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Appendix

Abstracts & Titles, No. 131~134

BULLETIN
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NOTICE

No. 131 May 1986

Papers and Reports	Author	Page
1. An Optimal Allocation of Energy Storage Systems in Electric Power Systems from an Economical Operating Viewpoint	S. MOROZUMI, K. NISHIYA and J. HASEGAWA	1
2. LOCAL AREA NETWORKS-A Stuctured Implementation Example	D. NOVAK and Y. AOKI	11
3. Shape analysis for particulates —— on its preparation and simplified discrete Fourier analysis ——	T. SHIBATA, N. YOSHIKI and K. YAMAGUCHI	21
4. Nanosecond-pulse Isolation Transformer with a High Withstanding Voltage Composed of Parallel-Bar Transmisson Lines	A. HOMMA and H. YAMAZAKI	37
5. Irradiation damage structures of aged Al-Mg-Li alloy	H. KINOSHITA, S. SUENAGA and H. TAKAHASHI	43
6. "PPA": A One-Dimensional Processor-Array System Using Shared-Memory Technology	K. MAKINO	49
7. Performance of a Processor-Array System as a Continuous-System Simulator	K. MAKINO	61

An Optimal Allocation of Energy Storage Systems in Electric Power Systems from an Economical Operating Viewpoint

Satoshi MOROZUMI, Kenichi NISHIYA and Jun HASEGAWA

(Recieved December 27, 1985)

Abstract

This paper describes an optimal allocation of energy storage systems in a power system from an economical operating viewpoint.

First, the optimal location of one energy storage system is discussed. Although it may be decided basically by a comparison run among all operating costs for each candidate location, an effective technique for the reduction of the number of locations where it would be required to calculate the operating cost is proposed in this paper. Some features of the optimal location are concluded from various results based on numerical simulations.

The optimal allocation of plural energy storage systems is also discussed in the latter part of this paper. It would be very difficult to find the optimal allocation by comparison of all allocating pattern, if the number of storage units or allocating sites increases in number. The present workers propose two algorisms by which to determine optimal or suboptimal allocation effectively. One of them, which is based on the branch-and-bound method is effective in determining the optimal one. The other, which includes successive applications of the optimal locating method in the earlier part of this paper, is only sufficient in finding the optimal or suboptimal one, however it may be faster than the first algorism. The two algorisms puposed are compared and discussed based on the results of some example problems.

LOCAL AREA NETWORKS-A Structured Implementation Example

Drago NOVAK and Yoshinao AOKI

(Received December 27, 1985)

Abstract

The article presents hardware and software aspects of a local area network implementation. First, the Open Systems Interconnection Reference Model, which enables structuring of the communication protocols is described. Taking this model as a basis for the implementation, we present then the intelligent Ethernet controller that serves as an interface between

the micro computer and the communication media. The controller is built as a single board computer that supports multiprocessing. For easier communication software structuring and implementation a simple real time kernel was developed. Its primitives and data structures are described next. The primitives enable parallel process execution, process synchronization, and assure mutual exclusion while using common resources. The final part contains the description of the interface data structures and processes implementing the network and transport layer communication protocols. We end thus with the transport layer and a "byte-stream" interface. With this all the work on the network side is done. The remaining communication layers that have to be implemented on the host are not part of this article.

Shape analysis for particulates —on its preparation and simplified discrete Fourier analysis—

Toshiharu SHIBATA, Norihisa YOSHIKI and Kenji YAMAGUCHI

(Received December 27. 1985)

Abstract

In algorithms of discrete Fourier methods applied to shape analyses for particulates, we usually choose the transformations, sine and/or cosine, according to the symmetrical nature of functions for its silhouette. These are quite justified. However, there are some problems such as phase angles which do not have the same nature as the other coefficients, and indicate restricted interpolation by the direct inverisions. The present method was newly refined regarding these points and it has the freedom to select a sine or cosine transformation.

At first the method is discussed with some polygonal shapes. And next it is applied to the shape analysis of Taiheiyo-coal char particles which were sampled from the water gas reaction with partial oxidation. In spite of its irregular shapes, informations such as areas and peripheral lengths are related to the sine coefficients.

Nanosecond-Pulse Isolation Transformer with a High Withstanding Voltage Composed of Parallel-Bar Transmission Lines

Akira HOMMA, Hatsuo YAMAZAKI

(Received December 27,1985)

Abstract

A novel nanosecond-pulse isolation transformer composed of paraallel-bar transmission lines was developed for the trigger system in an electron linear accelerator. To design it, the step-signal response of a transmission-line circuit modeling the transformer was analysed by using a reflection diagram. The insertion loss and time constant were estimated from the response analysis. The constructed transformer which can transmit 2 nsec wide pulses across a potential difference over 100 KV has a small rise time degradation (5% in 1 nsec rise time) and low insertion loss (−2 dB).

Irradiation damage structures of aged Al-Mg-Li alloy

Hiroshi KINOSHITA, Seiichi SUENAGA and Heishichro TAKAHASHI

(Received December 27, 1985)

Abstract

Aging structures and electron irradiation behavior of Al-4.1 wt % Mg-1.7 wt % Li alloy were investigated. After the specimens were annealed at 723 K for 2 hours, they were aged at 423 K for 2-500 hours and 453 K for 2-1000 hours.

An age-hardening occurred with precipitation δ' particles. With increasing the aging time, δ' grew and/or T phases precipitated, and then the hardeness of the specimen decreased. These precipitate structures were analyzed by using 200 KeV TEM and EDS.

Futhermore electron irradiations were performed at 373 K and 403 K up to 20 dpa. Void formation was recognized at about 5 dpa. The voids were distributed around the precipitation particles in all specimens.

When the irradiation temperature was high and the aging time was longer, the mean size of the voids became larger but the number density of the voids became lower.

During irradiation, the void number density did not vary greatly and the precipitations were stable even in higher doses

Thus it was clarified that the pre-existing precipitates acted as preferential void nucleation sites.

