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Appendix

Abstracts & Titles, No. 84~86

BULLETIN
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HOKKAIDO UNIVERSITY

NOTICE

No. 84 July 1977

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Convective and Radiative Heat Transfer Coefficients for the Human Body

Tohru MOCHIDA

(Received December 27, 1976)

Abstract

As a general equation to give the mean convective heat transfer coefficient for the human body, an equation which is the sum of the local convective heat transfer coefficients weighted with the skin area ratios was theoretically derived based on the heat equilibrium between man and his environment. In hot and high air velocity conditions, with the above equation derived and Hilpert's dimensionless equation of forced convection, the value of 18 cm was obtained as the diameter of a man-equivalent thermal cylinder from the standpoint of heat transmission by reverse calculation. Further, by applying Oosthuizen-Madan's dimensionless equation which considers both natural and forced convective heat transfer at the same time to a cylinder of 18 cm in diameter, an equation which shows the convective heat transfer coefficient for the human body was proposed and compared with the values and equations of convective coefficients from earlier studies.

A radiative heat transfer coefficient and a radiant temperature with new concepts were derived by extending Gebhart's absorption factor method on reciprocal radiation exchange and by applying it to the space between the human body and the surroundings and by linearizing from the so-called raising to the fourth power radiation law. The new radiative heat transfer coefficient is composed of the emissivity of the human surface, Stefan-Boltzmann Constant and the temperature factor and does not include the emissivity of the surrounding wall surface. On the other hand, the new mean radiant temperature is weighted with the absorption factors between the human body and its surrounding walls.

A Fundamental Study on the Reaction of Molten Lead with Hydrogen Sulfide

Hirohichi KIUCHI, Tetsuo IWASAKI and Tokiaki TANAKA

(Received December 28, 1976)

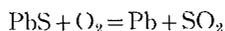
Abstract

The object of this study is to recover H_2 from H_2S which can be obtained from the desulfurization process of petroleum and from acid leaching or hydrogen reduction of sulfide ores. In the equilibrium between metal and H_2S , very high H_2 concentration can be thermo-

dynamically expected. For a solid metal, however, the formation of a dense sulfide film may cause serious interference of further reaction. Such a limitation in reaction kinetics may be avoided by use of molten lead.

The reaction kinetics and mechanism have been investigated by two methods of circulation and single-stage blowing of H_2S through molten lead over a temperature range of 380–790°C. In single-stage blowing, more than 80 vol-% of H_2 concentration was obtained at 790°C, as compared with 99 vol-% H_2 concentration in circulation blowing after several hours. It can be concluded that rate-determined step is in the chemical reaction itself and also that the reaction is markedly accelerated by an addition of a trace of Ni, which may be responsible for catalytic action of Ni dissolved in molten Pb.

As for the reproducing of Pb metal from PbS , the following reaction is available under low oxygen partial pressure:



The Constituent and Morphology of Liquid Sulfide Film in Steel

Hiroshi TAUMI and Kaichi MATSUEARA

(Received December 28, 1976)

Abstract

It has been suggested that hot-shortness of steel is due to the presence of enveloping liquid sulfide film at grain boundaries of steel.

Electrolytically isolated liquid sulfide film from 0.2% C steel was investigated by means of electron diffraction method, electron probe micro-analysis and scanning electron micrograph.

The results obtained are as follows:

- (1) Liquid sulfide film was composed of Q-sulfide with α -MnS crystal structure, containing 19.2% Mn, 44.3% Fe and 36.5% S, and FeS sulfide, containing 0.6% Mn, 62.9% Fe and 36.5% S.
- (2) The flake-like Q-phase in liquid sulfide film was dendritic sulfide.

Measurement of the Temperature Distribution on Urban Surfaces

Takeshi SAITO, Hiroshi TANIGUCHI, Takashi SONODA
Yoshio TASHIRO and Eiichi ISHIDA
(Received December 28, 1976)

Abstract

Rapid growth of a city leads to a change of the surface areas of natural to artificial grounds and results in consuming more energy in the city district. This causes the temperature on urban surfaces to rise and the humidity of the air to decrease.

This paper presents the results of measurements of the temperature on the surface areas of the City of Sapporo. This measurement was conducted from June to July, 1976, and remote sensing was adopted to obtain the temperature distribution, using a multi-spectral scanner and a thermo-camera.

The surface temperatures in the central district of the city showed higher values by about 20°C than that of the green zones in the suburbs, although the temperature showed considerable local differences.

As a result of the present survey, it was suggested that systematic arranging of wide green zones in the urban area is necessary to maintain the thermal environment comfortable for people residing in the city.

Dynamic Response of a Vibro-Impact System to Random Force

— Analogue Simulation —

Toshihiro IRIE, Gen YAMADA and Yoshihiro KOBATA
(Received December 28, 1976)

Abstract

The impact vibration arising when a mass collides with a rigid wall under the action of a harmonic force has been studied intensively in recent years. However, in the literature only a limited number of papers are available on the impact vibration caused by a random force.

