm or 50μm thick nickel-metal foil was placed between two 7mm × 10mm faces of the magnesia blocks. Then, the specimens were annealed at 1573 or 1873K for 176.4 to 921.6ks in air. The microstructural observations and three-point bending tests were examined. An original magnesia block has a segregation of calcium and silicon along the grain boundaries. In the joining parts of magnesia, these concentrations are changed into new distributions in a joining crystal.

The fracture strength of joining parts was up to ca. 60MPa. The recrystallization of magnesia was readily brought about by higher temperatures. Thus, strong joining was accomplished in a short period of time of the annealing at 1873K.

Effect of Additives on the High Temperature Oxidation of Silicon Nitride

Kazuya KUROKAWA, Ryukichi NAGASAKI and Tadayoshi TAKAHASHI

(Received June 30, 1988)

Abstract

In order to clarify the effect of additives (Al_2O_3 and Y_2O_3) on the oxidation

behavior of sintered slicon nitride, the scaling kinetics and scale morphologies of two kinds of Si_3N_4 ceramics and SiC ceramic in air at temperatures ranging from 1573 K to 1873 K were investigated.

The oxide layers formed on the pressure-less sintered SiC ceramic which contains little additives were substantially amorphous silica over the entire temperature region. The amorphous silica remarkably protected the ceramic from a further oxidation. On the other hand, the two ceramics, the pressure-less sintered (PLS) Si_3N_4 ceramic which contains about 4 mass% Al_2O_3 and 4 mass% Y_2O_3 and the gas pressure sintered (PS) Si_3N_4 ceramic which contains about 2 mass% Al_2O_3 and 2 mass% Y_2O_3, behaved in a similar manner exhibiting high oxidation rates for short times followed by decreasing rates for longer times. However, the oxidation resistance for the PLS-Si_3N_4 were lower than for the PS-Si_3N_4 at all temperatures studied, and the resistivity was closely associated with the formation of $Y_2Si_2O_7$. It was suggested that the oxidation resistivity of Si_3N_4 ceramic was improved by lowering the additive concentration.

Chemical Structure of Hexan Soluble Portion in Coal Tar by Means of HPLC−MS

Masaaki SATOU, Susumu YOKOYAMA and Yuzo SANADA

(Received June 30, 1988)

Abstract

The chemical structures of hexane soluble portion in coal tar were studied by high-performance liquid chromatography (HPLC) and mass spectrometry (MS).

The hexane soluble portions were characterized by the diagrams of compound type distribution, which indicated the structural distribution of the numbers of aromatic rings, naphthenic rings and carbons of alkyl groups attached to these rings based on the separation behaviour in HPLC and type analyses according to Z number by MS.

By the above mentioned analyses, it was clarified that the major compound types in hexane soluble portion of coal tar are polyaromatics which have 2~6 of aromatic rings. Alkanes and monoaromatics were hardly contained. And the average carbon numbers of alkyl side chains attached to aromatic and naphthenic rings are about 1~5 in diaromatic compound types and are almost 0~1 in polyaromatic compound types which has up to three aromatic rings.

Preferential Separation of Low Ash-Content Coal Particles by CO_2 Absorption and Liquid Fluidization

Tadatoshi CHIBA, Tohru YAMAGISHI, Hiroshi MORITOMI
Yuzo SANADA, Tadao JIMBA*, Masatoshi NAKAI* Tomoyasu ESAKI*
and Yukuo KATAYAMA**

(Received June 30, 1988)

Abstract

Preliminary experiments were carried out in an effort to evaluate the effect of CO_2 absorption on the separation process of coal particles with different ash contents. A mixture of coal particles and water was exposed to CO_2 gas under pressures up to 2.0 MPa and then released to atmospheric pressure. This resulted in the formation of froths of CO_2 gas on the surface of each coal particle. The froth formation depended on the ash content of individual particles and some of low ash-content particles floated onto the water surface. However, since the amount of the particles recovered from the water surface remained only a few weight percents, liquid fluidization was applied to classify the CO_2 treated particles, the apparent density distribution of which was broadened as a result of the selective froth formation. Weight fractions of the coal particles and ash elutriated from the bed at increasing liquid velocities were measured for several kinds of coals having different size ranges and ash contents. An improved separation by the CO_2 treatment was obtained for some coals.

Stacking Structure of Aromatic Molecule in Carbonaceous Mesophase

Masahide SASAKI and Yuzo SANADA

(Received June 30, 1988)

Abstract

Optical anisotropic mesophase spheres appear in isotropic matrix when petroleum heavy oils, coal tar pitches and some kinds of organic compounds are heat-treated at temperatures of early stage of carbonization. It is so far believed that the mesophase is composed of stacked lamellae in which large aromatic sheets are aligned parallel to each other and shows liquid crystal behaviours.

From the relation between density and H/C of various pitches, remarkable increase is not observed at the temperature range of mesophase formation (H/C $<$ 0.45). It is clarified that the density of carbonaceous mesophase is closed to super cooled liquid density rather than lattice density. It is concluded that the planar lamellae in carbonaceous mesophase are not aligned in parallel completely.

Recovery of Valuable Metals from Copper Alloy Scrap

Y. SASADA, J. TUJINO, H. KIUCHI
and T. NAGAI

(Received June 30, 1988)

Abstract

Copper alloy scraps such as German silver are released from communication machine scraps. Generally, copper alloy scraps are treated by copper smelting, but Zn and Ni in the alloy are not recovered because they go to slag during the smelting. The aim of this study was to investigate the utilization of hydrometallurgical methods for the recovery of valuable metals. German silver scrap was used as copper alloy sample in this experiment.

As one method, the combination of acid leaching and pressure hydrogen reduction was investigated. Because there was a industrial waste solution of 70% H_2SO_4 and 7% HNO_3, the waste acid was used in the leaching. The 2.5−time dilute solution gave the best dissolution result below 100℃. The imitation leach solution referred to the leaching was reduced under 20kg/cm^2 of hydrogen at 180℃ in the autoclave. It was found that more than 70% reduction was difficult to be obtained because the acid concentration of the leaching solution was higher than 170g H_2SO_4/l. But when a little of Bi ion was added to the solution, 96% of reduction could be obtained by catalytic action of Bi ion.

As second method, the utilization of disproportionation was investigated. Copper sulfate solution in contact with German silver scrap was heated to 200℃ in inert gas atmosphere. At high temperature, Cu^+ ion was stable and it was formed by the interaction between Cu^{2+} and metallic Cu in the alloy. The Cu^+ ion disproportionated by rapid cooling of the solution, which results in fine copper powder and Cu^{2+}. Also the cementation between copper ion and and metallic Zn and Ni in the alloy simultaneously occured at high temperature. Therefore, the copper content increased from 57% in the scrap sample to 93% in the final product.

The Rate of Formation of Calcium−ferrite Melt Measured by means of Penetration Method using CaO Cone

Haruhito NORO, Yoshiaki KASHIWAYA, Kuniyoshi ISHII

(Received June 30, 1988)

Abstract

The rate of formation of calcium ferrite melt was measured by the penetration method using CaO cone under isothermal (1200～1270°C) or nonisothermal (heating up rate ; 10°C/min) conditions.

The temperature of beginning of the melt formation was good agreement with the phase diagram in the cases of Fe_2O_3 and Fe_2O_3+5wt%SiO_2 system. In the system of Fe_2O_3+5wt%Al_2O_3, however,the melt formed above the temperature of 40°C higher than that in equilibrium.

The composition of primary melt existed within the region of monocalcium−ferrite ($CaO \cdot Fe_2O_3$) in the phase diagram.

As soon as CaO cone contacted with Fe_2O_3 substrate, at first, dicalcium−ferrite ($2CaO \cdot Fe_2O_3$) formed at the interface, and then it reacts with Fe_2O_3 to produce liquid phase of monocalcium−ferrite. Although the concentration gradient of Fe_2O_3 was found, nocompound, such as calcium−diferrite, was to appear in the interior of Fe_2O_3.

The apparent activation energy of formation of molten calcium−ferrite was very high and about 93kcal/mol, so this was explained by considering the chemical reaction controlling the kinetics.

Analysis of Negative Pressure in Solidifying Al −Si Alloy with the Effects of Fluid Flow and Solid Deformation

Ken-ichi OHSASA, Tatsuya OHMI and Tadayoshi TAKAHASHI

(Received June 30, 1988)

Abstract

A numerical analysis of the negative pressure developed during solidification of Al −Si alloy ingots was carried out, taking into account the effects of interdendritic liquid flow and solid deformation in the solidifying zone. In order to confirm the validity of the analysis, the calculated negative pressure distribution was compared with the density distribution in the solidified ingot.

