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Appendix

Abstracts & Titles, No. 108~113

BULLETIN
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NOTICE

No. 108 May 1982

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On the Interference of Circular Notches and Loaded Ends
(3rd Report: Plane Elastoplastic Stress Problem)

Michiya KISHIDA, Munekore WATANABE, Kenji ODA
and Tetsutaro YANAKA

(Received December 26, 1981)

Abstract

In the 1st and 2nd reports, the problems of interference of circular notches and loaded ends are discussed quantitatively, limiting the cases to elastic deformation.

In the present report, we investigate the influence of the eccentricity in uniaxial tensile loading on the deformations nearby notches in the case of the elastoplastic deformation. In order to obtain numerical results, the use is made of the finite element method. For four notch shapes and six loading passes, the appearances of the evolution of elastoplastic boundaries are traced. It is clarified that the directions of the evolution of elastoplastic boundaries depend on the notch depth rather than its sharpness.

Studies on the Electrical Breakdown of Liquid Nitrogen and Low Temperature Nitrogen Gas

Norio HONMA, Yoshimatsu KANEKO, Sadao SAWADA,
Yosuke SAKAI and Hiroaki TAGASHIRA

(Received December 26, 1981)

Abstract

Electrical breakdown characteristics of liquid nitrogen and low-temperature nitrogen gas were studied experimentally in the present work. With liquid nitrogen, prebreakdown phenomena, when a pulse voltage superposed on a dc voltage was applied to discharge gaps, were observed by an ultra-high-speed camera combined with a Schlieren photography instrument. The results show that the breakdown process differs considerably depending on the voltage polarity, and that negative streamers propagate at a mean velocity of about 2×10^4 cm/s. The measurement of the breakdown characteristics in low-temperature nitrogen gas reveals that at a given gas number density, the dc breakdown voltage, and the ac breakdown voltage also, at room temperature does not differ greatly from that at low temperatures. It was shown that Paschen's law may be extended to low temperatures with uniform-field gaps, and that the relationship between the values of the 50% flashover voltage at low temperatures and at room temperature depends on the gap configuration while a large scattering in the 50% flashover voltage was observed low temperatures.

Consensus Making Support Method in ISM

Masahito KURIHARA, Azuma OHUCHI and Ikuo KAJI

(Received December 26, 1981)

Abstract

A method is presented whereby two or more interpretive structural models may be compared, or combined, or both compared and combined to make a consensus.

A theory which specifies an implication relation on a disagreed element set is described. This theory is a generalization of the interconnection theory of Warfield.

It is demonstrated, using the theory, that consensus can be effectively accomplished with implication matrices and diagrams generated by the method.

A New Distortion Measure for Transform Image Coding

Hideo KITAJIMA, Tetsuo SHIMONO and Teiichi KUROBE

(Received December 26, 1981)

Abstract

A new distortion measure for transform image coding is presented. A purely statistical method for evaluating image blurs caused by the ommission of high spatial frequency components is developed. The blur measure defined as the correlation between quantization error and the image signal is combined with the conventional mean-square error criterion to define a new distortion measure, which is then utilized in the optimum bit allocation based on the rate-distortion theory. The new distortion measure suggests that signal components with small variances should not be omitted, as in conventional transform image coding, but should be retained with low signal-to-noise ratios.

Researcher-Oriented Japanese Word-Processing System Using Roman-Kanji Translation Method

Yasushi SAITOH, Yositaka OKAZAWA, Koji TOCHINAI
and Kuniichi NAGATA

(Received December 26, 1981)

Abstract

This paper describes a Japanese word-processing system which enables a research worker to write technical documents in his field with comparative ease.

The computer processing of Japanese sentences consisting of Kanji and Kana characters has many difficulties. Especially the input of Japanese texts has wide variety of problems, hence there exists no surpass method.

To obtain a method proper for technical writing, we investigated Kanji words and Kanji characters used in technical papers in a specific field, and developed an experimental system by means of a Romaji-Kanji translation method based on the results of the investigation. In this method, the dictionary for the translation is small and provided to each user. Moreover, its contents changes gradually and is kept at optimum for the user.

The result of several inputting experiments indicates high speed and easiness of the inputting operation, and it is concluded that the method is useful for technical writing.

A Few Geometrical Properties on the Traveling Salesman Problem

Katsuaki SAKAKIBARA

(Received December 26, 1981)

Abstract

In the traveling salesman problem, the use of the character of a convex polygon which includes all points in and on is found to be useful for searching for the shortest route. As an example, we consider the route for the capital cities in U.S.A., which are composed of 42 points. In this example, the number of the routes to be considered is 10^{49}, but if we use the character of the convex polygon it becomes 10^{42}. Moreover, dividing the points by groups according to the properties of the distribution, we can reduce the calculating operations from 10^{49} to 10^{3}.

Cold Neutron Quasielastic Scattering Study of Water

Kazuhiko INOUE

(Received December 26, 1981)

Abstract

Cold neutron quasielastic scattering experiments were performed on water at ambient temperature and on ice. From the quasielastic spectral profile, the parameters of fluctuating quasi-crystalline model were calculated by utilizing the elastic incoherent structure factor. We could not find any discrete peaks having a small energy transfer less than about 1 meV. Fluctuation of hydrogen nucleus between the doubling positions on ice is also discussed.

Microanalysis of Dust Particles from Road Surface Scraped off by Spiked Tires of Automobiles

Mamoru MOHRI, Shigeki KATO, Tatsuo OBATA, Masao HASHIBA,
Toru SATAKE, Toshiro YAMASHINA, Masashi KOBAYASHI and Susumu AMEMIYA

(Received December 26, 1981)

Abstract

Environmental problems arising from road surface particles scraped off by spiked tires of automobiles have been becoming a serious problem to inhabitants in urban areas of northern Japan in recent years. We have studied such dust particles systematically using various modern surface analysis techniques to clarify the morphology, and the constituent elements and even at a molecular level. Microanalysis by scanning electron microscopy (SEM), particle induced X-ray emission (PIXE), ion microprobe mass analysis (IMA) and Auger electron spectroscopy (AES) revealed that such dust powder is composed of fine particles of road surface materials, including rubber and metal of spiked tires. Most of dust particles are distributed in size ranging from 5 to 50 $\mu m\phi$. The compositions were found to be different depending upon sampling places.

A Supporting Environment System for Pascal Programming

Eiichi MIYAMOTO and Shin-ichi TAKEMURA

(Received December 26, 1981)

Abstract

This paper describes a Pascal programming system developed to support both debugging and editing of Pascal programs conversationally and structurally. As the system simulates the facilities as a Pascal machine for the programmer to run and edit his program, it accepts all of its commands on the source level of the program. Under the support of the system, the programmer can run his program at will, monitor its behavior including the dynamic data structure, and edit it without the management of the operation mode which the system is subject to.

The main features of the system are as follows:

(1) It manages machine code modules directly to execute programs efficiently and in a variety of execution modes.

(2) It can print out the updated values of variables concurrently with running, and the entire structure of variables including dynamic structure at break.

(3) It can restore the status of a program according to its structure.

(4) It accepts program corrections whenever the programmer detects some bugs, and continues to execute the updated program.

Some Considerations on Ellipsis for the Implementation of Japanese Language Understanding System

Yoshio MOMOUCHI, Eiichi MIYAMOTO and Shin-ichi TAKEMURA

(Received December 26, 1981)

Abstract

We examine the elliptic expressions and present a partial taxonomy of ellipsis. Elliptic expressions are linguistic elements omitted from texts as something understood without appearing in texts. We investigate several kinds of information used to restore elliptic expressions. This information comes from the context, knowledge, which is linguistic or nonlinguistic, and situations. We show that information from syntactic structures, word meanings or coherence relations between sentences plays an important role to restore elliptic expressions. It is our hope that these considerations are an underlying study to construct a coherent Japanese language understanding system. As an experimental system, we have implemented a language processing system. It processes a simple type of ellipsis, which requires information from syntactic structures of the immediately preceding sentence to restore the elliptic expression. We describe this process with an example.

Construction of Adaptive Production System (APSH)

Shigeru KOBAYASHI, Yoshio MOMOUCHI and Eiichi MIYAMOTO

(Received December 26, 1981)

Abstrat

In this paper, we describe about an adaptive production system APSH.