In this paper, a computer simulation was carried out on stationary impact vibration arising in such a vibro-impact system under the action of a random force with stationary Ergodicity and a harmonic force including random components by the use of the hybrid computer HIDAS-2000 consisting of digital and analogue computing systems. From the present study, the following conclusions were obtained. When a random force acts on the system with a small clearance, small collisions arise frequently at short time intervals, but deflections, colliding velocities and time intervals between two adjacent collisions become large with the

increase of the clearance. When a harmonic force including random components acts on the system, peak values appear in the vicinity of the frequency and 2, 3, ... and 1/2, 1/3, ... times as many as the frequency of the harmonic force in the powerspectrum density curves. The fact suggests that the fundamental, super- and sub-impact vibrations arise in the system.

Radiation Effect on the Heat Transfer of a Two-Dimensional Laminar Wall Jet

Nobuhiro SEKI , Shoichiro FUKUSAKO and Masahiro SUGAWARA

(Received December 28, 1976)

Abstract

Simultaneous heat transfer by radiation and convection from a wall surface over which a two-dimensional laminar wall jet of an absorbing and emitting gray gas is issued tangentially, is determined by solving a non-linear energy equation combined with both continuity of mass and momentum equation. The governing equations in the present investigation are obtained by considering a boundary layer type of analysis. The study variable parameters adopted is made to clarify the effects of those including conduction-to-radiation, optical thickness on temperature distribution or heat transfer at the wall surface.

Effect of Natural Convection on Equivalent Heat Conductivity of a Vertical Layer Packed with Glass Wool

**Nobuhiro SEKI , Shoichiro FUKUSAKO
and Hideo INABA**

(Received December 28, 1976)

Abstract

This report deals with the effect of natural convection on heat transfer in a vertical layer packed with glass wool of heat insulating material.

Experiments are carried out with air or water as a saturating fluid in the range of the specific weight of the glass wool, γ , from 3 to 50 (kg/m³) and the aspect-ratio H/W from 5 to 47.5.

The effect of the dimensions of cavities, the specific weight of the glass wool γ and the surface temperature of the cold wall T_c on the apparent heat conductivity λ_{eff} is investigated.

The results of the experiments show a strong influence of natural convection on λ_{eff} in the range of $\gamma=3\sim 20$ (kg/m³).

It is clarified that the results for water show a very complicated behavior as compared with those for air.

A Compacting Program for Binary Data File with low Redundancy Codes

Ken-ichi HAMABE, Katsumi FUJITA and Ikuo KAJI

(Received December 27, 1976)

Abstract

A high-redundancy binary file, in which most of the bits are '0', is transformed into a more compact one by means of minimum-redundancy or optimum codes.

9 pairs of transforming (encoding) and decoding programs are made. Each pair has different codes matching to different bit-pattern of data. A property of the bit-pattern of a data-block and a corresponding program to be selected are determined by a bit-1 probability of the block.

The usefulness of an optimum coding regarding each block is also surveyed by the bit-1 probability of the block, and if it seems of no use, such a block is straightly copied without optimizing.

A user of the program can set an upper limit for a relative final size of the optimized file. If this limit is exceeded during an execution of encoding, that execution is soon aborted.

The original data file is recovered from the optimized data file by running it through a decoding program.

An actual performance of the program is presented in this paper regarding a 13-block file on disc-pack, which has different bit-1 probabilities from 4% to 56% for each block. After optimum-encoding with FANO-codes, the length of the optimized data file is shortened into 79% of the original data file.

By decoding of the optimized file and by a cross-reference with the original file, the validity of the whole program is verified.

It requires about 0.11 seconds of CPU-time for 1000 words of the original data, including both encoding and decoding.

Slow-Wave Coplanar Strip Lines on Semiconducting Substrates

Hideki HASEGAWA and Hiroaki OKIZAKI

(Received December 28, 1976)

Abstract

A new type of coplanar strip line on semiconducting substrates, which supports low-loss propagation of a slow quasi-TEM wave at microwave frequencies, is described. The new line is potentially highly useful for monolithic integration of microwave semiconductor devices and also for construction of a new class of distributed functional devices. Propagation modes, design considerations and formulas for fundamental transmission characteristics are presented together with a confirmation of the mode existence by a preliminary experiment carried out on a line piece formed a GaAs substrate.

Speech Recognition by Optimization of Recognition Networks

Hiroshi YOSHIOKA and Yoshinao AOKI

(Received December 28, 1976)

Abstract

In this paper, we discuss optimization of recognition networks and have made an experiment to apply the technique to the recognition of speech.

A recognition network consists of the standard elements that have weighting resistors and a nonlinear logic circuit. The optimization of recognition network is achieved under the condition that a sum of false alarm and miss rates have a minimum value. The minimum point is found by a simplex method that is used to minimize a function of multi-variables. The advantages of this technique are the one-to-one correspondence between the optimization process and physical realization of the recognition network, and the real-time recognition. Whereas the disadvantage is that the optimization by this technique generally terminates on a local minimum.

