



Title	Summary International Reports, July 1986-June 1987
Citation	Memoirs of the Faculty of Engineering, Hokkaido University, 17(2), 185-261
Issue Date	1987-12
Doc URL	http://hdl.handle.net/2115/38023
Type	bulletin (other)
File Information	17(2)_185-262.pdf



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International Conference on
Computational Engineering
Mechanics (ICCEM), Beijing
China, 21-25 June 1987

Collocation Method for Free Vibration Problems in Structural Mechanics

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The purpose of this paper is to develop an efficient and accurate numerical method for free vibration analysis formulated as a two-point boundary value problem. The method presented herein is a collocation method. This is a weighted residual method in which the collocation points are taken as the roots of orthogonal polynomial. Although the method is well known in chemical engineering, the application of this method to problems in structural mechanics, especially eigenvalue problems, is comparatively limited.

In the present formulation, the equations of motion include the effect of shear deformation and rotary inertia for application to thin and moderately thick structural members. The versatility and accuracy of the method are demonstrated through numerical examples of various types of structures.

International Symposium on
Fundamental Theory of Rein-
forced and Prestressed Con-
crete, Nanjing, China, Septem-
ber 18-20, 1986

Punching Shear Strength in Free Edged Reinforced Concrete Slabs

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Yoshio KAKUTA
Dept. of Civil Engineering, Hokkaido Univ.

The purpose of this study is to examine experimentally the influence of free edges of a reinforced concrete slab on its punching shear strength. The results of the experiments show that the decrease of the average strength per unit length of the critical section takes place as well as the shortening of the length of the critical section occurs as the load approaches the free edge. It was found that the ultimate load of the slab subjected to the load near the free edge is only a half of the load without any effect of the free edges.

20th International Conference
on Coastal Engineering
November 9-14, 1986. Taipei,
China

Irregular Wave Transformation Affected by Opposing Currents

Shigeki SAKAI, Kenji HIYAMIZU and Hiroshi SAEKI

The aim of this study is to clarify the effect of opposing currents on the shoaling of irregular waves experimentally. A transformation model of irregular waves affected by opposing currents was set forth. A formation for the transformation of regular waves to individual waves of an irregular wave train is also proposed.

Coastal Sediments '87 May 12
-14, 1987. New Orleans,
Louisiana, U.S.A.

Sediment Transport in a Sheet Flow Regime

Masaki SAWAMOTO and Toshihiko YAMASHITA

A series of experiments on sediment transport was carried out in an U-shape tube under conditions of sheet flow motion. The sediment motion, transport rate and velocity distributions were measured. A 1.5 power relation between transport rate and bed shear stress was determined. The limit of sheet flow motion is also discussed.

20th International Conference
on Coastal Engineering
November 9-14, 1986.
Taipepei, China

Wave Height Decay Model Within A Surf Zone

Shigeki SAKAI, Kenji HIYAMIZU and Hiroshi SAEKI

The breaking waves within a surf zone play an important role in the generation of nearshore currents, the transportation of sediments and so on.

A new model of wave decay due to spilling breakers both in outer and inner regions was proposed, in which the development of the foam region is taken into account. It was found that this model explains the rate of wave decay fairly well, and that the optimum value of the correction

coefficient is 2.3-2.5 and it was also found that the optimum breaking coefficient varies with the slope of the beach.

IAHR International Symposium on Ice Problems
August 18-22, 1986. Iowa City, Iowa, U.S.A.

Testing Methods for Adfreeze Bond Strength Between Sea Ice and Various Materials

Hiroshi SAEKI, Naoki NAKAZAWA, Toshiyuki ONO, Eiji L. SUENAGA
and Takahiro TAKEUCHI

This paper summarizes the adfreeze bond strength experiments between sea ice and various commonly used construction materials for offshore structures such as concrete, steel and various coatings. Three testing methods (push out test, pull out test and twist test) were used in this study, and the following conclusions were drawn from this study: (1) The three testing methods developed by the authors showed no great difference for adfreeze bond strength. (2) When adfreeze bond strength experiments are conducted, the test pile material surface must be analyzed, and the push out method is recommended for laboratory tests because of the ease in conducting the test as well for obtaining test samples.

Proceedings of the 1st International Conference on Ice Technology July 10-12, 1986. Cambridge Mass. U.S.A.