"PPA": A One-Dimensional Processor-Array System Using Shared-Memory Technology

Keiji MAKINO

(Received December 27, 1985)

Abstract

This paper describes a parallel processor system PPA, which is the main component of the multi-purpose simulator HOSS at the Hokkaido University. PPA is a master-slave system consisting of two master processors and thirty-two slave processors. Its architecture is characterized by a one-dimensional array of slave processors sharing a three-port memory system. The shared memory, also, connects masters and slaves, and the masters control the slaves through it. The architecture allows each processor to exchange data with its neighbors through the shared memory without actual data transfer. This reduces the data-transfer portion of the overall execution time, the minimization of which is a difficult problem in a parallel processor system. It was demonstrated that PPA can be used as a real-time continuous-system simulator with a CSMP-type simulation language ICOSS.

Performance of a Processor-Array System as a Continuous-System Simulator

Keiji MAKINO

(Received December 27, 1985)

Abstract

This paper describes the performance of a parallel processing system PPA for the simulation of continuous systems. PPA is composed of two master processors and a circular array of thirty-two slave processors connected by a three-port shared-memory system. It emulates a conventional analog computer, solving differential equations through the use of a real-time continuous-system simulation software ICOSS. The dynamic characteristics of PPA as a real-time simulator will be graphically presented. This system can simulate dynamical systems in real time up to ten Hz with sufficient accuracy. Data-transfer time and actual computing time is compared by analyzing PPA doing numerical integration for one integration step.

NOTICE

No. 132 July 1986

Papers and Reports	Author	Page
1. Effect of Methane Concentration on the Detonation properties of Coal Dust Explosions in an Underground Gallery	C. WANG and K. HIGUCHI	1
2. The Feasibility of a Simultaneous Reaction Process of Iron Ore Reduction and Coal Gasification on Fluidized Beds	S. KONDO and K. ISHII	11
3. Development of Process Gas Analysis by using Quadrupole Mass Spectrometer	K. ISHII, T. AKIYAMA, Y. KASHIWAYA and S. KONDO	21
4. Measurement of the Simultaneous Reaction of Iron Ore and Coke Gasification by Using a Gas Analysis	K. ISHII, Y. KASHIWAYA, T. AKIYAMA and S. KONDO	31
5. The Effect of a Powdery Copper Layer on the Electrolysis of Dilute Cupric Sulfate Solution in a Stacked Rotating Bipolar Electrode Cell	T. SASAKI, Y. SHINNO and T. ISHIKAWA	41
6. Boiling Heat-Transfer Performance at Critical Water Level in a Porous Bed	S. FUKUSAKO, N. EGUCHI and N. SEKI	49
7. Longitudinal Vibration of a Circular Cylinder under a Thermal Field	S. IGARASHI	59
8. Dislocation Structure Introduced in Nickel by Cyclic Push-Pull Deformation	K. HAMADA and M. KIRITANI	71
9. An Optimal Operating Strategy of Energy Storage Systems in Electric Power Systems —— A Fast Calculating Method for the Optimization of Operation Considering Line Flow Limits ——	S. MOROZUMI, K. NISHIYA and J. HASEGAWA	77
10. Characterization of Interface Properties of Al_2O_3/native oxide/InP MIS Structure by Capacitance Transient Analysis	H. MASUDA, L. HE, H. HASEGAWA, T. SAWADA and H. OHNO	89
11. Photoconductive Detectors with GaAs Active Layer	S. NAGASAWA, N. FUJISHIMA, H. OHNO and H. HASEGAWA	101
12. Delay Equalization For MF Radio Sound Transmission Line using DSP	T. TAKAHASHI and Y. OGAWA	113
13. Studies on Short-term LPC Analysis and Variability of Vowel Sounds	H. MURAKAMI, K. SAIKAWA, K. TOCHINAI and K. NAGATA	119
14. Feasibility and Design of μeV Neutron Spectrometer by Spallation Cold Source	K. INOUE	129
15. Ionic Strength Dependency of Stability Constants of Uranyl and Thorium Chloro-Complexes	T. MOROZUMI and H. OHASHI	139
16. Electroless Copper Plating for Preventing Pulverization of $FeTi_{1.1}$ Hydrogen Storage Alloy	T. MIZUNO, J. KITABUKI and T. MOROZUMI	147
17. On a quantification method for 3-way data	T. YAMANOI and L. PUN	155
18. Growth of Silicon Crystals by VLS-Method and its Modification	K. ATARASHIYA, K. YAMAMOTO and R. NAGASAKI	161
19. SURFACE MODIFICATION OF NICKEL/TITANIUM THIN FILM BY MEANS OF ION AND ELECTRON IRRADIATION	S. OHNUKI, T. MIYOSHI, H. TAKAHASHI, S. MOCHIZUKI, Y. SATO and T. TAKEYAMA	173

Effect of Methane Concentration on the Detonation properties of Coal Dust Explosions in an Underground Gallery

Chan WANG and Kiyoshi HIGUCHI

(Received March 31, 1986)

Abstract

Experimental studies using an explosion testing tube (15cm × 15cm × 900cm) were conducted to assess the effect of methane concentration on the detonation properties of coal dust explosions in an underground gallery. Coal dust that was weighed previosly was evenly distributed on the shelves throughout the length of the testing tube.

Then explosive methane- air mixture in the closed end of the tube was ignited and this gas explosion was followed by coal dust explosion and detonation in the open end of the tube when possible. A coal dust explosion in the testing tube could not self - propagate when the concentration of coal dust was lower than its lower explosion limit.

But when some methane coexisted in the coal dust, the limit was markedly lowered. Under the condition of the same coal dust concentration, it was confirmed that distances and velocities of flame propagations increased with methane concentration.

The Feasibility of a Simultaneous Reaction Process of Iron Ore Reduction and Coal Gasification on Fluidized Beds

Shin-ichi KONDO and Kuniyoshi ISHII

(Received March 31, 1986)

Abstract

Merits and demerits of the iron ore reduction with fluidized bed were discussed as compared with a shaft furnace. A higher productivity and better control were expected in the fluidized bed reduction under a high pressure, which fits in with miscellaneous processes of reducing gas production.

A new process of simultaneous reaction of iron ore reduction and coal gasification was proposed. This process consists of two fluidized beds, where 90% of carbon in the coal is gasified while the iron ore is reduced to wustite in the first bed, and then the prereduced ore out of the first bed is further reduced to 90% in the second bed. Suitable operating conditions were selected based on the material and heat balance, and then the compositions, quantities

and temperatures of gas at various points were calculated.