Speech data are sampled from a continuous speech, a weather forecast broadcasted by NHK. As the recognition parameter we use coefficients of the digital inverse filter obtained through the short-term analysis.

Oxidation or Reduction of Ferrous Sulfate and Other Solid Inorganic Substances Induced by γ -Irradiation

Takashi MOROZUMI, Hiroshi OHASHI, Kiyooki NAKAZAWA
and Takahisa FUNAKOSHI

(Received December 27, 1976)

Abstract

Pulverized solid specimens of ferrous sulfate and another twenty kinds of inorganic substances were irradiated with cobalt-60 γ -ray, and the variations in amounts of oxidative or reductive reactions to the potentiostatically controlled iodide-triiodide redox system were measured. Although most of these substances were more or less oxidized or reduced following irradiation, the irradiation effect was most remarkable on ferrous sulfate. Ferrous sulfate was oxidized by the irradiation and it was shown that the amount of oxidation was almost linearly proportional to the exposure within some limitation. The irradiation effect was quite stable when accompanied by practically no fading for a long cooling period. In this sense, ferrous sulfate seems to be the most feasible material for the solid chemical dosimetry. Since the amount of oxidation of the irradiated ferrous sulfate was strongly dependent upon the amount of hydration, the first step of this reaction may be the decomposition of the water of crystallization. The maximum value of $G(\text{Fe}^{3+})$ was about 6 and it was much smaller than that in the aqueous solution containing this salt.

A Construction of Information Retrieval System as a Problem Solving Machine

Takashi MAEDA, Yoshio MOMOUCHI and Hajime SAWAMURA

(Received December 28, 1976)

Abstract

Various information systems, in particular, information retrieval systems or question answering systems are able to consider as a problem solving machine from the point of the user's view.

In this paper, we have presented a general model of such a system, and described a document information retrieval system as a implementation of such a model. To information structure in this system, a method of analysis of hierarchical semantic structure of document information is applied.

Some features of this system are described with examples for interactive retrieval process which is a process to supply the user's request of document informations.

Algebraic method of Calculating the Moment Generating Function in Gaussian Multiple Distribution

Masaji ONODERA

(Received December 28, 1976)

Abstract

The method of calculating the moment generating function in multiple gaussian distribution having correlations among variables, is given. The derivation is obtained from the investigation of the meanings of the integration of gaussian distribution, one of which is algebraic and the other is geometrical. The method of calculating is equivalent to obtaining a solution of simultaneous equations. The formula obtained is applicable to the calculation of the configurational partition function of ternary solutions.

An Analysis of Hierarchical Semantic Structures in the Documents

Yoshio MOMOUCHI, Takashi MAEDA and Hajime SAWAMURA

(Received December 27, 1976)

Abstract

This paper describes a method for analyzing the semantic structures of data and applications of it to documents. It is assumed that a datum has several components. The semantic structure is represented by an ordered n-tuple of semantic elements. The semantic element is constructed from a semantic feature of the component and a role which the component plays in the datum.

The method is extended to the data with hierarchical structures.

The following analyses which are important in the Document Retrieval System are considered by means of this method: key word analysis, title analysis, abstract analysis, subject analysis, reference analysis.

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Analysis of Dynamic Stability of Beams and Plates by Stiffness Method

Takashi MIKAMI Jin YOSHIMURA

(Received March 31, 1977)

Abstract

A study is made on the parametric stability of beams under axial loads and rectangular plates subjected to periodic in-plan loads. In this paper, the stiffness matrix method is applied for the parametric stability problems of beams and plates of arbitrary support conditions, namely, the finite element method for beams and the finite strip method for plates are developed.

Using this method, the regions of dynamic instability of beams and plates with various boundary conditions are determined, and effects of damping force on the instability region are revealed.

Mean Skin Temperature Weighted with Both Ratios of Heat Transfer Coefficient and Body Surface Area

Tohru MOCHIDA

(Received March 28, 1977)

Abstract

The purpose of the present paper is to present a calculation formula for mean skin temperature, weighted with ratios of heat transfer coefficient and body surface area and also to run a comparison against ordinary mean skin temperature formulas previously proposed.

Although various mean skin temperatures weighted with body area ratio alone has been generally used, if derived by considering the heat balance between man and his immediate environment, the mean skin temperature should include both convective and radiative heat transfer coefficients in addition to the skin area ratios. In the present study, a general equation for calculating mean skin temperature weighted with the heat transfer coefficient and skin area is derived and a concrete calculating formula in the case of dividing the entire human body into six main parts is proposed by substituting definite values into the weighting factors in the general equation.

Theories of Residual Stress Measurements in a Flexible Plate

— Restriction X-Ray Method, Restriction Strain Gauge Method —

Osamu DOI, Akinori YAMAGUCHI

(Received March 30, 1977)

Abstract

General methods to measure residual stress such as X-Ray Method and Strain Gauge Method are hardly applicably to a flexible plate of poor rigidity due to its easy deformability.