Experimental Study on Permeability Coefficient of Sea Ice

Hiroshi SAEKI, Takahiro TAKEUCHI, Masafumi SAKAI
Eiji L. SUENAGA

Recently, caisson type structures have been in use for offshore structures, such as artificial islands and oil drilling rigs, in extremely cold regions. As the liquid filling the caisson freezes, the internal pressure rises. It has previously been verified that this pressure rise, due to an increase of volume caused by ice growth, depends strongly upon the permeability coefficient of sea ice. Presented in this paper are results of experiments on the permeability coefficient of sea ice required to estimate the internal pressure. The following conclusions have been obtained from this investigation. (1) Saline water percolation in sea ice due to internal pressure in caissons can be described almost entirely by Darcy's law. (2) The permeability coefficient increases with both temperature

and salinity of sea ice. (3) The permeability coefficient is presented as a function of void ratio, the sum of included brine volume and air volume in sea ice.

International Conference
 "ROOMVENT 87" June 10th,
 11th and 12th. Stockholm
 Sweden

**On the Ventilating Characteristics
 of Space under the fluctuating Wind Pressure**

T. SASAKI, M. HAYASHI and N. ARATANI
 Department of Architecture

The swings of the air through the cracks will be dominated not only by the static resistance of crack but also by the depth of the crack, the air volume behind the crack and the dynamic features of the wind pressure.

The authors made an experimental test enclosure with a typical crack and a large cone type speaker which produces typical sine waves and have recorded the actual fluctuation of wind pressure and also have measured the air change number of the enclosure. The authors also led forth a new calculation method of natural ventilation under the conditions of fluctuating wind pressure. The results of this new method is almost the same as the measurement. When the standard deviation of fluctuating wind pressure becomes greater, the difference of the results of calculation between the new method and the ordinary statical methods becomes remarkably larger.

International Conference
 ROOMVENT-87, Air Distri-
 bution in Ventilated Spaces,
 Stockholm, Sweden, June 10
 -12, 1987.

A Feasibility Study on Open Cooling
 — The Characteristics of Buoyant Ventilation through
 High Side Openings

M. ENAI, N. ARATANI, K. KUBOTA and H. MATSUMURA

The most of cooling equipment is designed assuming that a building is a closed system. Even if it is cooled, the distribution of air temperature will be affected by the remnant heat of the inhabitant, lighting etc and a warm zone will always appear at the ceiling level. When cool air at the floor level is not adversely affected and warm air is exhausted nondiffusely through openings

at the ceiling level by buoyant ventilation, the thermal environment will be improved and also the cooling load will be reduced. Recently, floor heating systems are being used in office buildings. The system can also provide floor cooling by circulating cool water. Similarly the thermal storage of an earth floor can be used to increase comfort at the floor level in summer.

In this report, the feasibility of open cooling will be examined in such a building. And the authors will examine the state of non-diffusible warm air exhaust, and the inflow-depth of fresh air through openings in a model. We observed the air circulation visually by the aid of a laser. The tracer particles used were magnesium-carbonate dust. In the numerical analysis by using the successive integration method, we tried to divide a room into three parts (upper, middle and lower), and to discuss the characteristics of its thermal environment which manifested an inhomogeneous distribution of temperature.

ASME International Symposium on Cold Region Heat Transfer, Edmonton, Canada, June 4-6, 1987.

**An Analysis of the Thermal Environment of Buildings
using Surface Conductance as a Variable**

M. ENAI, N. ARATANI and Y. SHIRATORI

This paper analyzes a method for predicting transient heat-transfer in a large building, assuming a quasisteady heat state between the building members and the room air temperatures. Also, this paper shows the calculation results based on the presentation model and compares them with the traditionally used model. And the effect of heat-transfer for heating and cooling will be discussed with reference to the regional characteristics.

The Middle East and Mediterranean Regional Conference on Earthen and Lowstrength Masonry Buildings in a Seismic Area, Ankara Turkey, Aug. 1986.

Seismic Response of Residential Houses in Urban and Rural Areas as Revealed by an Intensity Questionnaire Survey in Greece

Antonios POMONIS, Hiroshi KAGAMI and Yutaka OHTA
Department of Architectural Engineering
Faculty of Engineering, Hokkaido University

To cover the lack of in sufficient instrumental data and for figuring the increased seismic vulnerability of rural areas in Greece, a comparative study by means of seismic intensity questionnaire survey was conducted in two selected (urban and rural) sites in Central Greece, where severe damage was experienall during the 1981 Corinth earthquakes. High precision intensity values were obtained in such a way as to indicate clear intensity differences, which cannot be explained either by the difference in the source distance on by the influence of the geological conditions. of the site the survey showed remarkable structural type distribution and contrastive features in the seismic responses of residential houses between the urban and the rural area that resulted in increased damage in the rural area. In combining such obtained questionnaire data with those from field inspections immediately after the earthquake the occurrence of empirical knowledge for the vulnerability characteristics of residential houses was significantly developed.