When only the effect of interdendritic liquid flow is considered, the calculated

negative pressure increases with the lapse of solidification time and shows a distribution of a concave shape having a maximum value of −26MPa along the height of the ingot. On the other hand, considering both effects of the liquid flow and the solid deformation, the increase in the negative pressure is restricted to the maximum value of about −0.7MPa because the negative pressure is accommodated by solid deformation and subsequent distribution of the negative pressure is almost uniform along the height of the ingot. The density distribution in the solidified ingot is consistent with the calculated negative pressure distribution obtained by the analysis considering the two effects.

Cryogenic Deformation Behavior of Al−Mg Binary Alloys

Masaaki HISA, Hiroshi KONDO and Katsuya WATANABE

(Received June 30, 1988)

Abstract

Mechanical properties of Al−Mg alloy (4.1 and 4.6at% Mg) were investigated by tensile test at 77K and 293K.

Both the ultimate tensile strength and the 0.2% proof stress increased with decreasing temperature, and the increment of the ultimate tensile strength was larger than that of the proof stress. The elongation also increased at the low temperature.

The mechanical property changes were thought to be the increase of work hardening exponent at the low temperature. At 77K the strength increased with strain rate, while the dependency at 293K was obscure. This was considered to be affected by the reverse temperature dependence of strength for this alloy.

On the Specific Conductivity and Decomposition Voltages of Chloride Melts Containing $AlCl_3$

Shoichi KONDA, Toshio NARITA and Tatsuo ISHIKAWA

(Received June 30, 1988)

Abstract

This report includes the specific coductivity and decomposition voltages of $AlCl_3$ in a NaCl-25mol%$MgCl_2$ melt, determined by the coexistence of aluminum particle products and chlorine gas bubbles during electrolysis at 750°C.

By increasing $AlCl_3$ contents from 2 to 9 mol%$AlCl_3$ the specific conductivity decreased from 2.30 to 1.85 S/cm and the decomposition voltage decreased from 2.005 to 1.985 V. When the resistivities were obtained from the I−V curves and plotted aganist the electrode distance, at zero electrode distance they were in the range 0.008 to 0.022 ohm, not zero. This resistivity seems to be due to nuclei producing chlorine gas bubbles on graphite electrode.

With these parameters the relations between current and voltage were discussed for electrowinning of aluminum from the chloride melt containing $AlCl_3$, and the cell efficiency and the minimum energy consumption could be determined for different sizes of bipolar electrode cells.

Effects of Composition and Cooling Rate on the Solidification Temperature Range of Carbon Steel

Kiyotaka MATSUURA, Youichi ITO and Kaichi MATSUBARA

(Received June 30, 1988)

Abstract

The effects of C, Mn and S contents and the cooling rate on the solidification temperature range of carbon steel were investigated in this work. The liquidus and the peritectic temperatures were measured by means of thermal analysis. The solidus temperature was determined from the Fe − sulfide eutectic structure in quenched samples.

The liquidus temperature T_L(℃) decreased with increasing C, Mn and S contents(wt%), while it was not influenced by the cooling rate varied from 0.5 to 14.8 (°C/min). These results were formulated as follows :

$$T_L = 1542 - 68[C\%] - 4.3[Mn\%] - 34[S\%].$$

The solidus temperature T_S(℃) decreased as C and S contents increased, while the

effect of Mn was complicated. In a low Mn range, the increase of Mn content produced a remarkable temperature rise, although the temperature decreased in a high Mn range. On the other hand, the solidus temperature dropped as the cooling rate V(℃/min) increased, and the degree of the temperature drop was accelerated for the steel with low C, low Mn and/or high S contents. These effects were summarized as follows :

$$T_s = 1360 - 130[C\%] + 94[Mn\%] - 120[S\%] + (-50[C\%] - 4.1[Mn\%] + 340[S\%])[Mn\%]^2 + (14 + 1.2/[C\%] - 4.6/[Mn\%] - 620[S\%])[V^{\circ}C/min]$$

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Influence of Organic and Inorganic Modifiers on the Selective Flotation of Fluorite from Calcite with Sodium Oleate

Masami TSUNEKAWA and Takakatsu TAKAMORI

(Received September 30, 1988)

Abstract

Flotation tests of fluorite-calcite mixture were carried out to elucidate the practical optimum conditions, using sodium oleate as collector and five kinds of modifiers.

Soluble starch, sodium lignin sulfonate, tannic acid and sodium metasilicate selectively depressed calcite and the optimum pH region for good separation lay at around pH8. Sodium phosphate depressed fluorite above pH12, however, its depressing action was not so strong. A suitable combination of plural modifiers such as soluble starch and tannic acid, and sodium lignin sulfonate and sodium metasilicate improved selectivity, limiting the optimum pH to a narrower region.

Potentiostatic Dezincification of Commercial Brasses and Its Inhibition by Organic Inhibitors in Acidified Sodium Chloride Solution

Takenori NOTOYA

(Received September 30, 1988)

Abstract

Inhibition action of three organic chemicals as dezincification inhibitors for six different commercial brasses was investigated using a potentiostatic acceleration technique in an acidified 0.5 M NaCl solution at 60°C. Brasses used were two dezincification resistant brasses of TCA (0% β phase) and NFS (9%), C3604 (14%) free cutting brass, C4641 (22%) naval brass, C3771 (27%) forging brass and C6782 (62%) high strength brass. Inhibitor performance was in the order of tolyltriazole (TTA) < benzotriazole (BTA) < thiabendazole (TBZ) based on chemical analysis for dissolved copper and zinc during anodic polarization at -0.200 V vs. S. C. E. It was concluded that dezincification attack in the brasses can be prevented by an

addition of a small amount (1 mili mol.) of either TTA, BTA or TBZ to dezincification prone environments.

Unsteady-State One-Dimensional Simulation of Laser-Sustained Plasmas

Masahiro TAZUMI and Kenichi ITO

(Received September 30, 1988)

Abstract

Unsteady-state phenomenon of laser-sustained plasmas for Laser-heated Rocket was studied with one-dimensional explicit MacCormack's scheme. Temperature dependant thermal-properties and radiation loss mechanism of plasmas were included in this model. Laser intensity were varied from 10^8 to 10^9 W/m^2 and the inlet velocity of low-temperature argon gas were varied from 0.1 to 200 m/s. Thermal growth, blow-out and blow-off of Laser -sustained argon plasmas were clearly observed.

Thermal Conductivity of the Frozen Layer of Aqueous Binary Solutions

Shoichiro FUKUSAKO and Masahiko YAMADA

(Received September 30, 1988)

Abstract

Measurements of the thermal conductivities of the frozen layer of aqueous binary solutions were performed using the transient hot-wire method. Solutions of propylene glycol and of sodium chloride were utilized as the testing fluids, and these were frozen in the test section in which the platinum wires of 40 μm in diameter with 170 mm in length were strung. Measurements were carried out under equilibrium at a variety of both the initial concentration of the solution and the temperature of the frozen layer. The expressions of the thermal conductivity of the frozen layer were determined. It was found that the thermal conductivity

of the dendritic ice layer was favorably assessed with the Lichteneker's model by introducing the solid fraction under an assumption of the equilibrium within the range of parameters examined.

Optical Transfer Properties of Parametric Image Upconverter I —In the Case of Thin Medium—

Atsushi OKAMOTO, Teruhito MISHIMA and Ichiro SAKURABA

(Recieved September 30, 1988)

Abstract

Optical transfer properties of two-photon-pumped Parametric image upconverter in the case of plane wave pumping and of a thin nonlinear medium are analyzed in spatial frequency domain.

A general solution of the differential equations of the lossless and low efficiency image upconverter is derived assuming that the one-wave approximation in which only a sum-frequency wave is affected by the parametric interaction. This solution shows the optical transfer relation between the infrared and the sum-frequency Fourier spectrum.

Phase matching properties of the device are considered, and it is shown that the transvers phase matching conditions were completely strictly satisfied in the case of plane wave puming and in a diffraction-free nonlinear medium.

The image upconverter can be characterized by the extension of optical transfer function (OTF), and if the medium is sufficiently thin, the OTF has the only phase factor from which the image formation is derived. The general equations of the image formation of sum-frequency response with infrared input are derived using the inverse Fourier transformation.

Optical Transfer Properties of Parametric Image Upconverter II —In the Case of Thick Medium—

Atsushi OKAMOTO, Teruhito MISHIMA and Ichiro SAKURABA

(Recieved September 30, 1988)

Abstract

Optical transfer properties of two-photon-pumped parametric image upconverter in the case of plane wave pumping and of a thick nonlinear medium are analyzed in a spatial frequency domain.