APSH has the ability to create new production rules, to remove production rules, and to deposit conditions and actions of production rules into the working memory. Operations to existing production rules use the information of the right hand side of production rules, and these operations are important functions of the system.

APSH is also constructed as a flexible programming system. For example, it allows for a description of a compositive program which includes some production memories, and to edit programs within the system.

APSH is expected to be a useful tool for some studies in cognitive science, such as programming of models of learing or problem solving.

The ability and capability of the system is discussed with an example program, which predicts the succeeding part of a sequence of letters.

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Statistical Analysis of Characteristics of Thin Film Polycrystalline Solar Cells

— Influence of Fluctuation in Local Characteristics on Output Characteristics —

Hiromu KOBAYASHI Yoshihiko OGAWA Teiichi KUROBE
(Received March 31, 1982)

Abstract

Local characteristics of thin film polycrystalline silicon solar cells which are low-cost solar cells, show a tendency to fluctuate under the influence of structural defects such as recombination centers for photon-excited carriers. As a result, output characteristics of individual cells vary to a great extent.

The causality was analyzed statistically by simulation under the couditions of experimental results reported by other workers. According to the fluctuation of the local parallel leak resistance, V_{OC}, P_{max}, and F. F. vary considerably and their mean values decrease. On the other hand, according to fluctuations of the local photocurrent, I_{SC}, P_{max}, and V_{OC} vary considerably. However, their averages are unchangeable.

In this paper, a new solution of the above problem, namely the introduction of an approximate linearization, is also presented. As a result of this solution, time spent for the calculation is shortened considerably.

Measurement of Quartz Crystal Resonator's Vibration by Laser Horogaphic Interferometer

Yoshiaki KANNO, Yoshihiko OGAWA and Teiichi KUROBE
(Received March 31, 1982)

Abstract

In the industrial application of laser holographic interferometer for quartz crystal resonators, an inexpensive and compact measuring system is required. For the purpose of developing such a measuring system, we carried aut experiments on the fundamental problems using time average method and the stroboscopic method. A random mode laser can be used as the source of the measuring system for the detection of the distri-

bution of interference fringes on the surface of the measured object, but the resulting reconstruction image is somewhat blurred. This indicates at the some time that the system can be constructed inexpensively. In the stroboscopic method, it is possible to extend the exposing light pulsewidth to 1/10 of the vibrational period for the vibrational amplitude corresponding to mutiple fringes. The extension of pulsewidth enables the use of a low power laser. This leads to an enexpensive and small size system. Displacement of the resonator surface was measured with respect to the vibrational phase.

Flow Characteristics of Solid Particles in Mixed Particle-Size Spouted Beds

Osamu UEMAKI, Ryuichi YAMADA and Masao KUGO
(Received March 31, 1982)

Abstract

The minimum spouting velocity and segregation behaviour of binary mixtures of particles differing in size were studied in this paper. Experiments were done in a bed of 20cm diameter at superficial gas velocities up to 1.3 U_{ms}, using silica sand of four different particle sizes from 0.655 to 2.23mm. An empirical equation of the minimum spouting velocity for binary mixtures was proposed.

Axial and radial concentration profiles of the coarser particles in the bed were obtained and the effects of the particle size ratio and the superficial gas velocity on segregation were investigated. It was found that radial segregation of the solids as well as axial segregation occurred markedly at the particles size ratios above 2. However, the radial concentration gradients gradually decreased by increasing the gas velocity.

The results obtained in this study are useful in analysing the performance as well as the position of the outlet pipes for a continuously operated spouted bed reactor of mixed particles.

Motion of Individual Polymeric Chains and Quasielastic Scattering

K. INOUE, K. KAJI, K. KIYANAGI and H. IWASA

(Received March 31, 1982)

Abstract

The motion of individual chains in polymers was studied by measuring the neutron time-of-flight spectra scattered from chloroprene and extended natural rubber strings. We used a quasielastic scattering spectrometer, LAM, installed in the KENS spallation neutron source at the National Laboratory for High Energy Physics. The observed spectra were composed of a sharp central peak and a broad shoulder part whose characteristics indicated with certainty the migration of kink of chain with the time constant of about 10^{-12} second. Further precise measurements and data treatment are now being conducted, and the results will be reported later.

Grooved Moderator for an Accelerator Based Neutron Source

Y. KIYANAGI, K. INOUE, H. IWASA, and H. UEDA
(Received March 31, 1982)

Abstract

Up to the present flat surface moderators have been used for accelerator based neutron sources. Recently the fact that a special shaped moderator, with a grooved surface, enhanced the emitted neutron beam intensity was reported. We conducted survey measurements to investigate the effects of the groove on the neutron beam intensity and pulse behavior.

In this paper, the results of a moderator of 15 cm × 15 cm cross section at ambient temperature are described.

LINAC-TOF Neutron Diffraction Experiment on Liquids

Norio OHTOMO, Yukio TANAKA and Kiyoshi ARAKAWA
(Received March 31, 1982)

Abstract

A time-of-flight (TOF) neutron diffraction facility has been developed to carry out structural studies on molecular liquids and solutions, using pulsed neutrons produced by the electron linear accelerator (LINAC) at Hokkaido University. This paper gives a detailed description of the experimental instrumentation together with its resolution and accuracy, and, further, describes the comprehensive data processing procedure including a flow diagram of the data reduction program, which is useful for the analysis of neutron diffraction data on liquids in general.

Dynamic Representation of Multi-Dimensional Data Using a Personal Computer

Masahiro MIZUTA, Yoshiharu SATO, Tsutomu DATE and Michiaki KAWAGUCHI
(Received March 31, 1982)

Abstract

The representation of data by a 2-dimensional plane often makes it possible to understand the data structure intuitively. Several graphical methods have been studied to this end.

We will present one of the methods that represent multi-dimensional data as the motion of points. A personal computer is available for this method. The basic concept of the method is that the plane is moved continuously from one direction to another in a p-dimensional vector space: the pair of independent vectors $(\boldsymbol{X}, \boldsymbol{Y})$ is altered from one direction to another, and we use the motion of the points that are projections of the data on the moving plane. This motion of the plane is designated by the user. The method is interactive and assists in heuristic investigations in the data structure. Also some concrete examples are given.

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Thermochemical Decomposition Cycle of H_2S with Metal Sulfides

Hiromichi KIUCHI and Tokiaki TANAKA
(Received June 15, 1982)

Abstract

In thermal decomposition of H_2S, the equilibrium H_2 concentration is a mere only 7 vol-% at 800℃. In order to improve this low decomposition, a two-step process was studied by combining sulfurization of metal sulfide at about 500℃ and thermal decomposition of the sulfurization product at 800℃ under reduced pressure. Ni_3S_2 powder was mixed out of necessity and dispersed in inert powder (Al_2O_3 or MoS_2) or other metal sulfide (FeS or Cr_2S_3) because of its easy sintering. Mixing of an inert powder prevented the sintering and provided a stationary high decomposition rate of H_2S. The average H_2 concentration was about 60 vol-%. The mixture with FeS caused the formation of pentlandite and the cycle gave a somewhat lower yield of hydrogen than that with the inert powder mixture. Though the mixture with Cr_2S_3 formed also a double sulfide, it gave about 60 vol-% of the average H_2 concentration. In addition, the sulfurization at such low temperatures as 300℃ was possible because the sulfurization rate was enhanced. The thermal efficiency was estimated to be 52 -55% for the cycle with the mixture of Al_2O_3 and Ni_3S_2. This high value implies that the production of H_2 from H_2S may be practical.

Partial Desulfurization of Copper Concentrates with Hydrogen and Copper Enrichment by Hydrochloric Acid Leaching

Ryoji SHIBAYAMA Tokiaki TANAKA
(Received June 15, 1982)

Abstract

The activated leaching of chalcopyrite with hydrogen was investigated in this paper for the up-grading of concentrates and the recovery of S as S^0 and of as Fe_3O_4. Desulfurization of copper concentrates with hydrogen was found to be most effective as compared to thermal decomposition under reduced pressure or in an inert gas stream. The reaction proceeds as shown below:

$CuFeS_2 \rightarrow \beta$-chalcopyrite $\rightarrow$ bornite + $Fe_{1-x}S \rightarrow Fe$ + bornite $\rightarrow Fe + Cu$.