The Middle East and Mediterranean Regional Conference on Earthen and Low Strength Masonry Buildings in Seismic Area, Ankara, Turkey, Aug. 1986.

Earthquake Casualty in Rural House : Occurrence Mechanism and Assessment

Yutaka OHTA, Hiroshi KAGAMI and Hitomi OHASHI
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Faculty of Engineering, Hokkaido University

In this paper we deal with earthquake casualties from two different view points. One is a macro and statistical analysis for taking a bird's eye view of casualty occurrence characteristics among countries based on the database compiled by NOAA, USA. In a comparison of human victims with monetary losses, the casualty features were characterized so that the earthquake

-prone countries are classified into three groups. The other one, the main topic in this paper, is a more minute analysis to disclose how occupants suffer death and injuries in an earthquake, based on a variety of field surveys in Turkey as well as in Japan. Investigated are not only the seismic resistance of houses and the distortion of indoor space safety but also the deterioration of behavioral performance of occupants themselves. We attempted a construction of a semi-empirical equation for assessing the occupant casualty rates in houses in a form in proportion to the structural vulnerability function having a correction term depending on indoor space-environmental, occupant-behavioral and occurrence-time factors. The derived equation was found applicable to the seismic casualty risk evaluation for the occupants in typical houses in Turkey, Japan and other countries and therefore would be beneficial to the pre-earthquake countermeasures.

Fourth US. National Conference on Earthquake Engineering, Charleston, SC, USA, Sept. 1986

A U.S.-Japan Comparison on Earthquake Disasters Using 1900-1979 Damage Data Statistics

Hitomi OHASHI

School of Architecture, University of Southern California

Yutaka OHTA

Department of Architectural Engineering

Faculty of Engineering, Hokkaido University

Among a number of countries in the world which have suffered frequent earthquake disasters, the United States and Japan are the most interested in and most concerned with earthquake engineering studies and disaster prevention measures. Thus it is very important to recognize the damage characteristics and earthquake environment of the two countries to mutually benefit from disaster experience and efforts toward preparedness and prediction. We seek to promote better communication and cooperation among researchers and planners involved in this problem.

This paper briefly compares and examines earthquake disasters and their affecting factors in USA and Japan using a worldwide catalogue of significant earthquakes by NOAA, USA in which 1900-1979 earthquake damage data are well compiled. It was found that Japan has suffered more fatalities and property losses than USA, and that in both countries, the number of damaging shocks and property loss have increased corresponding to population increase and economic development.

Eighth European Conference
on Earthquake Engineering,
Lisbon, Portugal, Sept. 1986.

**Characterization of Earthquake Disasters in Several Tens of
Countries by Worldwide Earthquake Damage Data in 1900-1979**

Yutaka OHTA, Hiroshi KAGAMI, Shigeyuki OKADA and Hitomi OHASHI
Department of Architectural Engineering
Faculty of Engineering, Hokkaido University

A statistical analysis for characterizing earthquake disasters in several tens of countries was made based upon the Significant Earthquakes 1900-1979 Database compiled and published by NOAA, USA.

Characteristic features of earthquake disasters from country to country were discussed in terms of indices of casualty and monetary loss. Earthquake-prone countries were thus classified into three major groups according to the damage details, and such grouping was found to have a good correlation with seismic activity and social backgrounds. A method for improved earthquake preparedness in a worldwide sense was proposed.

Eighth European Conference
on Earthquake Engineering,
Lisbon, Portugal, Sept. 1986.

**A Dense and Precision Survey of Seismic Intensity as an Effective
Tool in Engineering Seismology**

Yutaka OHTA, Shigeyuki OKADA, Hitomi OHASHI and Hiroshi KAGAMI
Department of Architectural Engineering
Faculty of Engineering, Hokkaido University

This paper briefly reports the dense and precise determination of seismic intensity by a questionnaire method advanced in both survey scheme and subsequent data processing and its application to engineering seismology. Following a short description of the survey procedure, a few examples of the applications to drawing minute isoseismal maps, and to exploring seismic sources and path characteristics, and further to elucidate microzoning characteristics in urban areas are given by the intensity data from a case study for the 1982 off-Urakawa, Hokkaido, Japan earthquake. The obtained results are found satisfactory through various comparisons with instrumental and other data.