It may be concluded from the result of these calculations that the proposed process is feasible.

Development of Process Gas Analysis by using Quadrupole Mass Spectrometer

Kuniyoshi ISHII, Tomohiro AKIYAMA,
Yoshiaki KASHIWAYA and Shin-ichi KONDO

(Received March 31, 1986)

Abstract

A system for rapid gas analysis of process gas was developed by combining quadrupole mass spectrometer (QMS) and a micro computer. It was observed that the mass spectrum intensity ratio of a component gas to Ar was closely correlated with their composition ratio. On the basis of this finding, the flow rates of component gases were rapidly and accurately measured by adding Ar at a constant rate into the subject gas.

Measurement of the Simultaneous Reaction of Iron Ore and Coke Gasification by Using a Gas Analysis

Kuniyoshi ISHII, Yoshiaki KASHIWAYA
Tomohiro AKIYAMA and Shin-ichi KONDO

(Received March 31, 1986)

Abstract

In order to confirm the feasibility of the simultaneous reaction process of iron ore and coal gasification experimentally, gas mixtures of various compositions of Ar-H_2-H_2O and Ar-H_2-CO_2 systems at about 950℃ were passed into a packed bed of mixed iron ore and coke. The following results were obtained.

1) The reduction by H_2 and gasification by H_2O are much faster than those by CO and CO_2.

2) The equilibrium of water gas shift reaction is not necessarily attained.

3) The iron ore is reduced to wustite even by Ar-H_2O mixture.

The Effect of a Powdery Copper Layer on the Electrolysis of Dilute Cupric Sulfate Solution in a Stacked Rotating Bipolar Electrode Cell

Takeshi SASAKI,* Yuji SHINNO ** and Tatsuo ISHIKAWA*

(Received March 31, 1986)

Abstract

The effect on the rate of electrolysis of a predeposited powdery copper layer on the electrodes in a stacked rotating bipolar electrode cell was studied in dilute cupric sulfate solutions. Polarization curve measurements and the electrolysis of 30 l of 100 or 500 ppm Cu^{2+} solutions were carried out with electrodes covered with powdery copper layers formed under various conditions.

The rate of electrolysis is promoted remarkably by the powdery copper and the higher speed is attributed to increases in surface micro-turbulence with increases in the active surface area. It is concluded that a powdery copper layer predeposited on electrodes enables high speed electrolysis, and the optimum pre-electrolysis conditions for the layer are proposed.

Boiling Heat–Transfer Performance at Critical Water Level in a Porous Bed

Shoichiro FUKUSAKO, Norio EGUCHI and Nobuhiro SEKI

(Received March 31, 1986)

abstract

An experimental and analytical investigation was conducted to determine boiling heat–transfer performance at a critical water level in a porous bed. Four kinds of the particles of glass, alumina, steel, and copper balls were utilized as the testing porous beds. It was observed that there might be a critical water level for which a maximum boiling heat–transfer coefficient took place at a given $\triangle T_s$. The critical water level was obtained carefully by injecting saturated water. The analyses were found to correlate reasonably the tendencies of the experrimental results.

Longitudinal Vibration of a Circular Cylinder under a Thermal Field

Satoru IGARASHI

(Received March 31, 1986)

Abstract

Space one dimensional equation of longitudinal vibration of a circular cylinder under a thermal field is obtained from the fundamental equations of an elastic body. Considering that the radius of the cylinder is small, equations in the zero-th, and the first order approximation are derived. The present method enables us to calculate approximate equations in any desired accuracy.

For longitudinal harmonic waves propagating in an infinite long bar under a thermal field, exact and approximate frequency equations can be obtained from equations derived in the present paper. Especially, the approximate frequency equations for a small radius are solved for several thermal conditions at the peripheral surface of the cylinder, and the phase velocity and the damping coefficient are calculated.

Dislocation Structure Introduced in Nickel by Cyclic Push-Pull Deformation

Koichi HAMADA and Michio KIRITANI

(Received March 31, 1986)

Abstract

A fatigue deformation apparatus was designed and constructed to test a thin plate suitable for making electron microscope specimens. Equal inclination fringes have been effectively used for the detection and measurement of small local orientation difference, and a new $\pm\mathbf{g}$ stereo method has been introduced to characterize tha sign of each individual dislocation in a high density region of dislocations. In cyclically deformed nickel, the orientation difference between two dislocation free regions bordered by a large number of tangled dislocations was found to be extremely small. Tangled dislocations are confirmed to be composed of the equal number of dislocations of opposite sings.

An Optimal Operating Strategy of Energy Storage Systems in Electric Power Systems —— A Fast Calculating Method for the Optimization of Operation Considering Line Flow Limits ——

Satoshi MOROZUMI, Ken-ichi NISHIYA and Jun HASEGAWA

(Received March 31, 1986)

Abstract

A fast calculating method for optimization of operating strategies of energy storage systems in electric power systems was proposed by authors in the past and is extended to the case of considering line flow limits in this paper. It is possible to take the line flow limits into account by using an optimal power flow calculation with line flow limits as a subroutine of the fast calculating method. However, in this case, it becomes difficult to decide several modes of storage operation (such as input mode, output mode and waiting mode) simply by incremental cost of the power system as in the case without line flow limits. Thus, the authors propose a forecasting method, which calculates the cost change against small change of input or output power of storage system and can offer criteria available for the decision of the operating modes.

Using the forecasting method, some reconstructed manners of the fast calculating method are investigated and simulated. Based on the results of the simulations, it is concluded that the manner including successive applications of the fast calculating method for one storage system is avaiable for most cases of the optimizations for plural storage systems when the line flow limits are considered.

Characterization of Interface Properties of Al_2O_3/native oxide/InP MIS Structure by Capacitance Transient Analysis

Hiroshi MASUDA, Li HE, Hideki HASEGAWA,
Takayuki SAWADA and Hideo OHNO

(Received March 31, 1986)

Abstract

Interface properties of Al_2O_3/native oxide/InP structure are characterized by detailed examination of capacitance transient using C-t measurements and Isothermal Capacitance

Transient Spectroscopy (ICTS). The results indicate that the interface states responding to injection pulse are distributed spatially and energetically. Those states are shown to exist below Ec and not above. This supports our"Spatially Distributed Interface State Model."