Coagulation of the deposited FeS into a massive particle and formation of bornite phase surrounding it were observed under a light microscope. Also, it was found that partially reduced products were leached readily by hydrochloric acid solution with a vigorous evolution of H_2S and then Cu_2S was formed. The dissolution of iron in bornite was affected significantly by nonstoichiometry of bornite and was slightly influenced on the acid concentration or leaching temperature.

Removal of Arsenic from the Waste Hot-Water from Geothermal Power Plants

Tadao NAGAI, Rintaro TOGASHI and Masanori YAMAGUCHI

(Received June 15, 1982)

Abstract

Removal of arsenic by means of ion-exchange technique was studied for the treatment of waste hot-water from geothermal power plants, in order to utilize the thermal energy for multi-purpose use. An inorganic ion-exchanger, hydrated zirconium oxide, was used in both the column adsorption and the two-stage counter-current adsorption techniques.

A specially designed ion-exchanger was used in the former technique, i. e., the hydrated zirconium oxide was dispersed on a granular porous carrier. Although some loss of the hydrated zirconium oxide from the carrier occurred during repeated experiments, no arsenic was found in the effluent until the break-through point and a significant improvement on the adsorption kinetics was observed in comparison with some commercial exchangers.

In the latter technique, the hydrated zirconium oxide powder, made by the Freeze-Melt process, was used for its adequate particle size for solid-liquid separation at the thickener. The results obtained were sufficient to pass the Government's regulation tests (<0.5 ppm), but insufficient for some local regulation tests (<0.05 ppm). Since the operations and maintenance are simple and also the assurance for the arsenic level in the effluent stream can be easily given, the latter technique seems to be practical, while some improvement are still required to pass the local regulation tests.

Direct observation of Softening, Melting, and Dropping Behaviour of Iron Ore Agglomerates

Kuniyoshi ISHII, Takayoshi KONISHI, Shuji SATO,
Shin-ichi KONDO and Chikao YOSHII
(Received June 15, 1982)

Abstract

A small scale apparatus with an X-ray fluoroscopy equipment was newly developed for measuring the high temperature properties of blast furnace burdens such as reduction degree, expansion and contraction, and pressure drop of ore bed. Using this apparatus pellet and sinter containing slag of $CaO/SiO_2 \simeq 1.4$ were examined under conditions simulating blast furnace.

In the low temperature region, it was observed that the following occurred in turn ; namely, thermal expansion, swelling due to reduction of hematite, and cracking or degradation of ores. By Raising the temperature higher, the ores began to shrink and primary slag flowed out from the core of a particle. In high temperature exceeding 1320℃, slag contained in agglomerates reacted with residual FeO and formed the very low melting point slag which separated from the reduced iron. The separated slag was violently reduced by CO gas and red-heated carbon. Subsequently, metallic iron was carburized and melted down.

The temperature of appearence of the phenomena mentioned above varied with the heating rate depending on the amounts of residual FeO.

Simultaneous Measurement of Viscosity and Density of Slag for Electro-Slag Remelting

Kuniyoshi ISHII, Takashi MATSUNAGA,
Koutaro ISHIMURA, and Shin-ichi KONDO
(Received June 15, 1982)

Abstract

The free falling droplet method for measurement of viscosity is applicable only at a low Reynolds number ($Re < 0.1$) because Stokes' law is the fundamental principle. In order to apply this method to molten slag and metal droplet system, the principle

was extended to a higher Reynolds number region (Re ≃ 1000) on the basis of well-known data between the drag coefficient and Reynolds number. Moreover, a new correlation function in which fall velocities of two foreign droplets were investigated in order to simultaneously measure viscosity and density of liquids. After the applicability was examined at room temperature, the method was applied to the measurement of viscosity and density of ESR slag ($NaF-MgF_2$). The results obtained were summarized as follows:

MgF_2 : $\mu = 4.07\times10^{-4} exp\ (18500/RT)$, $\rho = 3.24-5.25\times10^{-4}T$ (1603~1773 K)
30NaF: $\mu = 1.28\times10^{-3} exp\ (10550/RT)$, $\rho = 3.20-5.53\times10^{-4}T$ (1423~1573 K)
50NaF: $\mu = 2.11\times10^{-3} exp\ (7980/RT)$, $\rho = 3.13-5.54\times10^{-4}T$ (1373~1523 K)
76NaF: $\mu = 2.81\times10^{-3} exp\ (6220/RT)$, $\rho = 2.98-5.55\times10^{-4}T$ (1173~1323 K)
NaF : $\mu = 3.39\times10^{-3} exp\ (5600/RT)$, $\rho = 2.66-5.60\times10^{-4}T$ (1293~1493 K)

On the Restricted Feeding Solidification Zone to Dominate the Soundness of Ingots

Tadayoshi TAKAHASHI, Toshinori OHSHIMA, and LI WANLIN
(Received June 15, 1982)

Abstract

The study was made to elucidate the actual function of feeding in the process of solidification.

An Al-3 mass % Si alloy melted in a graphite crucible was cooled continuously to the temperature corresponding to certain fraction of solid and subsequently, it was quenched after 5 min holding at this temperature.

The soundness of an ingot was examined by density measurement, tensile testing and SEM micro-fractographic observation.

Results obtained were as follows.

In the process of ingot solidification, feedability varied in three steps as the fraction of the solid was increased.

This clarifies the existance of three kinds of solidification zones, ie, effective feeding solidification zone, restricted feeding solidification zone and ineffective feeding solidification zone.

In the restricted feeding solidification zone, the soundness of ingot deteriorated since the feedability was decreased with an increase in the fraction of solid.

Estimation of the Fluidity of the Liquid in the Solid-Liquid Coexisting Zone of an Al-Si Alloy

Masayuki KUDOH and Tadayoshi TAKAHASHI

(Received June 15, 1982)

Abstract

The fluidity of the liquid in the solid-liquid coexisting zone of an Al-2.4 mass% Si alloy was measured by the seepage of interdendritic liquid through a cylindrical hole formed in the zone. The effective permeability coefficient K_e which is an index of the fluidity of the interdendritic liquid was estimated in relation to the fraction of solid f_s and cooling rate R at the initiation of solidification. The specific permeability k depending on the geometrical pattern of dendrites was also deduced from the effective permeability coefficient. As a result, the following relations were obtained.

$$\log K_e = \log 0.079\ R^{0.44} + 15.3\ R^{0.17} \log (1-f_s) - 2 \quad (4)$$

$$\log k = \log 2.1 \times 10^{-6}\ R^{0.54} + 16.6\ R^{0.18} \log (1-f_s) - 4 \quad (6)$$

The fraction of the solid at which dendrites begin to form networks is about 0.30. Then the effective permeability coefficient is 7.9×10^{-6} m/s and the specific permeability is 1.3×10^{-12} m^2. On the other hand, the fraction of the solid above which the liquid cannot flow through the dendrites decrease from 0.70 to 0.60 as the cooling rate increases from 0.0083 K/s to 0.083 K/s. The effective permeability coefficient and specific permeability become constant values of 2.8×10^{-8} m/s and 3.7×10^{-15} m^2, respectively, although the fraction of solid is changed by the cooling rate. It was shown that the effective permeability coefficient is mainly controlled by the specific permeability.

The Solidification Contraction and the Soundness of Alloy Ingots

Tadayoshi TAKAHASHI Ken-ichi OHSASA Ryosuke MOCHIZUKI

(Received June 15, 1982)

Abstract

In order to clarify the relationship between the solidification contraction and soundness of an Al-3 mass% Si alloy, the contraction in a radial direction of a cylindrical

ingot with or without degasification was measured by the differential transformers. The soundness of the ingot was evaluated by density measurement.

As a result, it was shown that the contraction during solidification occurred resulting from the thermal contraction and the deformation of the solid having liquid core. The deformation of the solid was induced by negative pressure developed within the liquid core due to liquid-solid transformation at the late stage of solidification. The density of the ingot increased with the increasing solid deformation. The degassed ingot had a higher density than the non-degassed ingot because of large contraction and a lesser porosity.

A Study in Age-hardening of High Concentration Al-Mg Alloys

Toshimi TARUI and Katsuya WATANABE

(Received June 15, 1982)

Abstract

It has been reported that Al-Mg alloys show no remarkable age-hardening due to instability of the G. P. zone at ambient temperatures. From recent research, however, it seems that the solubility temperature of the G. P. zone in alloys with high magnesium concentrations is higher than room temperature.