The general solution of the differential equations of the plane wave pumped thick medium is derived assuming a two-wave approximation in which only infrared and sum-frequency wave is affected by the parametric interaction. This solution shows the optical transfer relation between the infrared and the sum-frequency Fourier spectrum.

The image upconverter with a thick medium can be expressed by the extension of optical transfer function (OTF) as well as in a thin medium. The phase factor of the OTF shows the image formation properties of the thick medium, and these are equivalent to of the thin one. But the amplitude factor of the OTF characterizes the thick medium. It is shown that the longitudinal phase mis-matching has a great considerable effect on the amplitude transfer properties of the thick medium and the mis-matching restricts the acceptance spatical-frequency bandwidth of the infrared image.

Superconductivity and Crystal Structure in high-T_c Bi-Sr-Ca-Cu Oxides

Norio HONMA, Kazuhiko YAMAYA and Yutaka ABE

(Recieved September 30, 1988)

Abstract

The superconductivity and the crystal structure were investigated in the Bi-Sr-Ca-Cu-O system with the following chemical compositions of Bi : Sr : Ca : Cu = 2 : 2 : 1 : 2, 4 : 3 : 3 : 4 : and 2 : 2 : 2 : 3. It was found in the chemical composition of 2-2-1-2 that the single phase of Bi_2Sr_2 Ca Cu_2O_y with the superconducting transition temperature, T_c of 80K

was obtained on the sintering condition of 860°C and 16 hours. It was determined that the lattice parameters are $a = 5.417$Å, $b = 5.417$Å and $c = 30.872$Å and the period of the incommensurate in the direction of the b-axis is 4.77. On the other hand, the multiphase mixtures was obtained in other chemical compositions, although the main phase is $Bi_2Sr_2CaCu_2O_y$. For various chemical compositions and sintering conditions, the magnitude of the a- and b-axis of $Bi_2Sr_2CaCu_2O_y$ were almost constant but that of the c-axis extremely varied and was the lowest for the highest value of T_c. The correlation between the magnitude of T_c and that of the c-axis is very similar to that in $YBa_2Cu_3O_{7-y}$. This suggests that the oxygen content plays a role on the magnitude of T_c and that of the c-axis also in $Bi_2Sr_2CaCu_2O_y$.

Studies on Pool Boiling Heat Transfer (1st.)

—Generalized Correlation of Nucleate Pool Boiling Heat Transfer—

Hiroto SAKASHITA and Toshiaki KUMADA

Abstract

Heat transfer correlation of saturated nucleate pool boiling is usually expressed by two parameters, heat flux and surface superheat. The use of this correlation is limited to the combination of the specific conditions of heat transfer surface and liquid. Therefore, several attempts for saturated pool boiling heat transfer have been made to obtain a generalized correlation consisting of three parameters, i.e., active nucleation site density, heat flux and surface superheat.

However, the physical meaning and the usefulness of the generalized correlation are not well understood.

In this paper, a study on the generalized correlation of saturated nucleate pool boiling heat transfer is presented. The correlating parameters, a suitable form and the physical meaning of the generalized correlation are examined. Based on this examination, several correlations that were proposed previously are analyzed and their validity were checked by using available experimental data.

Studies on Pool Boiling Heat Transfer (2nd.) —Measurement of Frequency of Coalesced Bubbles Formed on a Horizontal Circular Surface and Proposition of Semi-empirical Formulas—

Toshiaki KUMADA*, Hiroto SAKASHITA* and Hideaki YAMAGISHI**

(Recieved September 30, 1988)

Abstract

Recent papers have proposed a model that critical heat flux in saturated pool boiling is determined by the frequency of coalesced bubble formation and the thickness of a thin liquid film formed beneath a coalesced bubble.

The main purpose of this paper is to measure the frequency of bubbles formed on horizontal circular surfaces and to propose semi-empirical formulas among the frequency, the diameter of bubbles and the blowing rate of gas. Horizontal circular surfaces of two kinds were used to measure the frequency of bubbles and their diameters. Diameters of both surfaces ranged from 0.5 cm to 3 cm. Nitrogen gas is fed steadily into a sintered metal surface in water or freon-113 and passes out as bubbles through the surface. Bubble frequency was measured under atmosphric pressure by taking cine photographs of 16 mm or a conductive probe method. Two semi-empirical formulas, predicting the frequency of bubbles formed on circular horizontal surfaces, were proposed.

Radial Oscillations of a Pinch Plasma under the Alternating External Magnetic Field

Masaru IWAMATSU, Shigeo YATSU, Chisato IWASAKI and Tatsuo KASAHARA

(Recieved September 30, 1988)

Abstract

Radial oscillations of a pinch plasma under an alternating external magnetic field are analyzed numerically. The external magnetic field consists of a constant bias field and a periodically alternating field. On the assumption that the plasma is confined in a thin cylindrical annulus and plasma conductivity is infinite, the non-linear equation of motion is solved numerically by Runge-Kutta-Gill(RKG) method. The solution of the equation is

shown in phase space, including Poincaré map. Poincaré map is utilized to specify the oscillations. The frequency of oscillations is estimated by Fast Fourier Transform(FFT) spectral analysis.

From the results of the analysis, stable radial oscillations make almost periodic oscillations and have several modes, including an eigenfrequency of radial oscillations, a frequency of the external field and their higher harmonics. The stable-unstable diagram is shown for typical parameters. It is also shown by the linear analysis using the perturbation method that unstable solutions occurred at specified parameters are caused by resonance.

Experimental Analysis of the FRC Formation Process by Holographic Interferometry

Shigeo YATSU, Hitoshi YAMAOKA, Tatsuo KASAHARA
Yuichi OGAWA and Yasutomo OZAWA

(Recieved September 30, 1988)

Abstract

The formation process of Field Reversed Configuration(FRC) is analized experimentally by plasma density measurement using both end-on and side-on holography interferometers. Details of the formation process are clarified from the integrated density profiles and local density distributions obtained by an asymmetric Abel inversion.

Asymmetry distributions of axially integrated plasma density are sketched on a cross-section of a discharge tube from the results of end-on measurement. Axially integrated density profiles having two peaks are plotted along the specified discharge tube diameter. From temporal change of the profile a mode of axial plasma motion under the axial contraction of magnetic lines of force is investigated, and it is deduced that plasma is plowed toward the theta-coil central region with a motion onto the axis.

Side-on holograpy measurement is applied to FRC as the first experiment, and result is examined in terms of plasma motion. It appears that the local density distribution corresponds to the plasma plowed axially.

It is also shown that axial relaxation phenomena resulting from the axial contraction may be generated dominantly.

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ROLE OF TENSORIAL FORMULATIONS IN CHARACTERIZING THE POINTWISE MULTI-DIMENSIONAL PERFORMANCE OF DYNAMIC SYSTEMS

Haruo TAKIZAWA*

(Received September 10, 1988)

Abstract

A family of mathematical formulations of a strictly tensorial nature is shown to be advantageously used for obtaining better insights into the pointwise multi-dimensional features of earthquake shaking and structural response. This can be rendered sufficiently general and resorts primarily to the tensors of root-square values or root-mean-square amplitudes including also the tensors of their time-domain and/or frequency-domain decomposition. By permitting to interpret all these tensors consistently by means of the energy fed into simple oscillators of multi-dimensional isotropy, their individual roles are to be assigned within the framework of structural dynamics. Spectral decomposition accompanies an Hermite and non-negative definite tensor, mechanical implication of its complex cross-correlation components being noted with a specific interest. With the mechanics of structure related straightforwardly to the multi-dimensional characteristics of earthquake shakings, findings in the present study are then highlighted by geometric simplicities which characterize the tensor fields of response developed over the constitutive points of system. They prove useful for understanding important trends behind the quite messy appearence of spatial distribution. Examined in addition are practically important but non-tensorial properties in the pointwise directional dependence of peak amplitudes.

COMPARISON OF THERMAL MOVEMENTS AND THREE-DIMENSIONAL ELASTIC ANALYTICAL RESULTS OF REINFORCED CONCRETE BUILDINGS

Shigeru KUSHIYAMA*, Mamoru OBATA**

(Received September 10,1988)

Abstract

In three actual reinforced concrete (R/C) buildings (1,3 and 6-storied buildings), thermal movements measured until now are very different from analytical results obtained from the plane frame analysis. The present paper is intended to clarify thermal movements analytically, and to find out temperature conditions for analyses. Analysis attempted is three-dimensional elastic analysis considered the effect of slabs and walls, and the validity of analytical results are examined by comparison with the measurements of three buildings. It is shown that results obtained from three-dimensional elastic analysis show a good agreement with measurements, and it is necessary to consider the temperature data corresponding to position of structural members in buildings with heating apparatus.