The authors propose the theories of new methods to calculate the principal residual stresses in a flexible plate by measuring the surface stress with X-ray on a removing surface or on a non-removing one, or measuring the strain with a resistance strain gauge, restricting the bending deformation of a plate on a rigid surface with known curvatures after each successive thin layer removal.

Theories of Residual Stress Measurements in a Flexible Pipe

— Pressure X-Ray Method, Pressure Strain Gauge Method —

Osamu DOI, Shigeto KUMADA

(Received March 30, 1977)

Abstract

A pipe with large flexibility can hardly satisfy the assumption of rotational symmetry around the longitudinal axis for its easy deformability, so that the usual X-Ray Method and Strain Gauge Method are not applicable to measure the residual stress distributions in the cross section.

The authors submit the theories of Pressure X-Ray Methods and Pressure Strain Gauge Methods for residual stress measurements under the restricted state by proper internal pressure.

Experimental Study of Heat Transfer in a Horizontal Melt Layer Heated at its Upper Wall

Nobuhiro SEKI Masahiro SUGAWARA
Shoichiro FUKUSAKO

(Received March 30, 1977)

Abstract

This paper is concerned with the free convective heat transfer in a melt layer of ice heated at its upper bounding surface. As water has its maximum density at 4°C, the onset of free convection occurs in the melt layer. Therefore, the melting rate of ice becomes more rapid because of the increased heat flux resulting from convection through the layer. From the experimental results, it is recognized that the heat flux q through the melt layer depends remarkably on the temperature of the upper surface T_1 , but there is a region of an almost constant value of q in spite of the increased T_1 . The ratio of the depth of convection layer to that of the entire melt layer, A , proposed by Katto et al.⁹⁾ is a useful parameter for the evaluation of the heat transfer in a melt layer. It is concluded experimentally that critical Rayleigh number associated with the onset of free convection varies from 1700 to 500 with the increased temperature of the upper wall surface.

Heat Transfer in a Vertical Glass Wool Layer under Constant Heat Flux to the Wall

Nobuhiro SEKI Shoichiro FUKUSAKO
Hideo INABA

(Received March 31, 1977)

Abstract

This report deals with the effects of the width of the cavity W , surface temperature of a cold wall T_c and the specific weight of glass wool γ on apparent heat conductivity λ_{eff} (kcal/m h °C) or the coefficient of heat transfer α (kcal/m² h °C) are investigated experimentally under constant heat flux to the wall.

These experimental results are compared with the previous results¹⁾ under isothermal condition. The results under constant heat flux show a decrease of 5~15% of λ_{eff} or α as compared with isothermal condition in a range of $\gamma=0\sim 20$ (kg/m³). On the other hand, in a range of $\gamma>20$ (kg/m³), the results of both wall heating conditions show almost the same values of λ_{eff} or α .

It is clear that the value of λ_{eff} or α is independent of the heating condition of the wall in a range of $\gamma>20$ (kg/m³).

Ultrasonic Holography using an Electronic Reference with Arbitrary Wavefronts

Noriaki ITOH Yoshinao AOKI Kinji TANAKA

(Received March 31, 1977)

Abstract

A technique of ultrasonic holography is proposed, where an electronic reference with arbitrary wavefronts is introduced. A theoretical discussion shows that the reference wave can be simulated by controlling the phase of the reference signals from an oscillator. An experiment was conducted according to the theoretical discussion, where the phase control was carried out using the scanning motion of a receiving transducer and a phase delay circuit. Ultrasonic holograms were constructed by illuminating an object immersed in water with a 1 MHz ultrasonic wave, while the simulated electronic reference and the object signals from the receiving transducer were superposed and detected. The images were optically reconstructed from the holograms, resulting in the validity of the theoretical discussion. Referring to the obtained results, an advanced technique is discussed to simulate an electronic reference with arbitrary wavefronts. For a preliminary experiment a few kinds of wavefronts, such as cylindrical and spherical ones were simulated, where a micro-computer controlled the phase delay circuit. A discussion is made with respect to the availability of the ultrasonic-holographic technique proposed in this paper.

Scattering of Gaussian Laser Beam by Flowing Particles

Nobukatsu TAKAI

(Received March 30, 1977)

Abstract

The light scattered by the particles flowing with velocity fluctuations shows a random pattern with dynamic motion in space. This phenomenon is dependent on both the mean velocity and the velocity fluctuating around the mean. Such a scattered field produced by the particles under illumination of a gaussian beam is investigated statistically in this paper. The analysis of the scattered field shows that the temporal amplitude-correlation function of the scattered field is characterized by the product of two correlation functions: one is concerned with the mean velocity and the other is the velocity fluctuations. When the mean velocity is much greater than that of the velocity fluctuations, the correlation function is governed mainly by the waist width of the gaussian beam. The experiment was conducted by using an in-line heterodyning system for the amplitude-correlation of the scattered field and confirms the theoretical results on its velocity and beam-waist width dependence.