The solid solubility temperatures were determined in this study from aging curves of electric resistance for Al alloys with 9 at%, 12 at%, and 15 at% Mg are 65°, 85°, and 90°C. Age-hardening phenomena was clearly observed for alloys with higher magnesium concentrations, but the maximum value for the hardness appered at lower temperatures than that could be expected from the large size difference between the two atoms. This can be explained by ordered structure and the spherical shape of the G. P. zone. The proposed mechanisms for the precipitation of the G. P. zone consider a spinodal decomposition at lower temperatures and nucleation and growth at higher temperatures.

Thermal Expansion of the Directionally Solidified Ni_3Al-Ni_3Nb Eutectic Alloy and Its Constituent Phases

Masaaki FUKUCHI and Katsuya WATANABE
(Received June 15, 1982)

Abstract

The thermal expansion behavior of directionally solidified $\gamma'(Ni_3Al)$-$\delta(Ni_3Nb)$ eutectic alloys were studied. The coefficient of thermal expansion of γ' single phase crystal, which has a cubic structure, decreased close to that of the eutectic alloy with the increasing Nb dissolution in γ'. The crystalline structure of the δ phase is orthorhombic. An anisotropy was observed in the expansion. The largest expansion was in the crystalline direction of [100] which was the growth direction of the phase in the eutectic alloy, [001] was intermediate, and the smallest was [010].

It was found that a linear rule of mixture holds for the coefficients between the eutectic and its constituent phases at temperatures up to 500°C. At temperatures higher than 800°C this rule can no longer hold, because thermal stress developed by the difference in thermal expansion between the two constituents passes a critical value. The thermal stability of eutectic lamellar structure is discussed in relation to the thermal stress.

Electrowinning of Liquid Aluminum from Chloride Melts by using a Bipolar Electrode Cell

Tatsuo ISHIKAWA and Shoichi KONDA
(Received June 15, 1982)

Abstract

Experimental studies on electrowinning of liquid aluminum from aluminum chloride melts using bipolar electrode cells have been carried out for several years in our laboratry in order to develop a new process for energy saving.

This paper describes the outline of this research and development courses including cell design, construction of electrolytic apparatus and operational techniques.

Typical data on recent electrolysis are as follows. Funnel-type of graphite bipolar electrode 10 unit cell, electrolyte: $NaCl$-$MgCl_2$ (3 : 1) containing few % $AlCl_3$, temper-

ature : 750℃±10℃, applied current to end electrodes : 70 A (ca. 1 A/cm^2), cell efficiency : 88–90%, net electrolysis duration : 5 hours, average bath voltage per unit cell : 2.6–2.8 V, aluminum produced : 876 g, purity : 99.98%, electrolytic energy demand : about 10,000 kw•hr./ton-Al.

It was also found for further saving of energy that concentration of aluminum chloride in the melt should be maintained at the lowest level posible desirably, below 3 mol. % during electrolysis.

Benzotriazole and its Derivatives as Corrosion Inhibitors for Iron in Sodium Chloride Solutions

Takenori NOTOYA and Tatsuo ISHIKAWA
(Received June 15, 1982)

Abstract

Inhibitive effect of benzotriazole (BTA), tolyltriazole (TTA) and benzotriazole carboxylic acid (BTA-COOH) on the corrosion of iron was investigated in the inhibitor concentration range of 10^{-5} to 10^{-3} mol/l in aerated 3 % sodium chloride solutions at 50°C by weight loss measurements using a spinner test assembly and electrochemical techniques. The corrosion test results indicate that the inhibition efficiencies increase with the increasing inhibitor concentration and the effectiveness increases in the order of TTA (inhibition efficiency 18.7%) <BTA (26.5%) <BTA-COOH (34.9%) at the concentration of 10^{-4} mol/l. At the concentration of 10^{-3} mol/l, however, the inhibition efficiency of BTA-COOH remains almost constant because of its solubility limit in the solution while those of TTA and BTA were 57 and 63%, respectively. The potentiostatic polarization curves of iron show that the inhibitors increase both anodic and cathodic polarization and inhibition of the cathodic reaction, mainly oxygen reduction reaction, is more pronounced than that of anodic one. Relationship between the degree of potential change ΔE and the inhibitor concentration C suggests that the inhibition action may be attributed to Langmuir-type adsorption of the organic molecules at cathodic sites on the iron electrode.

Application of Rotating Bipolar Electrode Stack Cell to Electrolysis of Dilute Cupric Sulfate Solution

Takeshi SASAKI, Katsutoshi ORITA and Tatsuo ISHIKAWA
(Received June 15, 1982)

Abstract

A novel bipolar electrode cell, which we refer to as a rotating bipolar electrode stack cell, was developed for electrolytic recovery of heavy metals from very dilute solutions. The cell consists of the stack of two feeder electrodes and nine bipolar electrodes which are rotated at every other electrode. The solution is helically flowed through the inter-electrode gaps passing through the peripheries of rotors and the center holes of stators.

An electrolyte containing 100 ppm Cu^{2+} ions was continuously pumped externally and/or by a self-pumping action through the cell from a well mixed reservoir and the variation in cupric ion concentration in the course of electrolysis was investigated under various conditions of rotational frequencies, volumetric flow rates and electrolytic currents.

It was found that the mass transfer rate was markedly promoted by the rotation and the concentration differences between at inlet and at outlet of the cell were lowered under the high volumetric flow rate, and this results in an increase in the metal recovery rate and current efficiency. Under the electrolytic condition of 200 mA, 1400 r. p. m. and 3.4 $l\ min^{-1}$ the concentration of 30 l solution changes from 100 ppm to 10 ppm for 98 minutes and simultaneously the current efficiency reaches about 70%.

Growth of Manganese Sulfides in Carbon Steels during Isothermal Treatments

Hiroshi TAUMI Kaichi MATSUBARA
(Received June 15, 1982)

Abstract

The isothermal growth of nearly pure manganese sulfides in forged and chill-cast carbon steels, was investigated by means of quantitative metallography, under a scanning electron microscope.

The number and size of sulfides in both steels were correlated with the period and temperature of treatment.

As a result, it became clear that the size of sulfides in both steels varied in proportion to the homogenization time, nawely the growth of manganese sulfides in steel obeyed the law of Ostwald ripening.

Formation of Manganese Sulfide in High Carbon Steel

Kiyotaka MATSUURA, Yoichi ITO, Kaichi MATSUBARA

(Received June 15, 1982)

Abstract

The formation process of manganese sulfide in γ-solidified high carbon steel was investigated, and a comparison was run with that of δ-solidified low carbon steel.

Sulfides in high carbon steel were classified into the following two categories from the formatiom kinetics. One was a eutectic sulfide crystallized in the final period of the solidification. Another was sulfide precipitated from solid steel during and after the solidification. This classification was common with the case of low carbon steel and therefore it was concluded that whether the primary solid phase was δ-iron or γ-iron it did not have any effect on the formation kinetics of sulfide.

The amount of sulfides formed through each kinetic process, however, differed apparently between both steels: eutectic sulfides were favorable in high carbon steel and precipitated sulfides were remarkable in low carbon steel. This tendency was explained by the fact that the solubility of manganese sulfide to steel decreased steeply as a result of $\delta \rightarrow \gamma$ transformation.

Void Swelling and Segregation Phenomena in 316 Stainless Steel

Taro TAKEYAMA, Heishichiro TAKAHASHI, Soumei OHNUKI,
Susumu MOCHIZUKI, Yoshikazu SATO, Hisashi OSANAI and Yoshio NAGATO
(Received June 15, 1982)

Abstract

The characteristics of void swelling and irradiation-induced segregation in Ti -modified 316 stainless steel were investigated by electron-irradiation in the temperature range between 673 and 823 K using high voltage electron microscopy.

The peak void swelling, of which value was about 7% at 8.5 dpa was recognized at 823 K. The increase of the swelling is well described by an emprical equation, $\Delta V/V = N_V F (\phi t - \phi t_o)^n$ and its fluence exponent n was close to a value 3/2 indicating vacancy diffusion-limited void growth.

The solute concentration in the region including voids after irradiation changed and Ni, Si, and Ti enriched at voids, while Cr and Mo tended to be depleted from the voids. From these results it was indicated that void swelling could be affected due to an effect of solute segregation around voids.