(Transverse Reinforcement in Joints and Beam Ends)

INFLUENCE OF TRANSVERSE REINFORCEMENT IN JOINTS AND BEAM ENDS ON THE BEHAVIOR OF R/C BEAM-COLUMN SUBASSEMBLAGES

Osamu JOH, Yasuaki GOTO, Takuji SHIBATA

(Received September 10, 1988)

Abstract

In the recent earthquake-resistant design of reinforced concrete frames, the importance of the behavior of the beam-column joint is marked since the weak beam-strong column mechanism is recommended in general. The shear failure or shear cracking in joints must be prevented as a matter of course, and moreover the slippage of beam bars from the joint should be also avoided because it will reduce the energy absorbing capacity of frames. To avoid such slippage, the confinement of core

concrete in members may have some influence on the limitation of the deterioration of bond stress. Experimental work was carried out in order to determine the influence of transverse reinforcement in joint panels and/or the connecting ends of beams on the behavior of R/C beam-column subassemblages. The test results showed that the heavy transverse reinforcement in joints reduced the slippage of beam bars from the joint panel and enhanced the panel stiffness after cracking, and that such reinforcement in the beam ends showed little effect on relieving of the stiffness degradation of frames after yielding. One of specimens that was treated as bondless within the joint region of the beam bars developed sufficient ductility but low energy absorption.

(Three-Dimensional R/C Beam-Column Subassemblages with Slabs)

BEHAVIOR OF THREE-DIMENSIONAL REINFORCED CONCRETE BEAM-COLUMN SUBASSEMBLAGES WITH SLABS

Osamu JOH, Yasuaki GOTO and Takuji SHIBATA

(Received September10, 1988)

Abstract

An experimental study was carried out to clarify the shear resistance behavior of interior beam-column joints in two-way reinforced concrete frames. Four three-dimensional subassemblages with slabs are used as specimens to which lateral cyclic forces are applied in two directions perpendicular to each other by changing the direction alternately at every cycle. On the basis of the results of experiment and calculation, effective width of slabs participating in the bending strength of beams, ultimate strength of joint panels, effectiveness of the panel stiffness in story drift and energy absorption are discussed. As for the ultimate strength of joint panels, adaptability of two equations previously proposed in Japan and reasonableness of the requirements of ACI Code and New Zealand Standard also are discussed in comparison with the test results.

FROST DAMAGE OF CONCRETE CONSIDERING FREEZING POINT DEPRESSION OF CAPILLARY WATER IN HARDENED CEMENT PASTE

Eiji KAMADA

(Received September 10, 1988)

Abstract

Frost damage of concrete was discussed considering the freezing point depression of capillary water depending on the restriction of capillary walls and on the supercooling of distributed water in small pores.

From this point of view, the basic mechanisms of frost damage to concrete may become somewhat different from that which was commonly believed. The original hydraulic pressure theory seems to explain the frost damage of concrete which has many large pores such as that of early ages or very high water-cement ratios.

A Long-term Exposure Test of Various Concretes concerned with the Difference of Frost Damage due to Weather Conditions

Toshio HASEGAWA, Yoshiro KOH*

(Received September 10, 1988)

Abstract

In a survey of concrete buildings in cold regions in Japan, regional differences of frost damage of concrete were observed. Different weather conditions of the regions seem to cause these differences. We carried out a long-term outdoor exposure test at 11 selected places, under different weather conditions. To find out the difference of frost damage, 25 kinds of concrete mix were selected in this test. Large differences in the compressive strength, the static modulus of elasticity, and the carbonation depth were observed depending on the weather conditions of exposure sites. The collapse by frost damage of some concrete mixes occurred at Kitami, where the highest degree for the risk of frost damage is expected in Japan, after more than 4 years outdoor exposure. Concrete mix with high water-cement ratio quickly decreases its compressive strength, and carbonation of the mix becomes greater. Frost damage of non-AE concrete was recognized at some exposure sites with severe weather conditions after ten years exposure.

An Analysis of Population Density Distribution in View of the Relations between the Density and Distance from Urban Center in an Urbanization Promotion Area — Sapporo, 1975,1980,1985

Katsuyuki IIDA, Masaaki ISHIMOTO

(Received September 10, 1988)

Abstract

The structure of urban space in terms of distribution of population densities and the relations between the density and distance from the urban center are important indices which indicate the extent of the growth of a city. The studies on these, however, have not attained any good results although several attempts have been made by Colin Clark (1967) and some others.

In this paper, a study was conducted based on detailed data collected, during the past 10 years from 1975 to 1985, according to the block unit in the urbanization promotion area of Sapporo, one of the rapidly growing cities in Japan. The result was quite meaningful in that it includes the so-called doughnut phenomenon of the city and also that it is expressed by means of Weibull distribution function, one of the probability functions which show extreme accuracy and availability,

An attempt was also made, in terms of the distance relations of entropy, to grasp the active change of the density in the blocks and the complicated phases of the change. Additionally, the distribution of population densities in the area along the subway lines, the densely inhabited zone in the urbanization promotion area, and outside this area was analyzed quantitatively.

The Urban Improvement Problems Resulting from the Changing Urban Spatial Structures of Provincial Central Cities in Hokkaido — 1960 ~ 1980 —

Hidetsugu KOBAYASHI, Minoru OHTA*

(Received September 10, 1988)

Abstract

Throughout the high growth period beginning in early 1960's, remarkable changes in Japanese economy and society have been brought about. Urbanization of

the cities in Hokkaido has advanced rapidly and intensely during the past two decades. The phenomenon of urbanization with its remarkable urban transformation is becoming less marked these days. However, the social and economical structure is becoming highly complex with changing life-styles. Therefore, there is still much need for restructuring urban areas and for improving urban environment in provincial cities.

In this paper, the trend of rapid urbanization and the transformation of urban areas in provincial central cities of Hokkaido in the post-high growth period are analyzed. The study is made to find out a relatively broad understanding of how urban land uses are structured and how improvement plannings should be carried out with special reference to the provincial medium or small-size cities.

A study on the Motives and Processes of Rural Center Development in Farming Areas in Hokkaido

Yozo UEDA, Toru MURAMOTO

(Received September 10, 1988)

Abstract

This study is arranged for the purpose of gathering planning information for rural regions, and at the same time, gathering historical information on rural center planning and fundamental resources for a formative study of rural areas as well.

The study sets forth relevant processes of structural growth and changes that occurred in rural areas of Hokkaido.

The rural centers came into being within a relatively short period of time (100 years) after immigrants came and settled Hokkaido. The two principal motives of the rural centres were the "land readjustment" and the "spontaneous development", both of which were closely related to the laying down of the railroad.

The rural centers developed as a trading center of goods as well as a supply sources of daily life services, and the railroad as a means of mass transportation were important for the promotion of land development. That is the reason why the Hokkaido Goverment included it in the land readjustment and development of the rural centers.

Early Western Style Architecture and its Diffusion in Hokkaido

Takeshi KOSHINO, Yukihiro KADO

(Received September 10, 1988)

Abstract

One of the authors, Koshino, has published a book, *Kaika-no Katachi*, in 1979[-1)] to describe the historical outline of the earliest phase of architectural westernization in Japan, and in conclusion, pointed out that we should consider the historical meaning of the early western style architecture also in its diffusive process together with the characteristic changes inevitable in the course of assimilation to make it a very ordinary style of building in Japan. This paper deals with this subject in Hokkaido, focusing on three principal cities and the coastal region along the Sea of Japan. In two cities, Hakodate and Sapporo, a few of important buildings of, and after, the *Kaitakushi* (Colonial Department of the Government, 1869~82) and ordinary town buildings of the so-called *machiya*, which are the typical and traditional town houses in Japan usually having space for stores or shops in it will be discussed. In Otaru, town buildings with characteristic structure of timber-masonry will be discussed. In the coastal region, several early public buildings and fisherman houses will be considered.

In order to deal with the large numbers of ordinary buildings, some engravings published around 1880s and 1890s are surveyed together with observations of buildings standing today.

STUDY ON CHANGE FROM SUMMER ORIENTED HOUSES TO WINTER-ORIENTED ONES AND THEIR VENTILATION

Takashi SASAKI, Noboru ARATANI

(Received September 10, 1988)

Abstact

A traditional Japanese wooden house has many path ways for ventilation to exhaust the moisture and to preserve the wooden construction. In Hokkaido with cold winter, airtightening is a necessary change and much improvement has been tried to the present. The degrees of airtightness in several kinds of constructions are shown in this report. Though the vapor condensation in cold rooms become more

serious in an airtightend house, more insulation and airtightening are necessary when we desire to change the custom of partial warming to a whole house heating system. Natural ventilation by fluctuating wind was studied for the accurate calculation of ventilation and for the vapor exclusion from the exterial wooden wall having thick insulation. The design of ventilation routes in an airtightened house is important for health and heating economy. The authors show the designing principle and the measuring method of exchanging ventilation in a multi room house by using multi-tracer gases.