Eighth European Conference
on Earthquake Engineering,
Lisbon, Portugal, Sept. 1986.

Semi-Empirical Equation for Estimating Occupant Casualty in an Earthquake

Yutaka OHTA, Hitomi OHASHI and Hiroshi KAGAMI
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Faculty of Engineering, Hokkaido University

Based on the analysis of field data on occupant casualties due to disastrous earthquakes in Japan, a semi-empirical equation for estimating the personal risk to injury and death was constructed. Four major factors of the seismic input motion measured in terms of seismic intensity, the physical environment in which people spend their daily life, the behavioral performance of occupants themselves and the occurrence time of an earthquake, are considered. First an equation sufficient for estimating the occupant casualty rate was derived and then extended so as to describe the personal risk of casualty from light injury to death.

12th International Congress on
Acoustics, Toronto, Canada,
24-31 July 1986.

Sound Propagation over a Depressed Road Having Finite Impedances

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Faculty of Engineering
Hokkaido University, Sapporo 060 Japan

This paper describes a new theory to be used for predicting the effect of depressed road as a noise control method. In the immediate terrain of the depressed road, the projecting part of the terrain would act as the shield for the noise produced by the traffic flow. In order to develop the theory, we must describe the sound propagation from a point sound source over the terrain having a wedge-shaped part, that is, the depressed road whose surfaces have their characteristic surface impedances. Using our resultant theory, we compared the calculated results with the results of measurements conducted both indoors and outdoors.

The 6th International Heat
Pipe Conference, Grenoble,
France, May 25-28 1987

Transient Heat Transfer Characteristics of Heat Pipes

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Transient heat transfer characteristics of heat pipes were investigated. A heat pipe model, i. e. structural model, was proposed for analyzing the thermal response. It was shown that the important parameters for prescribing the transient heat transfer characteristics were Y^* , that signified the ratio of heat transferred in a radial direction to that in the axial one, and H^* which was a nondimensionality of the convective heat transfer coefficient of cooling water, respectively. Furthermore, analytical considerations were carried out for other heat transfer models although these were included in special cases of the structural model. Experimental investigations were carried out for typical heat pipes and thus obtained results of heat transport response were compared with the predicted ones. It was shown that the estimation of transient heat transfer characteristics seemed to be possible by the structural model with suitable values of Y^* and H^* corresponding to the actual heat pipe system.

Nigeria-Japan Joint Confer-
ence on Trace Metal,
Diarrhoea, Goitre, Medical
Entomology and Epidemiology
Studies, Jos, Plateau State,
Nigeria, April 30-May 2, 1987

Comparative Study on Trace Elements Levels in drinking Water of Jos in Nigeria and Several Japanese Areas

Mizoguchi, I.*, Ubom, G.A.**, Noda, C.***, Sasano, H.**** and Tsuchiya, Y.****

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**Department of Biochemistry, University of Jos

***Institute of Agricultural and Biological Sciences, Okayama University

****Department of Environmental Health, Tokyo Metropolitan Research Laboratory of Public Health

Concentration and distribution of trace elements in water samples from Jos area were compared with water qualities of several Japanese areas. Levels of trace elements such as Cu(0.001-0.009mg/l), Cd(0.001mg/l) and Pb(trace-0.006mg/l) detected in tap water of Jos area were similar

to those of Tokyo Metropolis. Diagrams of water characteristics were drawn by plotting the figures of concentrations of Na, K, SO₄, Cl, NO₃, SiO₂, Ca and Mg in surface water. The diagram of Jos was extremely small compared with those of Tokyo and the average of world river water. The diagram of well water in Jos suggested that waste and sewage from daily human activities polluted well water. Though Jos area has many tin mines, Sn, Cd, Pb and Cu were not detected in surface and underground waters. This result indicates that the mines have no effect on the water quality.

8th International Symposium
on Jet Cutting Technology,
Durham, England, September
9-11, 1986

Application of Water Jet Technology at Coal Mines in Japan

—Water Jet Drilling for Large Diameter Stress Relief Borehole in Coal Seams—

Kotaro OHGA and Kiyoshi HIGUCHI
Faculty of Engineering, Hokkaido University
Sapporo, 060, Japan

The fundamental tests were carried out at Akabira and Taiheiyo coal mines to drill large diameter boreholes in coal seams by using water jets.