An Electrolytic Etching Technique for Crystalographic Pits on Ti

Toshio SHIBATA, Tsuneo SUZUKI and Taro TAKEYAMA
(Received June 15, 1982)

Abstract

Electrochemical condition for obtaining crystalographic pits on Ti was examined using the potentiostatic etching technique in HF-HNO_3 solutions. Optimum composition of etching solution is found to be (0.5-1.0% HF+20% HNO_3) which produces a border line passivity. By examining polarization curves and etched surfaces in the above solution, it was found that well defined crystalographic etch pits are formed at -0.6 Volt in the active region for 10 min at 0℃.

Study on Ceramic to Metal Bondings

—Part 1—

Application of the Cu-O filler to the Al_2O_3-Ni Bondings

Toshio NARITA, Kenzi SUGAWARA and Keizo NISHIDA

(Received June 15, 1982)

Abstract

Alumina to nickel bondings were developed using the copper oxygen alloys as a filler in an inert gas atmosphere at temperatures between 1338 to 1356K. Copper and three alloys containing (A) hypo-, (B) hyper-, and (C) hyper rich in Cu_2O-eutectic compositions were used and the optimum bonding time was determined with a cathetometer, which allows for the determination of the onset of melting down the alloy fillers.

Numerous voids were found in the vicinity of the Al_2O_3/Cu-O alloy interface and their sizes tended to be smaller than those of the bonding heated in air. These voids seem to be attributable to the stress relief during cooling.

The three-point bending test was adopted at room temperature to reveal that weldabilities of copper and alloys increased in the sequence of copper, alloys of C, A, and B. The bonding made with the alloy B was fractured along the grain boundaries within the Al_2O_3 phase. It was found that the large specimen had a fracture strength higher than that of the small one, because the so-called notch effect became significant for the small specimen.

The good adhesiveness of the Cu-O alloy B could be interrelated to the lower contact angles of the molten alloys to the alumina surface, i. e., to the highly established wettability.

High Temperature Corrosion of Metals and Alloys In Sulfur-Containing Atmospheres

Kazuya KUROKAWA, Toshio NARITA, and Keizo NISHIDA

(Received June 15, 1982)

Abstract

In order to clarify the mechanism of simultaneous oxide and sulfide formation in metals and alloys at high temperatures in sulfur-containing atmospheres, the corrosion

of iron and chromium in SO_2 atmospheres was studied by thermogravimetry, X-ray diffraction, SEM-EDAX, optical microscopy, EPMA and Auger electron spectroscopy. The scale formed on iron at 1073K consisted of iron oxides (FeO, Fe_3O_4) and sulfide (FeS), while only chromium oxide (Cr_2O_3) was formed on chromium at 1273K in any SO_2 atmosphere. Especially, the iron oxides and sulfide showed the lamellar structure only in low SO_2 partial pressures where the sulfur partial pressure was lower than the dissociation pressure of FeS.

The formation of the lamellar structure on iron is explained by a rapid consumption of oxygen causing the sulfide formation, as a result of a local rise in the activity of the sulfur adsorbed on the scale surface, and the fluctuations in the adsorbed oxygen and sulfur activities. Thus, in order to control of the sulfide formation, the following methods were attempted.

(1) The increase of oxygen potential in atmosphere.
(2) The formation of a scale having a low cation diffusivity with some Fe-Cr alloys.

Finally, the latter exhibited a more remarkable control of the sulfide formation than in the former.

Some Aspects on the Preferential Sulfidation at the Grain boundary of Fe-Cr Alloys

Toshio NARITA and Keizo NISHIDA
(Received June 15, 1982)

Abstract

Grain boundary sulfidation, which is often observed beneath the surface scales on the heat-resistant alloys, is discussed on the basis of theoretical calculation and sulfidation experiments of the Fe-Cr alloys in H_2S-H_2 atmospheres. When the Fe-medium Cr alloys were sulfidized at sulfur pressures lower than the dissociation pressure of a ferrous sulfide, the preferential sulfidation along the grain boundaries emerged from below the thin surface scale. Diffusional analyses were made to simulate the sulfide growth and chromium depleted zone after considering thermodynamical limitations peculiar to sulfidation at very low sulfur pressures. A good agreement was obtained between the calculated and measured values, except for the parabolic rate constants k_p of the Fe-medium Cr alloys sulfidized below a critical sulfur pressure. In these alloys the measured values for k_p were much larger than the calculated ones so that the

preferential sulfidation at the grain boundaries may explain the difference between the two.

Two necessary conditions are proposed for the preferential attack at the grain boundary :

(1) The diffusion flux of the sulfide phase is higher than that of an alloy phase.

(2) The concentrations of less-noble metals in the sulfide phase are larger than the alloy compositions.

Radiation-Induced Segregation and Void Formation in C^+ Ion-Irradiated Vanadium-Carbon Alloys

T. TAKEYAMA, S. OHNUKI, H. TAKAHASHI, Y. SATO and S. MOCHIZUKI

(Received June 15, 1982)

Abstract

To clarify the effect of interstitial elements on radiation-induced segregation and void formation in V and V-C alloys irradiated by 200 keV C^+ ions to a dose of 48 dpa at 973 K, the microstructural observation and the measurment of C segregation to the surfaces were carried out by TEM and XPS.

Voids, dislocations and precipitates were produced in all of the specimens during irradiation. The addition of C in V led to a reduction of void size and to increase in void number density, consequently the void swelling was suppressed strongly. Radiation-induced segregation of C was observed clearly on and near the irradiated surfaces of V-C alloys and as a result of the enrichment of C atoms, carbides precipitated on the surfaces. It is the first evidence of the radiation-induced segregation of interstitial elements on the surfaces. Also, quasi-carbides were observed on the {210} habit plaints near large voids and dislocations in V. The phenomena show that C atoms, which was insolved and/or implanted, interact strongly with vacancies rather than self -interstitial atoms and migrate with vacancies toward defect sinks, such as surfaces, voids, and dislocations. The segregated zones of C reduced the sink efficency of the defects, and showed the effect of the suppression on void in V-C alloys.

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Laboratory Study on the Correlation between Mechanical Properties and Static Cone Penetration Characteristics of Sand

Shosuke TOKI, Seiichi MIURA and Fusao TANIZAWA
(Received June 30, 1982)

Abstract

A triaxial device by which static cone penetration test and static and cyclic shear tests can be performed under simulated in-situ stress conditions is developed. Using this apparatus, a series of cone penetration tests and static triaxial compression and extension tests on sand specimens prepared by various methods was performed to examine the relationship between cone penetration characteristics and mechanical properties of sand. Test results showed that cone penetration resistance depends strongly not only on the relative density but also on fabric characteristics of the specimen. However it was recognized that an unique correlation exists between the penetration resistance value and angle of shearing resistance obtained through the drained triaxial compression test. It was also clarified that the dilatancy characteristic during cone penetration affects the penetration resistance value and is closely related to that in the static triaxial test.

Penetration resistance values were calculated on the basis of the theory of cavity expansion taking the compressibility of sand into consideration and compared with measured values. Comparison of the predicted and measured cone penetration resistance showed that both values are in agreement with each other whereas the anisotropic dilatancy characteristics of sand must be introduced in the cavity expansion theory.

An Elastoplastic Stress-Strain Relationship for Sand Subjected to Cyclic Loading

Seiichi MIURA, Shosuke TOKI and Naomi INE
(Received June 30, 1982)

Abstract

This paper presents an elasto-plasticity model for sand under monotonic and cyclic stress conditions.

First, a series of drained triaxial shear tests with various stress paths was

performed to examine the fundamental stress-strain characteristics of sand. On the basis of these results, an elastoplastic stress-strain model under monotonic stress condition was developed. This theory is shown to predict sand behavior under various loading conditions with good accuracy.

Then, the monotonic stress-strain model above derived was extended to a cyclic stress condition, on the basis of sand behavior observed in a series of cyclic triaxial tests. The main aspect of the extended stress-strain model is that sand undergoes a combination of kinematic and isotropic strain hardening in order to simulate the observed behaviors of sand under cyclic stress condition. A Comparison of the predicted and measured cyclic stress-strain relationships showed that this theory is capable of simulating the important features of sand behavior under cyclic stress conditions, such as hysteretic behavior, and the subsequent change in the shape of hysteresis loop with the number of cycles and cumulative effect leading to large plastic strains.