It is also shown that there are two peaks in the spatial distribution of the interface states.

Photoconductive Detectors with GaAs Active Layer

Susumu NAGASAWA, Naoto FUJISHIMA, Hideo OHNO and Hideki HASEGAWA

(Received March 31, 1986)

Abstract

GaAs photoconductive detectors are promising elements in optoelectronic integrated circuits (OEIC's) because of their low driving voltage and simple planer structure. A slow response time and a long tail, however, were observed under low photon flux density excitation. Thus two new structure photoconductive detectors with GaAs active layer are proposed and investigated for the improvement of response time.

One is the AlGaAs/GaAs double heterostructure photoconductive detector and the other is the photoconductive detector with metal film. Both structures are conceived to eliminate the build-up of holes at the surface due to Fermi level pinning at the surface. The response time is improved by a factor of 10 to 10^3. This result shows that the detectors with a surface hole sink layer is promising for high-speed detectors.

Delay Equalization For MF Radio Sound Transmission Line using DSP

Tamaki TAKAHASHI and Yoshihiko OGAWA

(Received March 31, 1986)

Abstract

The group-delay characteristic of the sound signal for MF radio broadcasting is highly distorted when the signal is transmitted by MF radio sound transmission line. The distortion increases on the low frequency side. For this reason, the sound is heard with some strange echoes resulting in the lack of clarity. The delay distortion can be equalized by

using the inverse phase characteristic of the distortion in frequency area. In this paper, to compensate for this distortion a new delay equalizer using DSP with FFT technique is proposed and its characteristics and the results of compensation are discussed.

Studies on Short-term LPC Analysis and Variability of Vowel Sounds

Hiroyuki MURAKAMI, Katsuo SAIKAWA, Koji TOCHINAI and Kuniichi NAGATA

(Received March 31, 1986)

Abstract

Over long periods, words uttered by the same speaker, do not always have the same spectrum time patterns. This variability is the main cause for increases in error rates in automatic speakers varification.

A study on short-term LPC analysis was made using synthetic vowel sounds.

Using the short-term LPC analysis, the spectra of vowelsounds can be analyzed into the transfer-function of the vocal tract and the glottal source spectra.

Vowel sounds of Japanese spoken number digits uttered over one year period were analyzed, and it was observed that variability of the transfer-function is dominant in general.

Feasibility and Design of μeV Neutron Spectrometer by Spallation Cold Source

Kazuhiko INOUE

(Received March 31, 1986)

Abstract

Feasibility of the μeV neutron spectrometer using the pulsed spallation cold source was assessed. Therefore, it was revealed that quasielastic spectrometer, combined with the LAM-type crystal analyser of 88° Bragg angle, a 20 K methane pulsed cold source and a flight path of 150 m length, might be capable and may show practical performance for the μeV neutron spectroscopy. This paper describes the results of feasibility study and the outline of the LAM-88 spectrometer designed by this study.

Ionic Strength Dependency of Stability Constants of Uranyl and Thorium Chloro-Complexes

Takashi MOROZUMI and Hiroshi OHASHI

(Received March 31, 1986)

Abstract

Stability constants, K_{st}, of uranyl and thorium chloro-complexes decrease rapidly with increasing ionic strength. The ionic complexes are typical outer-sphere complexes, as the Fuoss formula is applicable to this relationship and the heat of formation is remarkably small. The inter-ionic distance of 1.9×10^{-8} and 4.0×10^{-8} cm were obtained for the uranyl and thorium chloro-complexes. The thermodynamic equilibrium constants of 33 and 212 mol^{-1} l were also determined for these chloro-complexes. The relatively low K_{st} values, which have been found for higher ionic strengths by previous investigators, are explained by the same outer-sphere complex model. The upper limit of the complexation was estimated as a function of ionic strength on the basis of the above model.

Electroless Copper Plating for Preventing Pulverization of $FeTi_{1.1}$ Hydrogen Storage Alloy

Tadahiko MIZUNO, Junichi KITABUKI and Takashi MOROZUMI

(Received March 31, 1986)

Abstract

An electroless copper plating technique was proposed to prevent the pulverization of $FeTi_{1.1}$ hydrogen storage alloy due to the repeated hydrogen absorption and desorption. The Saubestre (II) solution was utilized as a plating reagent, which was composed of $CuSO_4$, NaOH, formalin and Rocelle salt. The plating procedure was so simple that a reasonably uniform coating of 0.2 μm in average thickness was easily obtained by dipping the hydrogenated specimen in this plating solution for 5ks at 295 K.

Such treated specimens achieved almost perfect inhibition of pulverization even after 5000 cycles repeated absorption and desorption. The copper plating scarcely influenced the equilibrium absorption and desorption isotherms, but it retarded the rapid absorption of the hydrogen unbeared alloy with the mass flow mechanism.

The latter effect ceased by the change of reaction mechanism at lower temperature. No initial activation was needed for the copper-plated alloy.

On a quantification method for 3-way data

Takahiro YAMANOI and Lucas PUN

(Received March 31, 1986)

abstract

A method, called Hayashi's quantification II, was proposed by Hayashi for 2-way categorical data. The method, proposed in this paper, gives an extension of the quantification II to 3-way categorical data. As well as Hayashi's quantification method II, the method provides a quantification of data for classifying them into patterns.

Growth of Silicon Crystals by VLS-Method and its Modification

Koji ATARASHIYA, Katsuro YAMAMOTO and Ryukichi NAGASAKI

(Received March 31, 1986)

Abstract

The conditions in which platelike crystals of silicon are grown solely in the site of a liquid-forming agent on a silicon substrate were observed. Silicon crystals were grown by the hydrogen reduction of silicon tetrachloride at high temperature.

(1) When small amounts of silver were used for a liquid-forming agent, the liquid phase was divided into many droplets because the wettability of liquid silver-silicon alloy and solid silicon was low. Thus, the whiskers of silicon were grown by the VLS-mechanism.

(2) When large amounts of silver-silicon alloy were used for a liquid-forming agent, the liquid phase was aggregated into a large ball. Then, crystal growth fails to occur at the solid-liquid interface, but it occurs at the surface of liquid silver alloy.