In this report the results of these tests are described. The stress relief in coal seams by this method is as effective as by the conventional method and penetration speed by this method is 3.5 times as fast as other methods.

The International Symposium
on Coal and Safety, Seoul
Korea, April 22-24, 1987

Large Diameter Relief Boring by Using Water Jets in Coal Seam As a Countermeasure to Prevent Gas Outbursts

Kotaro OHGA and Kiyoshi HIGUCHI
Faculty of Engineering, Hokkaido University
Sapporo, 060, Japan

In this report the results of large diameter stress relief drilling tests in coal seams using water jets are described.

The stress relief in coal seams by this method is effective as by the conventional method and the penetration speed by this method is 1.5 times as fast as by the other method. At the end of this

paper the results of the preliminary tests for making slits in coal seams to relieve the stress in them effectively are described.

International Symposium on
Modern Coal Mining Tech-
nology Fuxin, China, Septem-
ber 15-18, 1986

Mine ventilation Control Using Fuzzy Sets Theory

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Gensei Riyu

Fuxin Mining Institute, Fuxin, Peoples Republic of China

It is shown that the aerodynamic resistance change of an airway in the main part of network has only a small effect on the working points of the main fans. In order to adjust ventilation in the airway using a local fan with thyristor control, the airflow rate under non-steady state conditions with an abrupt pressure change is derived. The applicability of fuzzy sets theory to ventilation control used in conjunction with an air velocity sensor, a computer and a local fan with thyristor control is considered by computer simulation.

The AusIMM Illawarra
Branch, Ground Movement
and Control related to Coal
Mining Symposium, New-
castle, Australia, August, 1986.

Summary of Japanese Coal and Gas Outburst Experiences and Measures taken against the Problem

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Kiyoshi HIGUCHI

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From statistics, it was confirmed that Japanese coal and gas outbursts have occurred frequently in the district of geological disturbance, symptoms immediately before outburst occurrence were phenomena in connection with failure of a coal seam and outbursts occurred frequently when the number of boreholes were not sufficient for degassing. Then it was described that fundamentally the improvement of degassing and stress relief methods and elevating of working efficiency might

be the the base of outburst protection.

Materials Research Society
1986 Autumn Meeting, Boston
December 3-6, 1986

Rolling anisotropy of Ni₃Al

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**Hokkaido Polytechnic College, Otaru

Ni₃Al has the L1₂ structure, which is the ordered fcc structure, and the intermetallic compound has a somewhat better plasticity among other intermetallics. While a sheet of Ni₃Al single crystal is rolled, the sheet shows a strong anisotropy when the sheet plane is (011), whereas when the sheet plane is (001) or (111) plane no anisotropy is observed. The process is simulated as a compression stress is working between two rolls and a tensile stress is applied in the direction of the rolling. The change in Schmid factor of the slip systems which can be activated by the compression stress as a function of the rolling direction has a close relation to the rolling anisotropy and work hardening.

4th International Symposium on
Flow Visualization Paris,
August 26-29, 1986

Buoyancy-Thermocapillary Convection in Rectangular Tanks with Evaporation by Laser Holographic Interferometry

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Wen-Jei YANG

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Steady and transient buoyancy-thermocapillary convection in rectangular tanks with evaporation were experimentally studied by means of the real-time laser holographic interferometry. The tank filled with ethyl alcohol had the side walls and the bottom insulated and two plexiglas windows installed at the ends for optical passage. A fine Nichrome wire connected to an electrical

power source was placed on the liquid surface at the tank center. It acts as a line source to induce surface tension gradients on the surface. The evaporation rate of ethyl alcohol was varied by changing the porosity of a perforated cover which was placed 10 mm above the free surface. The study has disclosed the existence of three distinct flow mechanisms: surface tension-driven convection, buoyancy-driven convection and mixed convection depending on the relative magnitude of surface tension gradient, buoyancy effect and evaporation rate. Each flow mechanism is characterized by its unique flow structure. The effects of the aspect ratio on flow structure are also determined.

8 th International Heat Transfer
Conference, San Francisco
August 17-22, 1986

Radiant Transfer in Gas Filled Enclosures by the Radiant Energy Absorption Distribution Method

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and Masahito OGUMA

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A radiant heat ray method is employed to determine the radiant energy absorption distribution in a nonisothermal enclosure filled with nonisothermal gas. This method eliminates the complexity of the zoning method in calculating the surface-surface, gas-gas and gas-surface direct exchange areas. It can also deal with the nonuniformity of the gas absorption coefficient and in a cylindrical enclosure reveals that the radiant heat ray method requires less computation time and yields more accurate results than the Monte Carlo method in determining the absorption distribution.