A Study on Coal Dust in a Return Airway —Some Considerations Based Upon Underground Measurements—

Kansyo RO, Toshiro ISOBE, Kiyoshi HIGUCHI and Kotaro OHGA

(Received June 30, 1982)

Abstract

Coal dust produced during the mining process is a cause of considerable trouble for safety and productivity of underground coal mines. The concentration of suspended coal dust and sedimentation velocity of coal dust on the floor were measured at several places in the return airway of the coal producing face. Distributions of particle size were studied in relation with distance from the face. It was confirmed that regarding the distance and portible sige the farther from the face, the smaller the particle size of coal dust and the narrower the range of the size distribution. The mean particle size was approximately 22 micron. Water injection technics using rubber packer and high pressure water into the coal seam reduced appoximately 73% of coal dust.

Analysis of Departure Queue in PRT Multiberth Station

Masahito KURIHARA, Katsuhiro NAKADA and Ikuo KAJI

(Received June 30, 1982)

Abstract

A multiberth off-line station in personal rapid transit systems (PRT) is modeled as a Markov renewal process with some non-regeneration points. Several measures of effectiveness, such as expected departure queue length, expected waiting time for departure, entrance factor, utilization factor, and departure rate are calculated.

The numerical examples illustrate the relationships among them under several traffic conditions.

Spectral Resolution of a Proustite Upconverter-Spectrometer

Kojiro KOYANAGI and Ichiro SAKURABA

(Received June 30, 1982)

Abstract

An upconverter-spectrometer system in the 10 μm spectral region, using a proustite crystal and a Nd:YAG laser as the pump, is described.

Experimental results regarding the spectral resolution of the system are also presented.

Measurements of Low Temperature Specific Heat on Small Samples

Yuji KAKIZAKI and Kazuhiko YAMAYA

(Received June 30, 1982)

Abstract

For measuring heat capacity of small samples (10 - 100mg) in a range of 1.2-15K,

we construct the calorimeter using a silicon on sapphire (SOS) bolometer as the sample holder, temperature sensor, and sample heater. The heat capacity is measured by the thermal relaxation method in which the heat capacity C is determined from the thermal conductance K_W and the relaxation time τ, $C=K_W\tau$.

The specific heat of platinum as a standard sample was measured in the range of 1.5−5.5K with an accuracy of ± 6.0%. From the temperature dependence of the specific heat, the electronic specific heat coefficient and the Debye temperature were determined and their values were found to be in good agreement with published values.

Neutron Transmutation of Long-Lived Radioactive Wastes

—— Depleting Calculation of ^{241}Am in a TOKAMAK Fusion Reactor ——

Takaaki MATSUMOTO, Meiseki KATAYAMA,
Norio SENDA and Kunihiko UEMATSU

(Received June 30, 1982)

Abstract

The physical feasibility of the neutron transmutation by a fusion reactor was evaluated. A single isotope ^{241}Am was assumed to be irradiated for 20 years in a blanket region. A calculating system of ANISN-ORIGEN was used.

It was shown that under the neutron flux 3×10^{15} n/cm^2.sec. the total quantity of the actinides is reduced to about 25% of that resulting from spontaneous decay.

Robustness of Discriminant Analysis with QDF

—— Study for Three Non-Normal Distribution Models ——

Hiroko NAKANISHI, Masahiro MIZUTA, Yoshiharu SATO,
Tsutomu DATE, and Michiaki KAWAGUCHI

(Received June 30, 1982)

Abstract

Quadratic discriminant function (QDF) is commonly used for a two-group-discriminant-analysis. This method is optimal when both samples are from normal

distribution with known means and variances. When QDF is applied to samples from non-normal distributions, the total probability of misclassification is larger than that of the optimal means (derived from Bayes discriminant rule). W.R. Clarke et al. showed that if non-normal distributions are highly skewed, QDF is sensitive, i.e. the total probability of misclassification of QDF is far from the optimal value.

In this paper, we check Clarke's study by use of 3-type non-normal distributions, and point out that the increase in misclassification depends on not only the skewness of distribution but also the mutual relation of skewness between the two distributions.

Moreover it is shown that this relation is more significant than the skewness itself. In order to investigate the robustness of QDF for non-normal distributions, a new measure is proposed.

A Graphical Dynamic Representation of Multi-Dimensional Data in Real-Time

Masahiro MIZUTA, Hiroko NAKANISHI, Yoshiharu SATO
and Michiaki KAWAGUCHI

(Received June 30, 1982)

Abstract

A method which represents multi-dimensional data using graphic displays and control-sticks is presented in this paper. One of the special features of this method is the use of motion of the points; these points are projections of the data on the plane which is under real-time control of the user with control-sticks. The method is interactive and assists in heuristic investigations of data structure.

This method itself is only one of the supporting tools for the data analysis. Hence it is profitable to combine this proposed method with other statistical methods. Some applications of the method are shown, namely the expression of the results of principal component analysis, discriminant analysis and cluster analysis.

A Research for the Visual Perception by Mathematical Engineering Based on the Output Function of Lateral Inhibition from Optic Nerves in the Retina

Takahiro YAMANOI, Masaaki SAITO, Satoshi KAJIKAWA
and Michiaki KAWAGUCHI

(Received June 30, 1982)

Abstract

A differential geometrical treatment of visual fields is shown with regard to the output function from optic nerves in the retina. One of the metrics of the visual field is assumed from the output function of the lateral inhibition introduced by Morita et al. By means of this metric the equation of geodesic, the straight line in the visual field, is derived and solved numerically.

Some structures of the perception to the geometrical-optical illusions: Orbison's, Zöllner's and Poggendorff's, are explained with reference to the geodesic in each fields.

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Is the Kayanuma Railroad the First One in Japan

Nobuto USHIZAWA

(Received September 30, 1982)

Abstract

It is well known that the first railroad in Japan was laid down is Meiji 5 (1872) from Yokohama to Shinbashi. On the other hand, there is a popular story that of Kayanuma Coal Mines in Hokkaido had already a railroad for transportation of coal years before. It was constructed by English engineers, E. H. M. Gower and James Scott, in Meiji 2 (1869) by the order of the Meiji Government.

It is true, in one sense, that Kayanuma Railroad was the first railroad in Japan. But it is not the first one in another sense, because the rails used for the line were wooden rails covered with iron plates and the wagons were selfrunning down grade by incline without the power of a steam engine. This is stated in any book of orthodox history such as "New history of Hokkaido". The popular story that the first railroad in Japan was constructed in Kayanuma is still believed among people in Hokkaido as well as in other parts of Japan. In this paper this story is studied in detail from a view point of technological history.

Open Diffusion Flame Heights of Vaporized Methanol and Ethanol

Setsuo TATSUTA and Kenichi ITO

(Received September 30, 1982)

Abstract

Open diffusion flame heights of vaporized methanol and ethanol were measured photographically, and were compared with those of LPG and city gas (6C) at room temperature. The effects of varying vapor temperature in the range of 80-140 °C and water addition of 0-30 wt% were also examined.

The heights of laminar flames were independent of vapor temperature at a constant mass flow rate. For water added fuels, the heights decreased with the increasing water concentration. The most dominant factor was the net flow rate of fuel vapor. The heights per heat release rate of both alcohol fuels were in no cases larger than those of LPG and city gas.

Structure of a Premixed Concentric Jet Flame at Main Flame Blow-off

Kenichi ITO and Yasuhiro ARAI

(Received September 30, 1982)

Abstract

The blow-off mechanism of the main flame in a premixed concentric jet flame with a recirculation zone was studied experimentally. Time mean values and fluctuations of the gas temperature and ionization current were measured to investigate the flame structure of the recirculation zone and a flame necking region between the recirculation zone and the main flame. A propane-air mixture was carried to a burner nozzle, which had an inner diameter of 12 mm and a rim thickness of 7.5mm, and a parallel air flow surrounded the burner nozzle coaxially.

The results showed that, in the case of a transition from a normal flame to the near blow-off flame, both of the mean gas temperatures and ionization current values at the flame necking region shownd a clear drop. However, in the blow-off mechanism of the main flame in this concentric jet flame, there was a difference between an inner flame and an outer flame, which were distinguished by the position of the flame fronts in the recirculation zone. The relation between fluctuations of the gas temperature and ionization current was also clarified.