Computer Processing of Mössbauer Spectrum Data

Masaharu OTSUKA Hiroshi OHASHI Takashi MOROZUMI

(Received March 30, 1977)

Abstract

Computer processing was adopted to pick up significant signals from the undefined Mössbauer spectra. A program, by which smoothing and curve fitting was made possible, was devised and applied to the analysis of the Mössbauer spectra of ^{57}Fe enriched iron and other specimens. Although this processing sometimes distorted the absorption peaks, it was quite effective for elimination of noise and finding of exact positions of absorption peaks. Availability of the processing was demonstrated by several examples obtained for ^{57}Fe enriched iron, natural iron, calcined ferric oxyhydroxides, red mud residue and its calcined product.

The Effect of Fe(III)-oxyhydroxides on the Oxygenation of Fe^{2+} Ions

Hiroki TAMURA Kenichi TAKAHASHI Masaichi NAGAYAMA

(Received March 31, 1977)

Abstract

The oxygenation of Fe^{2+} ions is accelerated by the Fe(III)-oxyhydroxides (amor-Fe(OH)₃ and α -, β -, γ -FeOOH) in neutral solutions. For constant pH and $[\text{O}_2]$, the reaction rate is expressed by

$$-d[\text{Fe}^{2+}]/dt = \{k + k' [\text{Fe(III)}]\} [\text{Fe}^{2+}]$$

where Fe(III) represents the oxyhydroxides; k is the rate constant for the "homogeneous reaction" occurring in the solution and k' is the rate constant for the "heterogeneous reaction" catalysed by Fe(III). The value of k' decreases in the order of amor-Fe(OH)₃ > α -FeOOH > γ -FeOOH > β -FeOOH. The catalytic effect is due to the fact that Fe^{2+} ions adsorbed on Fe(III) are more reactive to O_2 than the free Fe^{2+} ions in the solution. For a given pH and $[\text{O}_2]$, k' is equal to the product of the equilibrium constant for the adsorption (K) and the specific rate constant for the oxygenation of the adsorbed Fe^{2+} (k_s). The values for K and k_s were determined as functions of pH and $[\text{O}_2]$ for each Fe(III) species.

Tidal Response of Two-Layer Flow at a River Mouth

Shizuo YOSHIDA

(Received March 3, 1977)

Abstract

This paper describes various features of tidal effects on the behavior of a salt wedge and on an outflow pattern of fresh water.

The studies were performed through experimental work, field observations and theoretical considerations.

The condition upon which the fresh water begins to show a back flow owing to an increase of the tidal action was obtained with a parameter λ which is equal to the ratio of the tidal current to the mean velocity of fresh water.

The critical value of λ was as follows; $\lambda_c = 0.1/\theta$ ($0.1 < \theta < 0.5$) for the experiment and $\lambda_c = 0.006/\theta$ ($0.01 < \theta < 0.03$) for field observation, in which the parameter θ is the so-called Keulegan number. The back flow should occur for a flow with a λ value greater than λ_c .

Further, it became evident that a tidal motion of salt wedge can not be understood without due consideration to internal waves caused by the tidal action, in addition to the direct effect of the tide.

A Construction and Functions in the Fuzzy Question-Answering System

Toshiro HASHIYA Yoshiharu SATO
Tsunekazu ENDO Michiaki KAWAGUCHI

(Received March 31, 1977)

Abstract

The ordinary question-answering systems are regarded to have the following inference mechanism in which the assertions are either true or false and the action-rules are either valid or invalid.

This mechanism is not available for cases including inexact informations and for practical applications.

This report discusses a fuzzy question-answering system with a medical data base. This system is constructed from a natural language analyser, flexible pattern-matching routine, and searching routine for the manipulation of the fuzzy data base. The language analyser is based on the case grammar by C. J. Fillmore and this grammar may be suitable for the Japanese. And we use two inference rules based on Modus Ponens and the equivalent and analogical inference algorithms.

Then, this system can manipulate non-precise and fuzzy information and the mechanism of this system will be useful to approach to human question-answering behavior.

Implementation of a Pascal Compiler for the Computer FACOM 230-75 by the Bootstrapping Technique

Eiichi MIYAMOTO Kenji UEHARA

(Received March 28, 1977)

Abstract

Pascal, which is an ALGOL-like general purpose programming language, was implemented for the computer FACOM 230-75. Generally Pascal is characterized by its powerful facilities of user defined data structures, together with its compact grammar.

This paper deals with the implementation process by the bootstrapping technique, the compiling algorithms, particularly analysis regarding expressions, and run-time data structures. The implemented compiler is written in Pascal itself as a consequence of the bootstrapping technique, so that the compiler is highly flexible for the maintenance and extension of its specifications.