A combined method is developed which utilizes the absorption distribution as the data base for predicting the distribution of temperature and heat flux within an enclosure. The applications of this method are demonstrated by two systems: a continuous heating furnace and a marine boiler furnace. Theory is in good agreement with the field tests. The ultimate goal of the absorption method is to diagnose the enclosure radiation characteristics to find a means for homogenizing the surface heat transfer.

9 th International Conference on
MHD Electrical Power Gener-
ation, Tsukuba November 17-21,
1986

Heat Transfer Analysis in Radiating Gas with Solid Particle Suspension by Monte Carlo Method

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Satoshi HISAOKA

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A new method is proposed to solve three-dimensional radiation and convection heat transfer in MHD duct flow containing small solid particles. It is using the Monte Carlo method for the radiation calculation and can handle with scattering and absorption simultaneously. Sample calculations are carried out for a gas flow (850 m/s, 280 K, 0.368 MPa) containing particles ($D_i = 10^{-4} - 10^{-5}$ m, volume fraction 0.1 %, emissivity 0.5) through a duct (5 m L x 0.5 m H) surrounded by cooling walls (900 K, emissivity 0.2, 0.8). The results shows that the temperature in the boundary layer falls by 100 K due to the radiation heat transfer from the particles to the cooling wall. The temperature reduction is shown to be reduced by increasing the particle diameter and reducing wall emissivity.

5 th International Conference on
Numerical Methods for
Thermal Problems, Montreal
June 27-July 3, 1987

**Monte Carlo Method for Radiative Heat Transfer Analysis
of General Gas-Particle Enclosures**

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Ichiro NAKAMACHI

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A new Monte Carlo method is developed to analyze multidimensional radiative heat transfer in an enclosure containing gray gas with anisotropically scattering gray particles. One set of variables, called READ, are introduced to represent radiation transfer, thus appreciably reducing repeated computations required by the conventional Monte Carlo technique. An 1m x 1m square duct is used as the enclosure with the upper and lower walls at different temperatures in the one-dimensional case and with adiabatic specular or diffuse side walls in the two-dimensional case. Results agree very well with the existing analytical solutions for one-dimensional, nonscattering cases. It is concluded that with anisotropic scattering, an increase in the absorption coefficient and/or single scattering albedo produces adverse effects on radiative heat transfer. Anisotropic scattering effects cannot be simulated by the use of the effective absorption coefficient.

VII International Symposium on
Alcohol Fuels, Paris, France,
October 20-23, 1986

Photochemical Reaction of Alcohol-Fueled Engine Exhaust Gases

Kenichi ITO, Toshiaki YANO and Kouichi KURATA

Sampled exhaust gases from an S.I. engine fueled by methanol or ethanol were introduced into a reactor tube with dilution air at dilution ratios ranging between 10 and 2000. With the irradiation of ultraviolet rays, aldehydes were confirmed to be formed after the formation of alkyl nitrites resulting from the reaction between unburned alcohol and nitrogen oxides. The formation of alkyl nitrates followed the formation of aldehydes. At high dilution ratios the resulting photochemical product from both methanol and ethanol was methyl nitrate. 3.5 % of unburned alcohol,

both methanol and ethanol, was converted to methylnitrate in after a period of two or three days.

International Symposium on
Cold Regions Heat Transfer
June 4-6, 1987
Mechanical Engineering Building,
University of Alberta
Edmonton, Alberta Canada

[Freezing and Melting Characteristics in Internal Flow] (invited key-note paper)

S. FUKUSAKO and N. SEKI
Department of Mechanical Engineering II

A comprehensive review concerning a variety of reported investigations for water-freezing and ice-melting problems related to internal flow is presented. Attention is first focused on the problems of water-freezing and ice-melting with the main flow and then on the problems without main flow. Some reviews are performed on the freezing and melting problems of phase change medium. The demand for additional studies in this field are clearly demonstrated.

IUTAM Symposium on Boundary-Layer Separation August 26-28, 1986
University College London
London, United Kingdom

Structure of Flow in Leading-Edge Separation Bubbles
by M. Kiya

Department of Mechanical Engineering
Hokkaido University
Sapporo, Japan 060

This paper describes the turbulence and unsteady structures of the separation zone (separation bubbles) at the leading edge of a two-dimensional blunt plate; the growth of the length scale of rolled-up vortices, the structure of large vortices in the reattaching zone of the separated shear layer, the unsteady flow associated with the motion of the large vortices, the-frequency unsteady flow structure, etc. are presented and discussed. These vortices are likely to be similar to those of a wide range of separation bubbles formed behind a salient edge.