On the Notch Strength of Cast Iron

Tōru NOGUCHI and Kingo NAGAOKA

(Received September 30, 1982)

Abstract

In gray cast iron, the strength decrease by notches is much smaller than estimated by elastic formula. In order to clarify the reasons for the low notch sensitivity, different cast irons with various strength grades and notch configurations were investigated at room and liquid nitrogen temperature. The finite element method was used to calculate the stress distribution around the notch considering the non-elastic stress strain behavior of the material.

According to the stress analysis, the low notch sensitivity is caused by two factors. the non-elasticity of cast iron that reduces the maximum working stress to a much lower value than the elastic estimation, and an over stressed region at the notch root where the stress is higher than the tensile strength of the material.

A fracture criterion with an over stressed depth, δ, was established for the strength evaluation of cast iron under a stress gradient. The value of δ is about 3 mm at room temperature and less than 1 mm at liquid nitrogen temperature. These values are related to the metallurgical size of the graphite eutectic cell, and the mechanical conditions of initiation and propagation of cracks in cast iron.

Recent Trends of Studies on Ellipso-Interferometry

——A New Techique for the Determination of Two Dimensional Distributions of Thickness and Optical Constants of Thin Films——

Teruhito MISHIMA

(Received September 30, 1982)

Abstract

Studies on ellipso-interferometry are surveyed. The principle, the lateral resolutions, the thickness sensitivity and some relating experimental results of the technique are summarized. The technique is promising for the analysis of bulk surfaces, thin film, and interface layer because of its high lateral resolutions and high thickness resolution.

A simple method derived from the technique for the sample which is fabricated on a low absorbing substrate is also described.

Effects of Multiple Reflection and Diffraction on Lateral Resolution of Ellipso-Interferometry

Teruhito MISHIMA, Kunihiro SATOH, Yasuhiro ITOH, and Ichiro SAKURABA

(Received September 30, 1982)

Abstract

A nondestructive optical technique named ellipso-interferometry has been developed for the determination of the distribution of the thickness and the optical constants of thin films.

In this paper the lateral resolutions of the technique is analyzed in terms of multiple reflection effects and diffraction effects in the case of determining the distributions of the thickness and the optical constants of SiO_2 film on Si substrate. The effects of multiple reflection dominate the lateral resolution in case of thick film or large incident angle. On the contrary, the effects of diffraction prevail in the case of thin film and small incident angle. The resolution is calculated to be of the order of $1\mu m$ for the film thinner than several hundreds nm.

This new technique seems to be applicable to the determination of thickeness and optical constants in very small area such as in integrated circuits.

Temperature Resolution of an Upconverter-Thermograph

Kojiro KOYANAGI and Ichiro SAKURABA

(Received September 30, 1982)

Abstract

A thermograph based upon parametric upconversion processes is described. Temperature resolution is generally limited by background radiation, intensity variation of pump beam, and dark currents. The temperature resolution of the upconverter-thermograph with dispersion matching is disscussed.

Studies on the Sintering of $KNbO_3$

Kohei KODAIRA, Jun SHIOYA, Shiro SHIMADA and
Toru MATSUSHITA

(Received September 30, 1982)

Abstract

Sintering of $KNbO_3$ was conducted at 740—900°C for 30—240 minutes under dry air flow by P_2O_5. Rapid densification was observed at temperatures above 890°C. Compact with a highest relative density of 96% was obtained at 990°C for 30 minutes. Each grain in the compacts showed a highly uniform distribution without abnormal grain growth. The activation energy for grain growth was calculated as about 71 kcal/mol. Dielectric constants of the compacts could be expressed by the logarithmic mixture rule. The value of dielectric constants corresponding to 100% relative density was determined as about 1100. The compacts with 90—95%relative density indicated 5×10^{-2} as the value for dielectric losses.

Statistical and Computational Data Analysis in Quasielastic Neutron Scattering (II)

Kazuhiko INOUE

(Received September 30, 1982)

Abstract

A useful formula for the quasielastic neutron scattering studies with the conventional resolution was derived for computational data analysis. A scaling of the instrument function necessary for data analysis was also devised. Combining these results with the statistical data analysis technique reported in the previous report, we performed numerical experiments to assess the usefulness of the procedures and obtained satisfactory results.

On Binocular Visual Space as a Model of Affinely Connected Geometry

Toshimasa YAMAZAKI, Takahiro YAMANOI
and Michiaki KAWAGUCHI

(Received September 30, 1982)

Abstract

A concrete geometrical structure as the affinely connected space is given for the binocular visual space. On the basis of the supposition that the parallel alley and the horopter are paths in the visual space, an asymmetric connection under the restriction of teleparallelism is obtained by fitting a curve to the parallel alley data points. Solving the geodesics, which are derived from the above connection, under the restriction of Riemannian geometry by a numerical method and plotting the solution, the distance alley curve is drawn independently of the experimental data. The resulting curve is found to lie outside the parallel alley curve as before. This result substantiates the theory of non-Riemannian visual space. Furthermore by means of the curve fitting to horopter based on Ogle's data analysis, the connections under the regulation of two directions of the parallel alley and the horopter are determined. Regarding this result, a numerical experiment was made based on the hypothetical experiment.

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Dual Water Supply System with New Drinking Water Supply
— Measures to maintain safety of drinking water and to avoid supply shortage in a densely populated area —

Norihito TAMBO

(Received September 30, 1982)

Abstract

To maintain safety of drinking water supply and to avoid disruption of the supply in a period of water shortage in a densely populated and industrialized area, a dual water supply system with a new high quality drinking water supply is proposed. In this discussion, the author reveals that the modern monolithic water supply system cannot cope with the increasing miscellaneous micropollutions of these days to protect consumers and has no way to overcome disasters caused by stochastic water shortage in spite of its great efforts given. Therefore new systems are in demand to solve the essential point of difficulties of the modern system. Introduction of a new drinking water supply with high quality raw water and construction materials for a restricted amount of water demand shows that it provides a high degree of safety to consumers without difficulty. Introduction of reclaimed waste water or low quality raw water into a general water supply system which is not used as drinking water ensures quantitative requiremnts of water supply even in periods of severe water shortage with a moderate degree of water treatment.

Selection of Sludge Treatment and Disposal Processes in a Water Purification System

Norihito TAMBO, Mitsuna KOBAYASHI

(Received September 30, 1982)

Abstract

In many places of the world, disposal of untreated sludges from water treatment plants is prohibited by law. Investment of money for sludge treatment facilities is sometimes comparable with that of purification facilities where environmental restrictions are severe. Therefore, a rational design of sludge treatment facilities is strongly required. Treatment processes can be selected by taking both factors in the raw water and environmental

conditions of the individual water works into account. With respect to purification processes, the least amount of coagulant dosage is essential so as to improve treatability and decrease the amount of sludge generation. For this reason, direct filtration of low-turbidity water is recommended because of its much lower alminium/turbidity ratio. Sludge treatment processes can be selected mainly by the nature of sludges and the conditions of disposal and reuse. The authors show the advantages and drawbacks of typical systems. Quantitative experimental and statistical data with respect to those processes and systems are presented with discussions of the mechanism and theories of new processes. Disposability of treated sludges, secondary environmental pollution problems, reuse data of recovered alum, production of ceramics from sludges, and evaluation of sludge natures for gardening or agricultural use are discussed by the numerous experiences in the authors' research activities.

Biochemically Stable Organic Matters in Activated Sludge Process Effluent

Kazuhiro TERAMACHI and Tetsuo TAKAKUWA

(Received September 30, 1982)

Abstract

Activated sludge process effluents usually contain biochemically stable organic matters which are a matter of great concern with respect to the THM creation after chlorination. In this study, the existence and the generation of such organic matters were experimentally examined using domestic sewage.

In a batch test, the existence of such matters in the influent sewage was confirmed from the fact that the minimum levels of E_{260} and COD during aeration were proportionally increased with the initial COD concentration. For a given concentration of initial COD, the minimum levels were not affected by the SS concentration of the influent sewage, MLSS and SRT. In a continuous-flow test, the soluble COD of the effluent did not reach such a high level even after 100 h as observed in the batch test. The COD/E_{260} ratio of the effluent became lower as the detention time and this tendency was also opposed to the result of the batch test.