Measurements of the Thermal Environment of Traditional Houses and An Application Study of Insulated Buildings Using Thermal Concepts of Traditional Houses

Masamichi ENAI, Noboru ARATANI and Hideki ISHIDA

(Received September 10, 1988)

Abstract

In this report, we will try to validate some of the wisdoms of our ancestors, who lived in the humid and hot summer climate south of Hokkaido.

We measured the thermal environment of traditional houses on Honshu island, and from the measured results confirmed the wise constructional concepts of our ancestors for comfortable living in the summer. In addition we propose that some of the traditional and intellectual technics are useful to improve the thermal environment of insulated and air-tightened buildings during the summer in Hokkaido. Thus, we presented an application study on such dwellings and a feasibility study on the open cooling of an office building and clear canopy space in Hokkaido.

Dense Survey of Seismic Intensity for Wider Application to Earthquake and Engineering Problems

Yutaka OHTA, Hiroshi KAGAMI, Shigeyuki OKADA
and Hitomi Ohashi MURAKAMI

(Received September 10, 1988)

Abstract

Motivated by a belief that qualified seismic intensity data should have a wider application capability in engineering seismology and earthquake engineering, we have been continuing a series of investigations, based essentially upon a questionnaire method advanced in both of survey scheme and subsequent data processing. In this paper we demonstrate a few applications to drawing minute isoseismal maps, to exploring seismic source and path characteristics, and further to elucidate microzoning characteristics in urban and rural areas. The exemplified incidences are 1982 Off-Urakawa, 1983 Central Japan Sea, 1981 Corinthos, 1984 Morgan Hill and 1986 Hollister earthquakes. The obtained results are well examined through various comparisons with instrumental and other data.

Damaging and Restoring Process in a Rural Town due to the 1983 Central Japan Sea Earthquake

—— As for Elucidating Long-term Earthquake Effects ——

Hiroshi KAGAMI, Hitomi Ohashi MURAKAMI,
Shigeyuki OKADA and Yutaka OHTA

(Received September 10, 1988)

Abstract

This paper presents a study conducted on the elucidation as to how the local people have restored their houses and associated facilities so as to recover from seriously affected situations by a great earthquake attack. Surveyed was a typical rural town of Wakami, Akita prefecture, in the 1983 Central Japan Sea earthquake (M=7.7). As an extended study of damage investigation immediately after the

earthquake, a special field survey for investigating the restoring processes was performed 6 months later by means of both questionnaire and interview, and through an analysis of these data time-sequential restoration processes were figured out in relation to controlling factors. A simulation model for tracing such restoration processes was constructed, and actually executed for the purpose to explore better post-earthquake countermeasures in a private sector.

Conversion of Old Buildings into Reuse in Historic Quarters

Mitsuru MORISHITA and Fujio ADACHI

(Received September 10, 1988)

Abstract

Conversion of old buildings by renovation and remodeling into new uses is an effective way not only for revitalization of the old buildings but for preservation and revitalization of the historic quarter in which they stand.

The purpose of this report is to study the possibility of revitalization of old buildings in the "West Historic Quarter" of Hakodate through conversion into other uses, and the means to promote conversion and maintain the converted buildings.

The results may be summarized as follows :

1) Converted buildings amount to thirty in the "West Historic Quarter". The new uses, structures and styles of converted buildings are various. In particular, the new uses are for tourism and for the neighborhood and inhabitants. These converted buildings were renovated and remodeled according to the new uses, but their historical characteristics are preserved.

2) The converted buildings had some effect on revitalization of the Quarter by creating original and diverse spaces, putting the building in use for the public and conserving the characteristics of the historic townscape.

3) On the other hand, there are some old buildings which are to be demolished, besides it is not easy to maintain the converted buildings.

4) We think it necessary to answer the purpose of urban design such as improvement of surroundings around the converted buildings, and to make a communication system for various informations regarding the conversion.

Study on the Living Style and House Planning in the Snowy Region of Japan —— in case of Sapporo, Nagaoka, Kanazawa

Takahiro NOGUCHI, Fujio ADACHI and Jiro MAJIMA

(Received September 10. 1988)

Abstract

House planning should agree with the natural characteristics and various living conditions peculiar to the region. The living style and house plan in Hokkaido and Hokuriku district, both are located in the northern part of Japan and have a heavy snow, are greatly different from those in other warm- mild regions such as seen in Tokyo and Osaka. At the same time, we can also find some difference between Hokkaido and Hokuriku district. The purpose of this paper is to clarify the keypoints of living style and housing form in the snowy regions through comparative surveys among 3 cities; Sapporo, Nagaoka and Kanazawa.

The main distinctive features about daily life in the households are as follows;

1. People stay indoors almost all day long in winter. Therefore the time spent in the house is much longer than that in warm-mild regions.
2. Almost all domestic activities such as playing of children, working in the kitchen, cleaning and washing clothes and so on, are brought into the house in winter. The main space where most of these activities are carried out is the living space in Sapporo, and non-living space in Nagaoka and Kanazawa.
3. Family members frequently gather together in the living room. Accordingly the living rooms play a very significant role as many-sided living spaces especially in Sapporo.
4. Typical plan types suitable for the living style peculiar to each of the regions can be found.

It is an urgent and necessary problem to establish the original house planning system suitable for snowy regions.

Long-Time Deflection Analysis for Reinforced Concrete Floor Slabs under Working Loads

Satoru INO*[1], Akira SUGINOME*[2] and Shuji YOSHINO*[3]

(Received September 10, 1988)

Abstract

Herein we propose a modification of our previous method for predicting long-time deflections of floor slab systems of reinforced concrete. Improved are earlier *en bloc* treatments of slab stiffness reduced by partial cracking and of time-dependent portion of long-time deflections ; respectively by accounting for local details of either crack or steel distribution over a whole member length, and also by introducing the existent concept of increased modular ratio, whereby to replace our prior resort of a single index of time-dependent multiplier.

Compared former test results occasional in the literature with our predictions are shown to refer to relative adequacy of our procedure.

Bending of R/C Beam Members with Curved Reinforcement with its Bond-Slip Involved

Masaiki UEDA

(Received September 10. 1988)

Abstract

Herein an extension is made to the writer's earlier proposed system of finite element procedure, developed for analyzing the statical behaviors of ordinary types of r/c members with straight reinforcement, to the cases with curved reinforcement. This method thus modified is otherwise capable of its direct application now being tried by the author to the post-tensioned cases of p. c. beam members since the structures under consideration are analogous to those when the post-tensioning and anchorage of their curved tendons have been completed.

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Application of the Electrochemical Test Method for Copper Tubes (BNF Rapid Test) to Evaluate Pitting Propensity of Waters and Its Limitations

Takenori NOTOYA

(Received December 20, 1988)

Abstract

Evaluation of pitting corrosion propensity of supply waters was made by use of the BNF electrochemical cell which was developed by British Non-Ferrous Metals Technology Centre to determine the capability of water to support Type I pitting in copper tubes. Twenty five different waters sested include tap water, natural well water, aritificial water having different chemical compositions and dilute NaCl solutions in the presence of organic corrosion inhibitors for copper. The cell assembly, condition of operation, interpretation of the results, advantages and shortcomings of the BNF cell are described. The common types of pitting corrosion in copper tubes were classified. Feasibility of the BNF cell application was examined to waters prone to Type II pitting which is the most prevalent type of pitting corrosion in Japan. It was concluded that the BNF cell showed pitting propensity of waters susceptible to Type I pitting but it was not sensitive for those of Type II pitting. It is suggested that the morphology and coverage of corrosion products formed in the center and surrounding anode elements in the BNF cell determine the water corrosive aggresiiveness in copper tubes.

Failure Analysis Case Studies I : Fracture of Motor Block Chain ; and II : Fracture of Rotor Shaft in Marine Diesel Generator

Toru NOGUCHI and Noboru SHIRAMINE

(Received December 20, 1988)

Abstract

Failure analysis was performed on two fracture occurences. In case I, a motor block chain used for hanging a 370 kgf steel door fractured by low cycle fatigue after five and a half years of service. Overwinding resulted in about 3000 kgf loads on the chain, much higher than the block capacity of 500 kgf. The overload was repeated several hundred times over the service period. A limit switch to eliminate overvinding failed to work because the switch lever was damaged at an early stage, possibly by accidentally being exposed to the full door weight.