The 9th Australasian Fluid
Mechanics Conference De-
cember 8-12, 1986 University of
Auckland Auckland, New
Zealand

Vortices and Unsteady Flow in Turbulent Separation Bubbles
by M. Kiya

Department of Mechanical Engineering
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A wind tunnel experiment was performed to obtain the structure of large coherent vortices and the unsteady nature of flow in a turbulent separation bubble formed at the leading edge of a blunt plate with right-angled corners. Reynolds number based on the free-stream velocity U_∞ and the thickness of the plate was 23000. The coherent vortices are shed downstream with a velocity $0.5 U_\infty$ and with a frequency $0.65 U_\infty/x_R$, where x_R is the time-mean length of the separation bubble. The vortices are hair-pin vortices which significantly contributes to the production of Reynolds shearing stress. Unsteady flow in the separation bubble is mainly caused by two agents; one is the motion of the vortices while the other is a low-frequency unsteadiness whose central frequency is approximately $0.12 U_\infty/x_R$. The low-frequency unsteadiness is accompanied by enlargement and shrinkage of the separation bubble and also by a flapping motion of the shear layer near the separation edge.

The 2nd International Confer-
ence on Constitutive Laws for
Engineering Materials, Tucson,
Arizona, U.S.A. January 5-8,
1987

Constitutive Modeling of Cyclic Plasticity
Considering Induced Anisotropy

H. ISHIKAWA and K. SASAKI
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The authors proposed the constitutive model for cyclic plasticity incorporating the motion of the center of the loading surface and the the plastic-deformation-induced-anisotropy. The computer simulation based on this model was verified to be adequate to describe the essential features of proportional and nonproportional cyclic straining.

International Off-Highway &
Powerplant Congress & Ex-
position, Milwaukee, Wisconsin
September 8-11, 1986

**Effects of Combustion and Injection
Systems on Unburnt HC and Particulate
Emissions from a DI Diesel Engine**

Tadashi MURAYAMA, Noboru MIYAMOTO, Takemi CHIKAHISA and Kohji YAMANE
Dept. of Mech. Engrg. Hokkaido Univ.

This paper is a systematic investigation of the effects of combustion and injection systems on hydrocarbon (HC) and particulate emissions from a DI diesel engine. Piston cavity diameter, swirl ratio, number of injection nozzle openings, and injection direction are varied as the experimental parameters, and the constituents in the soluble organic fraction (SOF) of the particulate were analyzed.

The results show that the emission characteristics of deep dish chambers greatly differ from those of shallow dish chambers varying with the number of nozzle openings, the injection direction, and swirl ratio. The HC analysis shows there is a tendency towards increasing polynucleation of polynuclear aromatic hydrocarbon (PAH) in SOF with increasing soot formation. Additionally it was found that the particulate concentration can be expressed as an exponential function of the Bosch smoke density for a wide range of engine combustion conditions.

International Off-Highway &
Powerplant Congress & Ex-
position, Milwaukee, Wisconsin
September 8-11, 1986

**Improvement of the Dynamic Characteristics
in the Connecting passages for Measuring
High Frequency pressure Diagrams**

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Noboru MIYAMOTO and Tadashi MURAYAMA
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Remarkable progress has been made in recent years on pressure measuring techniques and apparatuses, yet they seem not necessarily successful in achieving accurate pressure diagrams at the high frequency range. The primary cause of difficulty lies in the occurrence of undesirable vibrations in the connecting passages which diminishes the accuracy of pressure diagrams.

In order to prevent such vibration, the authors have attempted to increase the natural frequency in the connecting passages by enclosing heat resisting silicon oil, to analyse the frequency characteristics of the passages, and to ensure the propriety of the analysis through comparison with experiments.

As a result, it is proved that the natural frequency of the silicon oil enclosed passage increases twice as high as that of the passage filled with working gas. Moreover, this paper presents a method for correcting a deviation of the pressure diagrams caused by a failure condition where the natural frequency of the passage can not be enhanced.

International Congress and Ex-
position, Detroit, Michigan
February 24-28, 1986

**Effects of Super Heating of Heavy Fuels
on Combustion and Performance in
DI Diesel Engines**

Tadashi MURAYAMA, Young-taig OH, Akihiro KIDO
Takemi CHIKAHISA and Noboru MIYAMOTO
Hokkaido university

This paper is concerned with the effects of temperature of heavy fuels on combustion and engine performance in a naturally aspirated DI diesel engine.