(3) When aluminium foil was used for a liquid-forming agent which is referred to as reactive agent, the platelike crystals of silicon was grown at the solid-liquid interface. Aluminium agent was carried out by the vapor of aluminum trichloride.

For all cases mentioned above, the effects of temperature, time, partial pressure of silicon tetrachloride and a flow rate of hydrogen on growth of silicon crystals were discussed.

SURFACE MODIFICATION OF NICKEL/TITANIUM THIN FILM BY MEANS OF ION AND ELECTRON IRRADIATION

Soumei OHNUKI, Takahiro MIYOSHI, Heishichiro TAKAHASHI
Susumu MOCHIZUKI, Yoshikazu SATO and Taro TAKEYAMA

(Received March 31, 1986)

Abstract

To investigate the possibility of surface modification by means of charged particle irradiation, titanium-evaporated thin films of nickel were irradiated with helium ions of 200 keV and electrons of 1000 keV. By the cross cut method in the electron microscopic observations, it was confirmed that the radiation-induced structures were found up to about 600 nm in depth. These damage profiles consisted of the the calculated results based on the scattering theory.

The helium ion irradiation of 200 keV at about 570 K caused a transformation to an amorphous structure at the surface layer of Ni/Ti thin film. Furthermore, the concentration of nickel and titanium was almost the same as in the amorphous phase region. In the case of electron irradiation, intermetallic compounds and amorphous layers were formed at room temperature to 480 K. At higher irradiation temperatures, the formation of the compounds and oxide layers was remarkable.

These results suggested that the phase transformation at surfaces layers during irradiation can be caused by the ion-mixing and/or radiation-induced diffusion.

NOTICE

No. 133 October 1986

Papers and Reports	Author	Page
1. Electron Irradiation of A Directionally Solidified Ni_3Al-Ni_3Nb Eutectic Alloy	M. HISA, M. FUKUCHI and K. WATANABE	1
2. A Study on the Measurements of Devolatilization and Fire Point of Solid Fuels by an Airflow Type Thermobalance	H. TANIGUCHI, K. KUDO, S. SAYAMA, M. KAMIDE, S. MORIMOTO, K. MAKINO, N. KUMAGAI and J. ABE	9
3. A STRESS ANALYSIS OF AXISYMMETRIC TENSION SPECIMENS BY RIGID-PLASTIC FINITE ELEMENT METHOD	S. TADANO and H. ISHIKAWA	15
4. Freezing Behavior of Layered Air-Liquid Flow in a Circular Tube	S. FUKUSAKO and M. TAKAHASHI	27
5. A Study of Reactive Sputter Etching —On the Etching Characteristies of Carbon Steel by using various gases—	T. YUHTA, J. OSANAI, T. SATOH and T. TAKAHASHI	39
6. A Generalization of Shannon's Sampling Theorem	M. YAEGASHI, T. NAGASHIMA and S. IGARASHI	47
7. Carrier Concentration and Composition Profiling for GaAs/AlGaAs Laser Diodes	T. SAWADA and A. MAJERFELD	59
8. Optimal Hierarchical Control of the Nuclear Power Plant Using the PPA	Y. YAMAGISHI, M. TSUJI and Y. OGAWA	73
9. A Support System for Microprogramming based on Architecturel Knowledge	K. MITANI and E. MIYAMOTO	85

Electron Irradiation of A Directionally Solidified Ni_3Al-Ni_3Nb Eutectic Alloy

Masaaki HISA, Masaaki FUKUCHI and Katsuya WATANABE

(Received June 30, 1986)

Abstract

A directionally solidified $Ni_3Al(\gamma')$-$Ni_3Nb(\delta)$ eutectic alloy was irradiated in a temperature range from 300 K to 773 K in a 650 kV HVEM.

For the γ' phase which has a Ll_2 superlattice structure, two kinds of extrinsic loops were observed after irradiation above 573 K. One loop was a Frank type lying on {111} with Burgers vector b=1/3 ⟨111⟩ , while the other was an edge type lying on {011} with Burgers vector b=1/2 ⟨011⟩ .

For the δ phase, which structure is β-Cu_3Ti type, a numerous number of faulted loops was found on {010} above 673 K. The nature of the loops, however, is not fully understood yet. These loops might induce {211} twin deformation during the growth and part of the loops were altered into unfaulted ones.

In both phases, small defect clusters were produced below the temperature specified as above but at 673 K no void was formed up to $10^{27}e/m^2$ dosage. It was found that part of the defects in the γ' phase moved toward the γ'-δ interface.

A Study on the Measurements of Devolatilization and Fire Point of Solid Fuels by an Airflow Type Thermobalance

Hiroshi TANIGUCHI, Kazuhiko KUDO, Sogo SAYAMA,
Mitsushi KAMIDE, Shigeki MORIMOTO, Kazuo MAKINO,
Naoki KUMAGAI and Jun-ichi ABE

(Received June 30, 1986)

Abstract

A combustion phenomenon of solid fuels is classified in two categories of decomposed combustion and surface combustion.

Therefore we should analyze the phenomenon by use of devolatilization of solid fuels and so on.

Then when we have some results of the devolatilization we should always consider how to measure the results.

When we use a non-airflow type thermobalance for this purpose the results have a problem which contains the effect of accumulation of gaseous volatile matter from the

fuels.

Furthermore if we have other results of fire points we should also consider which type of thermobalance is better. When we use the non-airflow type these fire points will have another effect of oxygen concentration because the accumulation of volatile matter dilutes its concentration.

The authors have attempted to measure the above devolatilization and fire point by an airflow type thermobalance which is introduced in this study.

This thermobalance is equipped with an oxygen control system in order to change the rate of air flow. Then the results of devolatilization are obtained under the effect of heating rate and the other results of fire point are obtained under the effect of oxygen concentration.

A STRESS ANALYSIS OF AXISYMMETRIC TENSION SPECIMENS BY RIGID-PLASTIC FINITE ELEMENT METHOD

Shigeru TADANO and Hiromasa ISHIKAWA

(Received June 30, 1986)

Abstract

A method of the stress calculation for the rigid-plastic finite element analysis employing the penalty method is presented.