In case II, a forged roteor shaft in a marine diesel generator fractured by high cycle torsional fatigze. Inspection showed cracks in seven other generator shafts of the same specification in service. The excess stress was shown to be caused by torsional resonance of the shaft system. A small fillet radius increased the stress, and a corrosive environment accelerated the crack propagation at the same time that it lowered the fatigue strength.

Free Convection Heat Transfer of Air-Water Layers in a Cooled Circular Tube

Shoichiro FUKUSAKO and Masato TAKAHASHI

(Received December 20, 1988)

Abstract

An experimental study was performed to investigate the influence of density inversion of water in a free convection heat transfer of air-water layers within a cooled circular tube. The experiments were carried out under the condition when the tube-wall temperature was successfully decreased at a uniform rate. A holographic interferometry technique was adopted to determine the time-dependent distributions of the temperature in the tube.

It was observed that the temperature-distribution characteristics were changed to a great extent by the cooling rate of the tube wall along with the time-dependent sequenthal flow pattern. The heat-transfer behavior along the tube wall was also extensively checkd. Furthermore, it was found that there were three peculiar dendritic ice formations within the water layer of the horizontal sube based on the cooling rate.

Thermal Conductivity of a Frozen Layer of Ethylene Glycol Solution

Shoichiro FUKUSAKO and Masahiko YAMADA

(Received December 20, 1988)

Abstract

Measurements of the thermal conductivities of the frozen layers of aqueous binary solution were performed using the transient hot-wire method. Solution of ethylene glycol, which is most popular as a secondary coolant, was utilized as the testing fluid. Freezing was conducted within the test section in which platinum wires of 40 μm in diameter of 170 mm in

length were strung. Measurements were carried out under an equilibrium state at various initial concentrations of the solution and the temperature of the frozen layer. It was found that the thermal conductivity of the frozen layer of ethylene glycol solution was favorablo assessed with the Lichteneker's model by introducing the solid fraction under an assumption of an equilibrium within the range of parameters examined.

Magnetoresistance of Two Dimensional Electron Gas in AlGaAs/GaAs Selectively Doped Hetrero Strkctures

Tatsuya HIROSE, Ken-ichiro MATSUZAKI
Ji-Kui LUO, Hideo OHNO and Hideki HASEGAWA

(Received December 20, 1988)

Abstract

The magnetoresistance effect in a two dimensiolal electron gas in selectively doped heterostructure with a high electron mobility (as high as 110000 $cm^2/V.$ sec at 77 k) is studied. The magnetic field Bz is applied perpendicularly to the interface with a magnitude 1T, while the electric field is applied parallel to the interface.

An asymmetric negative magnetoresistance is found for the first time to appear in the dark at 77 K. This behavior is nulified when the sample is illuminated once before measurement.

The observed anomalous behavior is explained qualitatively by imhomogeneties of sheet carrier concentration in the system due to filled DX centers.

The Growth of GaAs and InGaAs Selectively Doped Hetero-structures by Molecular Beam Epitaxy and Characterization of Two -dimensional Electron Gas

Kenichirou MATSUZAKI Hidemasa TOMOZAWA
Ji-Kui LUO Hideo OHNO and Hideki HASEGAWA

(Received December 20, 1988)

Abstract

Selectively doped (SD) AlGaAs/GaAs and AlGaAs/InGaAs/GaAs are grown by molecular beam epitaxy and the properties of the resultant two-demensional electron gas are studied.

The mechanism which determines the concentration of two-dimensional electron gas is clarified theoreticaly and experimentally6 It is concluded that the relationship between conduction band discontinuity $\triangle E_c$ of AlGaAs and GaAs and the difference of bandgap $\triangle E_g$ is $\triangle E_c = 0.65 \triangle E_g$.

For pseudomorphic SD-AlGaAs/InGaAs structures, a maximum thickness exists for stable absorption of mismatch stress. It is shown that with the InAs composition of 0.13, the critical thickness of the onset of degradation of elecrtrical properties lies between 200 and 300Å.

Asymptotic Approximations for the Distributions of Multinomial Goodness-of-fit Statistics Based on the Jensen-difference

Yuri SEKIYA, Yoshiharu SATO and Michiaki KAWAGUCHI

(Received December 20, 1988)

Abstract

The test statistic for a goodness-of-fit of multinomial distribution based on J-divergence, which is defined as the Jensen-difference of the entropy function, was discussed. The asymptotic distribution of the test statistic J_a, defined as Jensen-difference of the entropy function of the order α, was obtained under null hypothesis. In this paper, two asymptotic approximations of the disribution of J_1 under simple null hypothesis are proposed. One is an approximation of J_1 based on the asymptotic expansion with the discontinuous term for the null distribution. The other is an approximation of J_1 based on the asymptotic expansion of the moment under the null hypothesis. In the case of $\alpha \neq 1$ ($\alpha > 0$), the asymptotic approximations of the distribution of J_a under the equiprobable hypothesis are obtained in the same way as that of J_1.

Improvement in Efficiency of Implicit Enumeration Method for the Bounded Variable Pure Integer Programming Problem

Jun ANEZAKI, Toshio OHYANAGI and Ikuo KAJI

(Received December 20, 1988)

Abstract

In this paper an implicit enumeration method for the bounded variable pure integer programming problem developed by Trotter and Shetty is introduced and some new augmentation methods for the algorithm are proposed. Then several numerical experiments with those proposed methods are made using two different types of random problem. From the results, the best augmentation method is presented.

A Selctive System of Multiple Adaptive Algorithms for Speech Spectrum Estimation

Makoto HIROSHIGE, Yoshikazu MIYANAGA and Koji TOCHINAI

(Received December 20, 1988)

Abstract

This paper shows that two different kinds of adaptive algorithms must be applied to analyze voiced and unvoiced speech waveforms. The reason is based on the characteristics of the inputs of speech production model, i. e. a pseudo-periodical pulse train and white Gaussian process. As a suitable algorithm for voiced speech, we introduce a modified MRAS. As the other algorithm, we introduce the MIS for analyzing unvoiced speech. In this paper, a new method to separate voiced and unvoiced speech is first proposed. Then we apply the two adaptive algorithms to analyze them. Especially, it is shown that a set of accurate estimation parameters must be selected among the results given by using the modified MRAS since this algorithm shows an excellent accuracy only within a specific time interval. The selection can be performed by using the technique of knowledge engineering and a neural network.

Using the abouee methods, we organized a system which automatically selects an appropriate analysis algorithm, and produces an output of a highly accurate spectrum. In some experiments, this paper shows partialy that this proposed system is superior to only MIS, modified MRAS, and MPC at the point of spectra estimation.

Long Time Frequency Reproducibility Measurement of Zeeman Stabilized Laser

Sei-ichi KAKUMA, Keiichi TANAKA

(Received December 20, 1988)

Abstract

Frequency stability and reproducibility of commercially available stabilized He-Ne lasers are measured in comparison with an iodine stabilized He-Ne laser using the beat frequency counting method.

Measurements were carried out on two samples of Zeeman stabilized He-Ne laser and was repeated for three months for one sample and for three weeks for the other.

The obtained values of their wavelength reproducibility were 6.3×10^{-8} and 1.1×10^{-8}, respectively.

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Effect of Ti on the Isothermal Expansion of Fmake Graphite Cast Iron

Makoto SOHMA and Tadahiko KANAUCHI

(Received March 31, 1989)

Abstract

Flake graphite cast iron with coarse graphites (FC) and the 0.4% Ti alloyed iron with fine and eutectic graphites (FCTi) were repeatedly heated in the austenite with various oxygen concentrations to investigate the effect of Ti on the isothermal expansion. The results obtained were summarized as follows :

1) The growth of both irons increased with oxygen concentrations, but the gmowth of FCTi lowered to 1/2 that of FC by simple cyclic heatings and 2/3 by isothermalheatings.

2) The lowering of growth by adding Ti was due to the decrease in the migrating distance of carbon and the amount of the carburizing atmosphere produced on account of the inhibition of the penetration of the oxidizing atmosphere into the interior owing to finer graphites.

3) The growth of both irons increased with the width of the pearlite ring rather than the weight change.

4) Ti exerted its effects to improve the mechanical properties and to lower the growth by changing coarse graphite to finer. But the carbon potential in the colonies of eutectic graphites was higher in the dilute oxygen coocentrations below 10%, hence the growth was promoted due to the increase in the amount of migrating carbon during the isothermal heating and the slow cooling. That is to sty it became clear that Ti had the dual effects of lowering and promoting growth.

Residual Stress Distribution and Distortion in a T-Welded Joint

Takayoshi UKAI and Shiroh MONZAKI

(Received March 31, 1989)

Abstract

In this paper, the residual stresses and distortion of T-welded joint as a reinforcement member are measured by the inherent strain theory based on the finite element method.