Evaluation of Design Criteria and Performance for Activated Sludge Process

Tatsuo SHIMIZU and Yoshikazu NASU

(Received September 30, 1982)

Abstract

The performance of microbial reactor systems such as the activated sludge process was investigated by using aeration tanks with different degrees of fluid mixing under various organic loadings. The experimental results indicated that the partial fluid mixing system with a relatively large Peclet number had some definite advantages with respect to the purification efficiency and sludge settleability in the corresponding complete mixing system for any applied organic loadings. The higher performance of the activated sludge system with partial fluid mixing was shown quantitatively by use of the axial dispersion model in conjunction with the growth kinetics which involved the biosorption and subsequent oxidative biodegradation processes of organic substances.

Architecture and Algorithm of APL Based Package Program for Continuous System Simulation in Personal Computing Age

Shigeru MATSUURA

(Received September 30, 1982)

Abstract

In this paper, a self-contained package software for computer simulation of varied types of continuous system is proposed.

First, a historical survey is made as to the transition of simulation concepts and it's practical applications. As a result, it seems that the most important point for a simulation model as to have a one-to-one correspondence between the elements, or submodels, of the model and those of the real physical system.

To attain this point in practical simulation technique, the author proposes to start with a circuit representation of a physical system. Then a signal flow graph is conveniently employed in completing an algorithm which enables us to automatically form a purely digital simulation model for the original physical system, even if it contains elements with a widely separated time constant.

Since APL language is used in the final self-contained package software, and since it consists of a set of module programs, it can be adapted to any type of conventional com-

puters, to say nothing of personal computers, in interpretive uses.

In this sense, this package, reported here in detail, can be said to be a novel type of software suitable to the forthcoming personal computing age.

Air Leakage Calculations for NBS Administration Building U. S. A.

Kiyoshi OCHIFUJI and Tamami KUSUDA

(Received September 30, 1982)

Abstract

A comprehensive computer program for the prediction of air flow and air pressure in a building was applied to the 11 story administration building of the National Bureau of Standards, Washington D. C., U. S. A. Natural air leakage rates under various climatic conditions for several ventilation system operations were obtained. The major factors that controlled the air leakage such as outdoor temperature, wind speed, envelope porosity, air-conditioning system operation have been studied with respect to the total air leakage, floor by floor air leakage and room by room air leakage.

The Effect of Wall Emissivity on Mean Radiant Temperature

Tohru MOCHIDA

(Received September 30, 1982)

Abstract

Radiant temperature is a factor which governs the heat loss by radiation from the human body surface and the influence on man's thermal sensation can not be ignored. Although mean radiant temperatures weighted with wall area ratios or with angle factors have been used, these temperatures can not evaluate the effect of the surface emissivities of the surrounding walls.

The present author has derived and has proposed both a mean radiant temperature and a radiative heat transfer coefficient under a new concept by extending Gebhart' s absorption factor method on the radiation heat exchange and by applying it to the space between the human body and walls and by linearizing from raising the radiation to the fourth power.

The characteristic feature of the new mean radiant temperature weighted with absorption factors is that considerations are made not only to the geometric position of the human body in a room but also for the emissivity of each wall surface. The comparison of the mean radiant temperature derived in the present study with the mean radiant terperatures used hitherto is made and the results are reported.

Estimation of Road Traffic Noise by Simulation

Kozo KANEYASU

(Received September 30, 1982)

Abstract

In the case of complicated traffic, on roads and at the roadsides, a simulation method is useful for the estimation of road traffic noise.

In this paper, some problems in question of the equally spaced and equally powered model are pointed out, and an application of the simulation method is introduced.

Concepts, procedures, equations and constant values applied in the estimation are presented and the actual noise level measured at roadsides are compared with the estimated noise level by simulation.

An Experimental Study on Aerobic Biodegradation in a High Piled Layer of Municipal Solid Waste

Nobutoshi TANAKA, Akihiko MAKI, Keiichi KOYAMA

(Received September 30, 1982)

Abstract

The aerobic decomposing phenomenon in a layer of municipal solid waste where oxygen may be supplied at a low flow rate, compared with the amount of oxygen required by aerobes, under a natural oxygen defficient condition was experimentaly studied. Such an oxygen shortage condition appears to be normal in sanitary aerobic and semi-aerobic landfills.

Consequently, it was noted that there was a refuse decomposing zone with high oxygen comsumption of aerobes and that the zone gradually moved downwards. It was noted that almost gas phase in the layer was effective for gas movable space and the flow pattern of gas

through the layer can be closely simulated by the piston flow model. It is expected to develop this study and make the simulation model of heat evolution and biological reaction in the layer, in order for this phenomena to be generally described and solved on the specified boundary conditions.

A Study of the Two Phase Anaerobic Digestion Process as a Sewage and Wastewater Treatment Method

Yuzo INOUE, Keiichi KOYAMA and Takayuki MATSUO

(Received September 30, 1982)

Abstract

To clarify the possibilities of treating actual sewage and wastewater with a two phase anaerobic digestion (TPAD) process, a series of laboratory scale experiments were carried out with synthetic wastewater using starch and skim milk.

The TPAD process consists of an acid fermentation reactor (AFR) with sludge recirculation, first sedimentation tank, a methane fermention reactor (MFR) which is a fixed bed biofilm reactor packed with honey comb type packed material, and second sedimentation tank lined in a series.

The process was operated at loading rate of 0.15 to 0.4 kg-Carbon/m^3/d (0.5 to 1.4 in AFR, 0.2 to 0.6 in MFR) and at 38° C. The production ratio of the total volatile fatty acids (TVFA) was nearly constant, independent of the loading rates and was achieved at 54% to 57% in AFR. But the proportion of each VFA was dependent upon them. 30% of the organic matter fed in AFR was removed, while 95 to 97% in MFR was removed. Most of these were decomposed to CH_4 and CO_2. Consequently 90% of the fed organic matter was exchanged into gaseous matters. It was found that the performance of the TPAD process is more attractive for dissolved organic matter than that of the aerobic treatment process such as an activated sludge process. The TPAD process could remove over 99.0% dissolved organic carbon (DOC) and could remove over 99.9% dissolved BOD. Effluent quality showed DOC less than 10mg/l as well as BOD. It was also shown that the TPAD process could be operated without any excess sludge production over the entire experiment periods.

Measurement of Atomospheric NO_2 Concentration Using Filter Coated with Triethanol-amine

Toshiichi OKITA, Sachio OHTA, Masakazu FUKUI,
Hideo YATABE, Takao AKEI and Yasuyuki KATAYAMA

(Received September 30, 1982)

Abstract

The collection of atmospheric NO_2 on triethanol-amine (TEA) coated cellulose filter was studied. The filter was prepared by soaking Toyo 51 A filter of 5 cm in diameter with 6.6 or 20% (w/w) aqueous solution of TEA and subsequent drying of the filter. With a sampling flow rate of 0.4 ℓ/min the mean efficiencies of collection of NO_2 by the 6.6 and 20 % TEA filter were about 45 and 55 % respectively although a fairly large scattering of the efficiency for each sample was observed. However, when the air temperature was below −5 ℃ the collection efficiency showed drastic drop. It was suggested that the collection of NO_2 into TEA was not through the reaction of HNO_2 and HNO_3 with TEA as proposed by Levaggi et al. but by direct absorption and reaction of NO_2 with TEA.

Measurements of Pollutants in the Exhaust of Coal Burning Stoves

Sachio OHTA, Toshiichi OKITA, Shinichi NAOTA, Kiyoshi MASUMOTO,
Norio ASAI and Hirotoshi FUKUI

(Received September 30, 1982)

Abstract

Measurements were made on pollutants in the exhaust of a coal burning stove. Measured components were CO_2, CO, O_2, NO_X, NO_2, SO_2, HCN, HF, HCl, particulate total carbon (TC), particulate free carbon (FC) and particulate sulfate (SO_4^{2-}). In a period from 20 to 60 min after ignition, the concentration of O_2 decreased by only 2%, and the concentrations of NO_X, NO_2 and SO_2 showed a definite decrease. On the centrary, the concentrations of HCN, HCl, TC, FC and SO_4^{2-} showed a great increase. Most of Cl in the coal is emitted as HCl gas. 47 and 2% of the combustive sulfer in the coal are emitted as SO_2 and SO_4^{2-} respectively. Carbon is emitted as CO_2, CO, particulate carbon (TC) and HCN which have a share, respectively, of 89.2, 6.3, 3.5 and 0.1% of total carbon in the coal.