Applying the experimental technique of visio-plasticity, stress is calculated easily and simply from the optimum strain-rate. The optimum velocity field can be obtained by determining adequate values of the penalty constant and by considering the work-hardening effect in each step deformation. The values of the penalty constant have a great influence on the volume change as well as on the increment of the plastic work. Therefore, the most suitable values of the penalty constant is obtained by estimating the energy dissipation rate related to the penalty constant.

This method is verified to be effective from the numerical calculation of the tensile deformation of cylindrical bars.

Freezing Behavior of Layered Air-Liquid Flow in a Circular Tube

Shoichiro FUKUSAKO and Masato TAKAHASHI

(Received June 30, 1986)

Abstract

This paper describes the experimental results of transient freezing characteristics of layered air-water flow in a circular tube, in which cooled air and water flow together. The experiments were carried out under a variety of conditions of air velocity, water velocity, and tube-wall temperature kept uniform less than freezing temperature of water. Special attention was paid on photographical visual observations of the developing ice layer along the tube wall. It was shown that the water level rose based on the growth of ice along the tube wall which was submerged in the water flow then the ice layer along the upper tube wall grew thicker than lower position due to the splashing of the water droplets based on an intense ripple which occurred at an air-water interface.

A Study of Reactive Sputter Etching

— On the Etching Characteristics of Carbon Steel by using various gases —

Toshio YUHTA, Jun OSANAI, Toshikazu SATOH
Tatsuo TAKAHASHI

(Received June 30, 1986)

Abstract

In this study, we have processed carbon steel with the reactive etching method by using various gases.

As a result we obtained the etching characteristics of steel by gas, and also utilyed x-ray photoelectron spectroscopy to examine the cold-worked layer which was produceed after the etching process.

Some results obtained are summarized as follows ; we obtained a large etch rate of carbon steel by using gases which contain abundamt chlorine and which have a large molecular weight. The gas pressure Pmax which has the maximum etch rate is lower than that of CF_4.

In the case of the gases containing chlorine, the values of surface roughness per unit etch rate η, that express the quantity of etching selectivity, are nearly equal to

about 0.2.

But η of CF_4 is several times higher than the maximum etch rate, and it is considered to be due to the difference in etching mechanism.

The thickness of cold-worked layer is about 30 Å, and it consists of oxide iron which contains hematite and magnetite.

A Generalization of Shannon's Sampling Theorem

Mitsutoshi YAEGASHI, Tomomasa NAGASHIMA and Satoru IGARASHI

(Received June 30. 1986)

Abstract

Shannon's sampling theorem is a well known fundamental theorem in relation to discretizing continuous quantities in signal processings. However, the condition to be satisfied by the theorem is much too strong for practical purposes, e.g. sampling intervals must be constant.

In this paper, we propose a new sampling formula which has a condition of not necessarily constant sampling intervals by employing an infinite product as a sampling function. Several examples of numerical calculation are presented.

Carrier Concentration and Composition Profiling for GaAs/AlGaAs Laser Diodes

Takayuki SAWADA* and Arnoldo MAJERFELD**

(Received June 30, 1986)

Abstract

A computer controlled automatic carrier concentration profiler is used to assess GaAs/AlGaAs single layers and multilayers for laser diodes.

For the reliable profiling of high/low-doped multilayers and transition regions between epitaxy /semi-insulating substrate, the definition of electrolyte/semiconductor contact area becomes important, since the capacitance arising from excess side area becomes relatively large. This undesirable area is considerably reduced by using a thick photoresist or a light-tight wax with a large sealing ring, so that the profiling extending for 3 orders becomes possible even for small etching area of about 1 mm^2.

A simple and convenient composition profiling technique for $Al_xGa_{1-x}As$ layers, utilizing the photovoltaic effect of the electrolyte/semiconductor system is also described. The result is consistent with PL measurements.

Simultaneous profiling of the carrier concentration and Al composition is successfully done against GaAs/AlGaAs multilayers.

Optimal Hierarchical Control of the Nuclear Power Plant Using the P P A

Yasuaki YAMAGISHI, Masashi TSUJI and Yuichi OGAWA

(Received June 30, 1986)

Abstract

Optimization of a large-scale system is a very difficult task due to the requirement of an extremely large amount of calculation. One effective way to avoid the difficulty is to divide the system into a number of subsystems and carry out the optimization calculation with each subsystem allowing mutual cooperation among the subsystems to meet the need to optimize the whole system. When an algorithm based on the dividing method is realized in the parallel multi-processor system instead of the conventional computor of series type operation, the efficiency of calculation will be largely improved.

In this paper, using the PPA (Parallel Processor Array) located in the "General Purpose Simulator Facility" of this school, and utilizing the hierarchical structure which is furnished within the PPA system, we prepare a software for the multilevel optimization system, and confirm the effectiveness of the hierarchical algorithm. We then, using the prepared algorithm, design the optimal control of the primary system of two loop PWR power plant, and confirmed the effectiveness of the designed optimal control.

A Support System for Microprogramming based on Architecturel Knowledge

Kazufumi MITANI and Eiichi MIYAMOTO

(Received June 30, 1986)

Abstract

This paper describes a support system for microprogramming which requires programmers to master the sophisticated structure of the micro-architecture and aquire skilled knowledges to use it. The system aims to give support to programmers in writing microprograms without special skills regardeing micro-architecture and microprogramming.

Under the support of the system, the programmer writes microprograms in the high-level language, and the system compiles the micro-instructions. The parsing phase of the system is machine independent and is processed based on typical compiling techniques, while the code generation phase is processed based on architectural knowladges which are represented by three kinds of predicated in PROLOG; "type", "path" and "function". Each means the class of architecture units, interconnections between the units and functions of units respectively.

This system can also be applied to architecture design, because the system is adapted to any architecture by replacement of the knowledges.