Generally, at a welded joint, a residual imherent strain is formed in the weldline and its neighborhood through the thermal elasto-plastic deformation. Applying the inherent strain theory, by neasuring of residual inherent strains which are related to the residual stresses directly, the residual stresses are computed.

In this study, dividing a T-joint into small pieces, and calculating inherent stsains by measuring elastic strains, the residual stresses and distortion are computed.

The results are as follows :

(1) The residual stresses of woeldline direction are much greater than others. At close proximity to the weld line a maximum residual stress appears, and the value attains to about 500 MPa.
(2) The inherent strain has a maximum value of about-3000 μ, and generally, values at upper side of flange are greater than at lower side.
(3) The longitudinal distortion depends on residual stresses, but the transverse does not always depend on it.

A Study on the CSG Based Solid Modeling of Blending Surfaces by the Potential Method

Yoshiyuki SHIROMA*, Kazuhiro MIHARA**, and Yukinori KAKAZU

(Received March 31, 1989)

Abstract

This paper describes a method to represent blending surfaces using the CSG based solid modeling. As an implicit representation of surfaces is essential to handle the surfaces with the CSG nodeling, the Potential Method is applied in this paper to defiue blending surfaces by implicit functions in 3-D orthogonal coordinate system. The method requires a couple of ordinary surfaces to be blended and their offset surfaces for calculation of the potential values. Functional equations between the potential values and the offset parameters are derived mathematically for PLANE, CYLINDER, CONE, and SPHERE in this paper. Computational algorithm based on this work has been developed and implemented in the CSG modeling system TIPS-1. According to these experiments, it is clear that this work is effective for modeling the fillet volumes with round corners such as edges or vertex of the solid object shapes.

Current Controlled PWM Inverter Using Current Error Vector

Akiko HASEGAWA, Shoji FUKUDA and Akio NII

(Received March 31, 1989)

Abstract

With the development of the so-called factory automation system in manufacturing

industries, a demand for AC servo motors has been increating. To feed power to the AC servo motors, inverters with the output ability of variable frequency, variable amplitude and variable phase-angle current are necessary. For this purpose, current controlled pulse-width-modulated (PWM) inverters using hysteresis comparators haue been used. However they have some drawbacks. i) the number of switchings of power device is high, ii) which generate magnetic noise in the drive motor.

In this paper, an improved PWM scheme, Current Controlled PWM Inverter Using Current Error Vector, is proposed. The scheme enables us to reduce the current harmonics and magnetic noises of the motor as compared with the conventional one. Experimental results using the proposed scheme are compared with the conventional ones. It is confirmed that the proposed scheme has an advantage over the conventional in reducing the number of switchings and magnetic noises.

To implement the scheme, however, some problems caused by the time delay of current sensors are indicated. Two methods to solve the problems are proposed and some discussions about them are carried.

A Technique of High-Speed Processing of Snow Search Radar System with a Linear Antenna Array

Yoshinao AOKI, Ryuichi MITSUHASHI
Hiroaki YOKOMICHI, Takayuki ISHIKAWA

(Received March 31, 1989)

Abstract

In this paper we discuss a technique of high-speed processing of holographic imaging radar for searching objects under accumurated snow. An experimental system was constructed with a linear antenna array with 16 array elements, where the array was rotated to collect radar signals reflected from objects, resulting in high-speed acquisition of radar data compared with the conventional technique of mechanical roster-scanning of an antenna. To detcect weak radar signals efficiently a DSB (Double Side Band) modulation with 455 kHz modulation frequency was adopted and demodulated signals were used for image reconttruction. A recently developed DSP (Digital Signal Processor) was used in reconstructing radar image in order to realize quasi-real-time reconstruction of radar images. An experiment with X-band microwave was conducted to test the constructed system. A FZP (Fresnel Zone Plate) was recorded asa holographic radar data of a point object and a point image was reconstructed according to the theory. The experimental result confirms that the proposed experimental system is promising for realizing a real-time snow-radar.

The Development of User Friendly Pointing Device

Hidetoshi NONAKA and Tsutomu DA-TE

(Received March 31, 1989)

Abstract

A new pointing device "inertial mouse" is presented. It is a mouse with an inertial function, which releases a mouse-user from the irritating pointing operations : "moving the mouseforward and backward repeatedly in order to transfer the mouse-cursor to a distasce". The mental image of the inerial function is constructed in a user naturally and easily therfore, the function makes the pointing operations operations to be friendly to the user. The inertial function is realized at a low-cost and high-reliability in our method.

A system of inertial mouse is constructed on a personal computer by way of trial. The controller of inertial mouse is designed in the form of a device-driver in an operating system "MS-DOS", then this system is available for many application-softwares on "MS-DOS". Adaptability of the inertial mouse for the existing hardwares and softwares is discussed in general. Some suggestions in its applications are discussed to some extent. The efficiency and usability of the inertial mouse is investigated in an experimental approach.

Efficiency and Flexibility in Processing Polynomial Approximation —Application of the Properties of Chebyshev Polynomial Coefficients

Mayuka KAWAGUCHI and Tsutomu DA-TE

(Received March 31, 1989)

Abstract

In this paper, certain properties in regard of Chebyshev polynomials have been elucidated, and utilized in the estimation of computational errors in numerical methods by means of Chebyshev polynomials. These properties can be applied to estimating errors in the evaluation of the polynomials. The estimation formulae we have derived are concerned with summations of the absolute values of Chebyshev coefficients and their derivatives, and are shown to be sufficiently effective by the numerical experiments in the sense that they are coincident with practical behaviors of the errors.

We show our estimation formulae with respect to computational errors in evaluating Chebyshev polynomials in Section3, and the result of their efficiency test is given in Section 4.

Phase Matching Properties of Plane-Wave-Pumped Parametric Image Upconverter

Atsushi OKAMOTO, Teruhito MISHIMA and Ichiro SAKURABA

(Received March 31, 1989)

Abstract

Phase matching properties of a plane-wave-pumped parametric image upconverter are analyzed by using the optical transfer function which describes the system. The condition that maximizes the conversion efficiency yields the generalized phase matching condition for the available coupling strength. Phase matching spatial-frequencies are calculated analytically with a paraxial ray approximation.

Crystal Structure, Electrical Resistivity and Superconductivity in YBa_2 $(Cu_{1-x}$ $M_x)_3O_y$ (M = Mg, Zn, Ga) Systems

Michio FUJIWARA and Kazuhiko YAMAYA

(Received March 31, 1989)

Abstract

Measurements of lattice parameters, oxygen content, normal state resistivity, and superconducting transition temperature, T_c in YBa_2 $(Cu_{1-x}M_x)_3O_y$ (M = Mg, Zn, Ga) systems reveal that there is a clear difference in crystal structure that elucidate the electrical and superconducting properties between the Ga-substitution system and the Mg- and Zn-substitution systems. The crystal structure of the Mg- and Zn-substitution systems are orthombic and Mg or Zn atom substitutes for Cuatom in the Cu2 site. With the increasing concentration of Mg or Zn atom, T_c decreases rapidly, but the increase in ρ is extremely small. On the other hand, the crystal structure of the Ga-substitution system is transformed from orthombic structure to tetragonal one at 5% Ga concentration and the Ga atom substitutes for Cu atom at the Cul site. No long-range ordering of Cul-O chain is found. With the decreasing oxygen content, ρ increases extensively, but Tc decreases gradually. These results suggest that there are two-type carriers in $YBa_2Cu_3O_y$ system ; one plays an important role in the superconductivity and the other in the electrical conduction in the normal state.

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Natural Vibration Analysis of Plane Frame Structures and Accuracy Investigation of Eigenvalues

Toshiro HAYASHIKAWA, Yasuharu SATO and Yoshio KAKUTA

(Received July 25, 1989)

Abstract

Three different mass matrix methods for determinig natural frequencies and mode shapes of plane frame structures are presented. One mass matrix method is the exact method based on the general solutions of the different equations of motion for both axial and flexural vibrations, and it is called the continuous mass method. The other two matrix methods are the lumped and consistent mass methods based on the approximate finite element approach. The mathematical relationship between the exact and approximate methods is discussed, and the accuracy of the eigenvalues obtained by three different mass matrix methods is investigated. Some typical continuous beams, arch bridges, and rigid-frame bridges are analyzed to illustrate the applicability of the lumped, consistent, and continuous mass methods, and the computed results are also given in tabular form.