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Neutron Measurement by Solid-state Track Detectors in Mixed Fields of Intense γ Rays and Neutrons

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Abstract

Measurement of thermal and fast neutrons was carried out by solid-state track detectors in mixed fields of intense γ rays and neutrons. Two types of detectors were used in the experiment. The first type is a sheet of mica or polycarbonate set in contact with thorium or uranium foil (fission track detector). The second type consists of a sheet of polycarbonate alone (recoil track detector). Neutron flux distribution was obtained in a fuel element of a sub-critical assembly using the first type of detector. Both types of detectors were used in the determination of the neutron flux in an e-n target of spherical shell structure irradiated by an electron beam from a 45 MeV LINAC. The optimum etching condition and the sensitivity of the second type of detector were determined.

Results obtained from the measurements performed with solid-state track detectors were compared with those by the activation technique. The agreement was quite well. It was found that the solid-state track detector was excellent in the experiment of nuclear reactor physics.

A ${}^6\text{LiF}\cdot\text{ZnS}\cdot$ Polyethylene Mixed Neutron Counter with Spherical Moderators

Masakuni NARITA Yasutomo OZAWA Norio OHTOMO
Sadashi SAWAMURA Takao TOJO Tomohisa MIKADO

(Received August 24, 1977)

Abstract

The variation with neutron energy of the sensitivity of a spherical paraffin moderated ${}^6\text{LiF}\cdot\text{ZnS}\cdot$ polyethylene mixed scintillation counter was experimentally investigated. The extrapolation sensitivity $S_0(E)$ defined for the opaque scintillator ZnS, was determined using time of flight method from thermal to 10 keV and ${}^{252}\text{Cf}$, ${}^{241}\text{Am}\text{-Be}$, D-D and D-T neutrons. The counter with 6.1 cm diameter has an excellent sensitivity from thermal to 10 keV and is particularly useful for determining the rem dose and the fluence rate of intermediated energy neutrons. The good γ -ray discrimination of the counter allows it to be used under a high γ -rays and neutron mixed field.

Measurement of Fast and Intermediate Neutron Spectra by the Time of Flight Method

Tadashi AKIMOTO Masafumi ITAGAKI Yuichi OGAWA

(Received August 31, 1977)

Abstract

Measurement of neutron spectra in an assembly of materials utilized for the fast reactor is recognized to be an effective means to evaluate reactor constants of the materials and calculating procedure of the neutron transport equation which is used in nuclear design of a reactor. The time of flight method utilizing an electron linear accelerator as a pulsed neutron source is one of the effective methods for measuring the fast and intermediate neutron spectra. This report describes the establishment of the experimentation in which problems related to the realization of effective neutron collimator, determination of detector efficiency, discrimination of background counts and so on are discussed based on a comparison of experimentation and calculation, choosing graphite as the constituent of assembly and constructing appropriate data handling code. The experimental results agree quite well with the numerical results obtained S_N code DTF 4-J with 25-group JAERI-FAST set and ABBN set, which indicates high reliability of the spectrum analysis system. Application of this measuring system to other material assembly is straightforward.

Application of the Nonlinear Decoupling Theory to the Control of the Coupled Core Reactor

Masashi TSUJI Yuichi OGAWA

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Abstract

In this paper, the decoupling theory for a nonlinear time invariant system is introduced to the power change problem of a coupled core reactor. Application of this theory allows us to deal with the power change problem, the power regulating problem for a system subject to a large perturbation and the improvement problem of dynamic characteristics which can not be treated by the decoupling theory for a linear time invariant system. But, this decoupling theory can not be applied immediately because the theory requires that all state variables are available and, in general, a reactor has some non-measurable state variables such as the concentration of the delayed neutron precursor. In this paper, this difficulty is overcome by using the observer theory for a nonlinear system.

From simulated dynamic behaviors of the coupled core reactor having the decoupling controller and observer, it was found that the decoupling controller can control the

coupled core reactor in a decoupling manner and give the desired dynamic characteristics of each core and the observer can estimate nonmeasurable state variables with a high convergence rate.

Kinetic study on dissolution of uranium oxides in a nitric acid solution

Hiroshi OHASHI Shunji KATO Takashi MOROZUMI

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Abstract

The dissolution of uranium dioxide, triuranium octaoxide and uranium trioxide was studied in nitric acid solutions of various concentrations at various temperatures. The dissolution rate, in general, increased in magnitude by the sequence of $\text{UO}_2 < \text{U}_3\text{O}_8 < \text{UO}_3$. Uranium dioxide obeyed a linear law in nitric acid of low concentration, while it obeyed a parabolic law at higher concentrations. If the dissolution occurred at temperatures higher than 35°C or in a solution of higher concentration than 3N, triuranium octaoxide invariably obeyed a simple parabolic law. However, at low temperatures or at low concentrations, the dissolution proceeded through two distinct stages, which were separated by an intermediate induction period up to several hours. The first stage, in which the rate controlling step seemed to be the diffusion of a proton through the surface layer formed during the dissolution, obeyed a parabolic law. In contrast, the second stage obeyed a linear law which was interpreted by assuming an electrochemical mechanism. Finally, the dissolution of uranium trioxide obeyed a linear law, and in this case an interpretation was given on the basis of a different electrochemical mechanism.