NOTICE

No. 134 January 1987

Papers and Reports	Author	Page
1. Premixed Double Concentric Jets Flame with Swirl Flow	K. ITO and K. SONG	1
2. On the Relation between Growth Characteristic and Graphite Nodule Size of Spheroidal Graphite Cast Iron	M. SOHMA	9
3. Effect of the mixing ratio of reactant oxides on the rate of powder reactions in Fe_2O_3 – MeO (Me = Mg and Zn) systems	R. FURUICI, K. KAMADA, Y. YOSHIOKA and T. ISHII	19
4. Development of a Capacitance Method Measuring Wave Configuration on Liquid Film Surfaces	I. MURAI and R. ISHIGURO	33
5. A Evaluation of the Effective Multiplication Factor of a Nuclear Reactor by Using a Parallel Calculation Based on Monte Carlo Technique	T. TAKEUCHI, M. TSUJI and Y. OGAWA	39
6. Oxidation Kinetics of Uranium Dioxide	H. OHASHI, H. HAYASHI, M. NABESHIMA and T. MOROZUMI	49
7. Equilibrium characteristics of hydrogen absorption and release in $FeTi_{1.1}$ reservoir alloy	T. MOROZUMI, K. ITO and T. MIZUNO	59
8. Kinetics of hydrogen absorption in $FeTi_{1.1}$ reservoir alloy	T. MOROZUMI and K. ITO	69
9. On the Behaviors of Errors in the Approximation of Functions by Legendre Polynomials	M. F. KAWAGUCHI and T. DA-TE	79
10. "ICOOS": An Interactive Continuous-System Simulation Software System	K. MAKINO	89

Premixed Double Concentric Jets Flame with Swirl Flow

Kenichi ITO and Kyukeun SONG

(Received September 30, 1986)

Abstract

Swirl flow has been commonly used for the stabilization of the high intensity combustion process. The swirl flow is imparted to the secondary airflow by the swirl vane. Flame stability limits, flame shape, concentration of combustion gas and temperature distribution in the recirculation zone were measured and high speed schlieren photographs were taken. The results indicate that flame stability limits the decrease with the increasing swirl number in weak swirls because the mixing air and mixture deteriorates by the swirl in the recirculation zone. But, the increase with the increasing swirl number in strong swirls is seen the mixing ratio is promoted by the swirl. when there are no swirl or weak swirls, a recirculation zone formed behind the burner rim affects the flame stability. When there is a strong swirl, a recirculaton zone formed by the swirl affects the flame stability.

On the Relation between Growth Characteristic and Graphite Nodule Size of Spheroidal Graphite Cast Iron

Makoto SOHMA*

(Received September 30, 1986)

Abstract

To ascertain the growth theory of irreversible graphite migration again, two spheroidal graphite irons of coarse and fine graphite nodules with the same molten iron were heated cyclically in still air and the relation between the growth characteristics and the change of graphite phase of different size of graphite nodule were investigated. Furthermore, the effect of the size of graphite nodules on the heat-resistance of spheroidal graphite iron was considered theoretically.

The results obtained were summarized as follows;

1) The growth theory of irreversible graphite migration became evident again from the quantitative evidence on the redistribution of graphite followed by growth.

2) Growth characteristic of spheroidal graphite iron with the same chemical composition significantly depended upon the nodule size and the growth-rate of coarse graphite iron that was generally greater.

3) It became clear by the theory of irreversible graphite migration that the heat-resistance of spheroidal graphite iron could be effectively increased by reducing the size of graphite nodules.

Effect of the mixing ratio of reactant oxides on the rate of powder reactions in Fe_2O_3-MeO (Me=Mg and Zn) systems

Ryusaburo FURUICI, Kazuyoshi KAMADA, Yuji YOSHIOKA and Tadao ISHII

(Received September 30, 1986)

Abstract

Two ferric oxide samples, Fe_2O_3 (I) and Fe_2O_3 (II), prepared from ferric hydroxides were calcined at 500, 700 and 900°C for 3h and then were sieved between 250 and 325 mesh. These Fe_2O_3 were allowed to react with MgO and ZnO powder (250-325 mesh) at various mixing ratios (r_m) of the reactant oxides.

The value of r_m was represented by the molar fraction of Fe_2O_3 in the mixed sample. A v-shell blender was operated for 2h to prepare the mixtures of the oxides and a pellet sample was obtained by pressing the mixture (150-300 mg) at 2.7×10^3 kg/cm^2 for 10 min. Isothermal reaction was carried out in air at 800-950°C. The rate of $MgFe_2O_4$ and $ZnFe_2O_4$ formation was found to obey Jander's kinetics, which is based on the diffusion mechanism, but in the case of $ZnFe_2O_4$, an initial rapid surface reaction was suggested to occur before the diffusion process started.

The diffusion rate was observed to change with r_m, that is, the apparent rate constants (k_j or k_{jc}) vs. r_m showed a v-shaped curve with a minimum value near $r_m=0.5$. This fact indicates that the rate depends on the number of contact points between the reactant particles. The rate constants k_A^0 and k_B^0 were calculated; the former is the value corresponding to the situation where MgO (or ZnO) particles are surrounded by only Fe_2O_3 particles and the latter corresponds to that where Fe_2O_3 particles are surrounded by only MgO (or ZnO) particles. The values of k_A^0 and k_B^0 decreased with the increase in the calcination temperature of Fe_2O_3.

Development of a Capacitance Method Measuring Wave Configuration on Liquid Film Surfaces

Ikuo MURAI and Ryoji ISHIGURO

(Received September 30, 1986)

Abstract

Studies on flow characteristics of liquid film falling down along flat surfaces have many fields of engineering application. Exact measurements of wave configurations which are formed on the film surface and those chenging process are the most important to understand the nature of the liquid film kinetics. Among the measuring techniques of the wave configuration the capacitance method has some advantages, because the change in capacitance between the film surface and the probe is picked up without contact to the film itself. However, some problems, which should be improved, are still left. They are, for example, the non-linearity of the probe output with film thickness or drifting outputs due to temperature variations of the system.

In the present report a development of new system is described. The capacitance is measured by the frequency modulation method. A logarithmic circuit is utilized to improve the non-linear character. The data are processed with A-D converter. As a result of much effort, the surface area of the probe, important to the high resolution of wave shape, can be 1/4~1/10 times smaller and the responding speed which is important in observing the changing process, becomes 10~100 times larger as compared with older systems. We finally succeed in parallel running of two systems with high sensitivity and wider band.