The Influence of Grain Shape and Grain Size Distribution on Physical Properties of Sands

Kinya MIURA, Yoshihide MATSUMOTO, Keiju HASEGAWA and Shosuke TOKI

(Recieved July 25, 1989)

Abstract

It is extremely difficult to estimate properly the physical and mechanical properties of sands, because sands all are produced in nature and their properties vary considerably. Each sand has primary properties of its own, such as grain shape, crushability and grain size distribution. To show the significance of primary properties in sand deformation-strength characteristics is the aim of the present study. The report deals with the relationships between physical properties and primary properties.

To investigate the effects of primary properties of sand on physical properties, some 80 sand samples with different grain shapes and grain size distributions were prepared from three different kinds of sands after crushing and sieving processes. On all these sand

samples specific gravities, maximum and minimum void ratios were measured, and the grain shape was quantified in terms of angularity. The discussion results are summarized as follows;

1) Crushability and specific gravity of sand grain is determined by its mineralogy properties and are also influenced by grain size. With higher grain size, the crushability incrases and the specific gravity decreases.
2) The main influencing factors of maximum and minimum void ratios are grain shape, uniformity coefficient and grain size. The sand which consists of less angular and larger grains and has a larger uniformity coefficient, exhibits smaller void ratios.
3) The deviation between maximum and minimum void ratios depend on the grain shape and size, but not on the uniformity coefficient.

Estimation of the State of a Tree-type Water Distribution Network by a Statistical Method

Naoyuki FUNAMIZU and Tetsuo TAKAKUWA

(Recieved July 25, 1989)

Abstract

In order to control a water distribution system, estimation of the state of the pipe network is required. The state of network having N nodes and J pipes can be specified by energy grade E and withdrawal rate P at each node and flow rate Q and pipe constant S in each pipe.

The present paper deals with the case when the hydraulic pressure alone at each node is monitored but P, Q and S are unknown in a tree-type network.

Statistical analysis of a network shows that the variance of withdrawal rate P at any node i calculated by the true values of pipe constants is minimal when the correlation coefficient between P at node i and the other node is 0. This special character of the variance provides an estimating method of pipe constants.

The validity of the method is comfirmed by the Monte-Calro simulation using a model network. The estimation error of the method is also discussed.

A Turbulent Combustion Model for Swirl Chamber Type Diesel Engines

Noboru MIYAMOTO and Hideyuki OGAWA

(Recieved June 30, 1989)

Abstract

The purpose of this work is to establish a quasi-dimensional turbulent spray combustion model for swirl chamber type diesel engines.

This model assumes uniform turbulent fields in both main and swirl chambers. The fields were described with a global k-ε model based on in-cylinder air motion caused by the jet from the other chamber independently formed in each chamber. The pressure and the temperature in each chamber were calculated with energy and continuous equations of the working gas. The fuel spray was divided into small elements to account for non-uniformities, and movement of the elements were determined by the law of momentum conservation. Air entrainment into each element was estimeted from the motion of the spray relative to the in-cylinder air and the turbulence intensity derived from the k-ε model. The mixture in the elemont was formed from the entrained air corresponding to specific turbulent mixing times, and the rate of combustion was calculated with specific turbulent combustion times.

The results showed that this model predicts the rate of heat release and various optimum operating conditions and design factors in terms of indicated thermal efficiency with a certain accuracy.

Thermal Conductivity of a Frozen Layer of Aqueous Binary Solution Formed on Downward Facing Cooled Plate

Shoichiro FUKUSAKO and Masahiko YAMADA

(Recieved July 25, 1989)

Abstract

Measurements of the thermal conductivity of the frozen layer of aqueous binary solution were conducted using the transient hot-wire method. Solution of propylene glycol, which is used for the secondary coolant and food additive, was utilized as the testing fluid. The frozen layer was formed on the downward facing cooled plate within the test section where platinum wires of 40μm in diameter of 170 mm in length were strung. Measurements were

carried out under an equilibrium state at various initial concentration of the solution and the temperature of the cooled plate. It was found that the thermal conductivity of the frozen layer formed on the downward facing cooled plate became greater than that formed on the upward facing one due to the effect of the convection.

A Study on the Analysis System for Dynamic Characteristics of Robots

Norihiko TAKATORI and Yukinori KAKAZU

(Received July 25, 1989)

Abstract

This paper deals with a CAD System for robots. A method is proposed for analyzing the dynamic characteristics of robots. The robot model is assumed to be an open-loop linkage and to have elastic arms and joints. In the proposed method, elastic displacement of the arms is evaluated which is caused by inertia forces as well as loads. The displacement is calculated by FEM (Finite Element Method). The evaluation is proceeded on each arm. Consequently, it is possible to treat the robot which has any degree of freedom. The analysis system is developed which is based on the method. The inputs for the system are geometry data of the arms, linkage data and motion condition which contains angular velocities and angular accelerations given by each joint. The geometry data is assumed to be prepared by CSG (Constructive Solid Geometry) geometric modeller. Examples of the system are shown.

Development of Personal Computer Communication System for Intelligent Image Transmission and Experiment on Data Transmission between Japan and China

Yoshinao AOKI, Pei-kai ZHENG, Yang CHUN, Jun XU and Zhong ZHENG

(Received July 25, 1989)

Abstract

A communication system using personal computer is developed for the purpose of promoting the joint-research on intelligent image transimission between Japan and China. Software for communication was developed, where automatic transmission of data was done according to the communication parameters registered before starting communication. Control of the communication was done by the personal computer of Japanese side, because automatic dialing is available in Japan. To prevent excess charge of communication by going out of control of the system, a relay is installed in the communication circuit which cuts the communication system within 2 seconds in the case of program runaway. Two modes are prepared for transmitting data, that is the text mode by ASCII code and binary mode by binary code and it was stipulated that the massages were transmitted by text mode. Experiments on communication by the developed system were done between Hokkaido University and Computer Institute of Shenyang Polytechnic University using the international telephone line, where transmission speed is 1200 baud. Texts of Japanese sentence with Chinese characters were transmitted and the experiments were a success. The experimental results confirm the possibility of using the developed communication system by personal computer for intelligent image transmission.

A Study of the Application of Visual and Behavioral Properties to Image Display Systems

Hidetoshi NONAKA and Tsutomu DA-TE

(Recieved July 25, 1989)

Abstract

We developed an image display system with properties of binocular vision and motor vision. The properties enable users to obtain 3-D information through a single video monitor in real time. Users are not requimed to practice in order to master the properties

beforehand. And then they are available to improve the utility of display systems in the sense of human-interface.

The binocular vision is realized by means of two video cameras and a pair of liquid crystals. Two images from video cameras — one is for right eye and the other for left eye — are displayed alternately on CRT display which users observe through liquid crystal optical with synchronous opening and shutting.

The motor vision is realized by means of a stepping-motor and supersonic sensors. Supersonic generating element is attached on operator's head and the supersonic wave from it is received by a pair of receiving elemetents attached to the above CRT. From the phase difference of two waves, the right-left motion of operator's head is evaluated, which specifies the corresponding motion of two video cameras.

We discussed the geometric distortion of 3-D image constructed by binocular and motor vision. The distortion is reduced by means of appropriate position arrangement of both video cameras and CRT display.

Spatial Frequency Transfer Properties of Gaussian-Beam-Pumped Parametric Image Upconverter

Atsushi OKAMOTO, Teruhito MISHIMA and Ichiro SAKURABA

(Recieved July 25, 1989)

Abstract

Gaussian-beam-pumped parametric image upconverters are analyzed by using spatial-frequency transfer equation in a thin and diffraction-free nonlinear medium. The response of the image upconverter for plane wave input is derived in the spatial-frequency domain. The result shows that the phase-matching properties depend not only on the direction of pumping Gaussian beams but also on their beam parameters (spot sizes and curvatures). The general equations of the image formation of sum-frequency response with infrared input are derived, and it is proved that the equations can be applied to both cases of plane-wave pumping and point-source pumping as special cases.

Preparation of a Single Phase of Bi (Pb)-Sr-Ca-Cu-O System and the Superconducting Properties

Kiyotaka MATSUURA, Kazuhiko YAMAYA and Yutaka ABE

(Received April 26, 1989)

Abstract

The crystal structures and the superconductivity were investigated in the Bi (Pb)-Sr-Ca-Cu-O system with various chemical compositions. It was found that the single phase of $(BiPb)_2\ Sr_2\ Ca_2\ Cu_3\ Oy$ was obtained on the chemical composition of Bi : Pb : Sr : Ca : Cu = 1.72 : 0.39 : 1.91 : 2.03 : 3.06 and the sintering condition of 855°C and 140 hours. The lattice parameters were $a = b = 5.409$Å and $c = 37.098$Å. The superconducting transition temperature, T_c determined by both measurements of the resistivity and the Meissner effect was $110K$. It was found from the magnetic field dependence of the Meissner effect that the superconducting nature was a bulk which is composed of weak links between grains.