Anodic Corrosion of Hastelloy-C in Sulfuric Acid Solution

Makoto MORIYA Kazuhito NAKAGAWA Takashi MOROZUMI

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Abstract

The corrosion behavior of anodically polarized Hastelloy-C was investigated in an 1N sulfuric acid solution by using various methods as follows; e.g. potentiostatic and potentiokinetic polarization characteristic measurements, colorimetric analyses of the dissolved alloy elements and ESCA method.

Both of the two kinds of polarization characteristic measurements gave results indicating that the alloy behaved in three different ways according to the potential from -0.2 to 1.0 Volt vs S.C.E. Below 0.2 V, although iron tended to selectively dissolve,

the total amount of dissolution was very slight and the alloy was almost maintained in a passive state. At the potential between 0.2 and 0.8 V, local attack of the alloy and selective dissolution of molybdenum were observed. The electrolytic current reached its maximum value at 0.6 V, and a steep rise of the current was observed at about 0.9 V. Above the latter potential, the alloy was uniformly attacked and all elements dissolved in proportional manner to their alloy contents. Different ESCA spectra were also obtained according to the polarization potential.

The Vibrational Relaxation in Molecular Crystal Studied by Cold Neutrons

Kazuhiko INOUE Yoshiaki KIYANAGI Hirokatsu IWASA
Yukio SAKAMOTO Tsutomu OHKUBO

(Received August 31, 1977)

Abstract

A differential scattering cross section for cold neutrons was calculated, using a model of molecular crystals in which a molecule performs consecutive transitions between two different vibrational states. The elastic scattering process is not a true elastic process but a quasi-elastic one. In the case of molecular crystals containing hydrogen bonds such as uracil and nucleic acid bases, vibrational relaxation of low-lying external mode are believed to occur. Using the model developed, the observed neutron spectra of uracil can be explained for a value of mean time of consecutive transitions longer than 10^{-11} seconds.

Liquid Structures of Concentrated Aqueous Electrolyte Solutions Determined from Neutron Scattering Data

Norio OHTOMO

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Abstract

Many workers have studied the "structures" of liquid water and aqueous solutions of electrolytes by means of various methods. Neutron scattering method has proven to be a very useful tool in elucidating the structures of various liquids. We have proposed a "revised watery model" for the "static" structure of water based on our diffraction data by means of LINAC neutron diffraction method. The model has a basic arrangement of molecules in a form of tetrahedrally-coordinated star-pentamer, namely a small cluster, in its short range order. From a view point of the small cluster structure model of

liquid water, we have made some discussions on the “structures” of concentrated aqueous electrolyte solutions. The “static” structures for electrolyte solutions have also been studied by neutron diffraction method and informations of the dynamic structures have been obtained from self-diffusion coefficients determined by neutron quasi-elastic scattering data. These “structures” are closely dependent on types and concentrations of ions.

Coarse-Graining of Fluctuations and Preservation of Normality

— A Review of At-Power Reactor Noise Theory from the Statistical Mechanical View Point —

Keiichi Saito

(Received August 30, 1977)

Abstract

Rooted on the rapidly developing non-equilibrium non-linear statistical mechanics, at-power reactor noise are now better understood, in that it feeds back to and nourishes the original discipline of the mechanics. The reactor noise patterns accumulated in the course of the process is stored and exchanged on the basis of an international cooperation for a highly qualified utilization.

Electrical and Thermal Instabilities and Their Suppression in Thermally Equilibrium MHD Plasma

Yasutomo OZAWA Naoyuki KAYUKAWA Taichi KON
Shigeo YATSU Yoshiaki AOKI

(Received August 31, 1977)

Abstract

Transition processes from the, diffuse discharge to the constricted and/or filamentary arc discharge were analysed for the MHD plasma-electrode contact region. The variational analysis for such an instability problem was successfully carried out. It was clarified that Hall's effect was one of the most influential parameters giving rise to the occurrence of the electrothermal instability. It was also concluded that by use of the spatially non-uniform magnetic field, which declines sharply within the hydrodynamical boundary layer was most effective in order to suppress the instability.

Experiments on the Energy-loss of Proton under Channeling along the $\langle 111 \rangle$ axis in Silicons

Tetuya HAGA Ikuo TORIMI
Tuneharu SHIOJIRI Yutaka ABE

(Received August 31, 1977)

Abstract

Experiments on the energy-loss of channeled protons along the $\langle 111 \rangle$ axis of silicon single crystals were carried out over a range of medium incident energies. The experimental results did not obey the "equipartition rule" in this energy range and this fact suggested that both close collisions and collision with distant plasma resonance were responsible for the energy-loss of the channeled protons.

The contributions of valence electrons and core electrons to the energy-loss were investigated according to the theory of Dettman and Robinson. It was pointed out that the main physical origin of the deviation of experimental results from the theoretical calculations was due to the overestimation of valence electron contribution in this energy range.