A Evaluation of the Effective Multiplication Factor of a Nuclear Reactor by Using a Parallel Calculation Based on Monte Carlo Technique

Toshiaki TAKEUCHI, Masashi TSUJI and Yuuichi OGAWA

(Received September 30, 1986)

Abstract

The effective multiplication factor Keff of a nuclear reactor is calculated by Monte Carlo technique that is a source iteration procedure based on a fixed number of fission points per generation. In this paper, in order to reduce the statistical errors included in the

estimated Keff value by accumlating a large number of neutron histories for a given computing time, a parallel computing technique is applied by using the PPA (Parallel Processor Array) system located in the "General Purpose Simulator Facility" of Hokkaido University. The architecture having this parallel computing machine permits a parallel Monte Carlo calculation such as a Monte Carlo game requried for the estimation of the Keff value. This is carried out in each processor, independent of the other processors and in parallel with each other. For this purpose, we prepare a software that can maximize a computing capability of the PPA system under a unique architecture having the PPA system and some limitations such as a small capacity of a storage memory of each processor. The verification studies by using this software have confirmed that Monte Carlo technique with the parallel computing machine is very useful for three dimensional neutron transport problems as dealt with in this paper.

Oxidation Kinetics of Uranium Dioxide

Hiroshi OHASHI, Hideyuki HAYASHI, Masahiro NABESHIMA
and Takashi MOROZUMI

(Recieved September 30, 1986)

Abstract

Oxidation rates of three kinds of UO_2 of different particle sizes were thermogravimetrically measured as functions of temperature and oxygen pressure. The weight gain-time curves varied markedly with particle size. The UO_2 microspheres for HTGR oxidized in a single stage from UO_2 to U_3O_8, while the UO_2 powder oxidized in two distinct stages from UO_2 to U_3O_7 and then to U_3O_8. The behavior of the crushed UO_2 microspheres was intermediate to the above two extremes, and the weight gain-time curves had plateaux at compositions below U_3O_7. The phenomena were attributed to the delay of the oxidation from U_3O_7 to U_3O_8. For the powder, the oxidation to U_3O_8 started after UO_2 completely converted to U_3O_7. For the microspheres, the oxidation of UO_2 proceeds inwards from the surface of the spheres with UO_2-U_3O_7 and U_3O_7-U_3O_8 interfaces. Because of the nearly equal linear rates of advancement of these two interfaces, the thermogravimetric oxidation curves show as one stage, as if oxidation directly proceeds from UO_2 to U_3O_8. The steady state thickness of the U_3O_7 layer between UO_2 and U_3O_8 was estimated to be 1-2 μm. Further, α-U_3O_7, β-U_3O_7 and β'-U_3O_7 were identified as intermediate oxidation products, and it was concluded that the relative fraction of these products controls the second stage of the oxidation from U_3O_7 to U_3O_8.

Equilibrium characteristics of hydrogen absorption and release in $FeTi_{1.1}$ reservoir alloy

Takashi MOROZUMI, Kunio ITO and Tadahiko MIZUNO

(Received September 30, 1986)

Abstract

Equilibrium isotherms were measured under a variety of experimental conditions during the hydrogen absorption and release processes in a $FeTi_{1.1}$ reservoir alloy, and approximate equations were given for these characteristics. These isotherms exhibited a large hysteresis within a cycle of absorption and release processes, but no perfect horizon was observed in the plateau.

These characteristics were explained by postulating the special nature of the alloy micro-structure, in which storage sites were irregularly distributed with different hydrogen potentials and vacant sites with higher potentials constructed a blockade front line against the penetration of hydrogen atoms into the depth of alloy matrix. From the results of estimation with the above-mentioned equations, it was suggested that a depletion of absorption rate observed at high temperature could be attributed to the decrease of available vacancy.

Kinetics of hydrogen absorption in $FeTi_{1.1}$ reservoir alloy

Takashi MOROZUMI and Kunio ITO

(Received Seprember 30, 1986)

Abstract

Kinetic studies were persued on hydriding of non-stoichiometric iron-titanium reservoir alloy, and the effects of temperature and hydrogen gaseous pressure upon the reaction rate were determined. At temperatures above 273 K, the rate changed in a proportional manner to the square root pressure driving force, $P^2-P_e^2$, and the available vacancy density, $\triangle n_{H2}$. As the most plausible mechanism, non-linear diffusion was postulated, in which the diffusion constant varied with $\triangle n_{H2}$. The potential field assisted diffusion with a finite pressure drop was also suggested as another possible mechanism. At $T < 263$ K, the rate indicated a dependency of higher order upon both of gaseous pressure and $\triangle n_{H2}$, but the exact explanation was not yet obtained.

On the Behaviors of Errors in the Approximation of Functions by Legendre Polynomials

Mayuka F. KAWAGUCHI and Tsutomu DA-TE

(Received September 30, 1986)

Abstract

In the practical use of approximations of functions, unexpected troubles are encountered e. g., the resulting accuracy often drops even if the degree of polynomials for approximation is increased. We deal with a problem of approximating functions by Legendre polynomials, which is one of the most important and useful orthogonal polynomials for approximating functions, and estimate quantitatively both the truncation errors and the computation errors in the approximation.

The problem is to find the best polynomial determining approximate values of a given function on its domain with a required accuracy of values by means of computers of which possible significant digits are not always sufficient. This paper theoretically elucidates how the truncation error reduces and how the computation error increases according to the increase of the degree of polynomials.

The results are shown in the form of curves plotted in the figures of error vs. degree of polynomial, and shown to be almost coincidetal.

"ICOSS": An Interactive Continuous-System Simulation Software System

Keiji MAKINO

(Received September 30, 1986)

Abstract

This paper describes a software system of a CSMP-type continuous-system simulator ICOSS, which is installed in the multi-purpose simulator HOSS in Hokkaido University, which is open to researchers. ICOSS is an interactive on-line simulation system. It is characterized by a trial-and-error process improved by on-line simulation techniques and man-machine communication in the process of the simulation. The program body is composed of only the model description with a simulation environment consisting of separate input and output descriptions. Control operations are a series of system commands issued

in the exectution. ICOSS supports a parallel processing system PPA of a master-slave architecture. It emulates, through ICOSS, a conventional analog computer for high-speed and real-time simulations. The language system and software configuration are also discussed.