The Crystal Growth of Layered Semiconductor InSe and its Electrical and Optical Properties

Kazuaki IMAI Yoshimichi HASEGAWA Yutaka ABE

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Abstract

The existence of several, well-defined temperatures of phase transitions in indium selenide was found experimentally. We carried out the specific heat measurement, X-ray analysis, electrical-conductivity and dielectric-constant measurements, respectively.

Between room temperature and the melting point of InSe, it was found that specimens evacuated in a quartz ampoule have two characteristic temperatures, i.e. 156°C and 554°C, at which points the specific heat shows sharp peaks. Under pumping by a vacuum rotary-pump, InSe has the following three characteristic temperatures. At 156°C the measurement of temperature dependences of the electrical conductivity σ and the dielectric constant ϵ show anomalous kinks. At 230°C the thermal expansion and ϵ give rise the discontinuous changes, whereas, at 360°C the X-ray analysis, σ and ϵ give anomalous changes. Under vacuum pumping conditions and above 360°C, InSe cannot be considered to have a layered structure such as D_{6h} , D_{3h} or C_{3v} ; a complex change in crystal structure ensues.

Through these experiments, we can obtain mono-phase InSe crystals. Using this crystal, the optical properties of InSe are given at room and liq. N₂ temperatures.

**Study of Adsorption and Decomposition of Formic
Acid on Clean Surface of Nickel by means of
SIMS-FDS-AES Combined System**

Toshiro YAMASHINA Kuniaki WATANABE
Mamoru MOHRI Masao HASHIBA

(Received August 31, 1977)

Abstract

The catalytic decomposition of formic acid was studied by a combined system of SIMS (Secondary Ion Mass Spectroscopy)-FDS (Flash Desorption Spectroscopy)-AES (Auger Electron Spectroscopy). Deuterium labeled formic acids (HCOOH, DCOOH and HCOOD) were used to clarify the reaction mechanism. SIMS measurements revealed that the adsorption layer after exposure to DCOOH at room temperature mainly consisted of D, O, OD, DCO and DCOO. As the temperature of the sample was elevated linearly, DCO⁺ and D⁺ ion signals disappeared completely from the surface at 380 K and 450 K, respectively. The activation energy of DCO (a) dissociation into D (a) and CO (a) was estimated to be 7.7 kcal/mol from the changes of the surface concentration. FDS showed that the decomposition products were D₂, CO₂ and CO. D₂ and CO₂ had a peak at 360 K, and CO at 410 K. The activation energies for desorption corresponding to these peaks were estimated to be 20-22 kcal/mol for D₂ and CO₂, and 29.5 kcal/mol for CO. A reaction mechanism was proposed based upon the results obtained from the SIMS-FDS-AES combined system. The usefulness of this system for analysis of heterogeneous catalysis was demonstrated.

**Heat Transfer around a Circular Cylinder
in Liquid Sodium Crossflow**

Ryoji ISHIGURO Toshiaki KUMADA Kenichiro SUGIYAMA

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Abstract

The local and average heat transfer coefficients are experimentally determined for sodium flow normal to a circular cylinder. A sodium loop with special specifications is designed for the purpose. The measurement covers the range of Reynolds number 360~16,900 with three test cylinders of different diameter. The data are compared with the analytical values obtained by Grosh and Cess under the assumption of inviscid flow. Their analysis predicts satisfactorily heat transfer coefficients at the front part of a cylinder where a boundary layer is developing. However, the experimental data are much smaller than the analytical values over the region beyond separation point.

It is concluded that the assumption of inviscid flow leads to large errors in the prediction of both local and average heat transfer coefficients even in such a fluid of low Prandtl number as sodium. A numerical analysis is also tried under the assumption of viscous flow at a Peclet number of 7.8 and is in agreement with the experimental data in reasonable accuracy.

Pulse radiolysis Studies on Radiation-induced Polymerization reaction of α -Methylstyrene

Meiseki KATAYAMA

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Abstract

Pulse radiolysis studies on the polymerization reaction of α -methylstyrene was summarized. Pulse radiolysis with optical measurements as well as electric conductivity measurements showed that anionic radicals are very important intermediates in very dry system. These facts, together with the fact that the radiation-induced polymerization of α -methylstyrene is greatly accelerated by drying the monomer strongly indicate that the anionic radicals play a very important role in the polymerization.

Measurement of a θ -Pinch Plasma by Holographic Interferometry

Yasutomo OZAWA Takeaki ENOTO Yuichi YASUTOMO

Shun-ichi Himeno Katsuyuki Miyata Masayasu Tanjo

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Abstract

Since the holographic interferometry has great advantages of experimental simplicity and flexibility associated with common path interference, it may be said that the holographic interferometry is a new plasma diagnostic method having excellent spatio-time resolving power.

Although end-on holographic interferometry of a linear theta pinch plasma has been carried out thus far, in this paper we report side-on holographic interferometry of a two-coil mirror-type theta pinch plasma and the results of the measurement of magnetic field distribution by multi-coil magnetic probes. Both results show that electron densities at the midplane of the mirror field is extraordinarily high. This is caused by the injection of plasma from both theta pinch coils and the confinement effect by the mirror field.