Engine performance and exhaust gas emissions were measured for rapeseed oil, B-heavy oil, and diesel fuel at fuel temperatures from 40°C to 400°C.

With increased fuel temperature, mainly from improved efficiency of combustion there were significant reductions in the specific energy consumption and smoke emissions. It was found that the improvements were mainly a function of the fuel viscosity, and it was independent of the kind of fuel. The optimum temperature of the fuels with regard to specific energy consumption and smoke emission is about 90°C for diesel fuel, 240°C for B-heavy oil, and 300°C for rapeseed oil. At these temperatures, the viscosities of the fuels show nearly identical value, 0.9-3 cst. The optimum viscosity tends to increase slightly with increases in the swirl ratio in the combustion chamber.

International Congress on Combustion Engines, Warsaw, June 8-11, 1987

Efficient and Low-Smoke Combustion of Various Low-Grade Fuels in High-Speed Small Diesel Engines

Tadashi MURAYAMA, Hokkaido University
Noboru MIYAMOTO, Hokkaido University
Takemi CHIKAHISA, Hokkaido University
Shigeru TOSAKA, Hokkaido Institute of Technology

In low-speed large diesel engines, low-grade or heavy petroleum fuels have long been used as an economy measure. Efficient use of various low-grade fuels have recently become a topic of great concern also for high speed small diesel engines.

This paper describes and analyzes improvements of the thermal efficiency and smoke emissions by fuel heating and blending with low-viscosity fuels in high-speed diesel engines with a range of low-grade or high-viscosity fuels.

11 th International Congress on Electron Microscopy, Kyoto, Aug. 31-Sep. 7, 1986

Electron Radiation Damage of Copper Base Dilute Alloys

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Electron radiation damage of Cu base dilute alloys was performed with a high voltage electron microscope to study the effect of solute addition on the point defect processes. As the solute atoms, Ni(-8.45 %), Si(+5.08 %), Ge(+27.77 %) and Sn(+83.40 %) are selected with varied volume size factor (given in the parenthesis respectively) which is expected to characterize the interaction between point defects and solute atoms. The amount of solute atoms are 0.05, 0.3 and 2 atomic percent for each kind of solutes. These 12 kinds of dilute alloys and pure Cu were irradiated with HVEM (H-1300) operated at 1000kV in the temperature range from room temperature to 250°C. In addition to in-situ observation with HVEM, high resolution observation were performed with JEM-200CX after irradiation.

International Conference on
Vacancies and Interstitials in
Metals and Alloys, Berlin, Sept.
14-19, 1986

**Point Defect Processes in
The Defect Structure Development
from Cascade Damage**

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A variety of the component processes controlling the development of defect structures from large cascades have been extracted from the observation of point defect clusters in 14 MeV neutron irradiated metals and alloys. The direct formation of point defect clusters from cascades is analyzed, including the relation of damaged zone with primary knock-on energy, sub-cascade structure and formation energies, and the amount of self-annihilation of point defects within cascades. Clustered defect formation is classified from the thermal stability of small point defect clusters. Estimation of the number of free interstitials created is successfully made, and their resultant fate in the final defect structure development are categorized. A generally applicable simplified analyses is proposed. An example is given of its application to the linear development in thin foils and the square root progress in bulk. Dynamical effect of collisions and cascade overlap effect on defect structure evolution are discussed.

11 th International Congress on
Electron Microscopy, Kyoto,
Aug. 31-Sep. 7, 1986

**In-Situ Electron Radiation Damage Study of Materials
by High Voltage Electron Microscopy**

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Radiation damage study of materials and its application to the understanding of solid state reactions are the topmost field of research by high voltage electron microscopy, which could not stay within a closed society of electron microscopy and went out to compete with other scientific research techniques. In addition to the most effective use of HVEM as a powerful electron irradiation source, the research has been performed on the basis of the unified combination of the characteristic superior feature of electron microscopy, which allows us to grasp directly the nature of solid state reactions, and the effort to utilize the microscopy as a quantitative measurement tool. The present status of ten research subjects, majority of which dealt with metals and alloys, are

explained with comments on some future prospects.

11 th International Congress on
Electron Microscopy, Kyoto,
Aug. 31-Sep. 7, 1986

Role of Stacking Fault Tetrahedra as Favourable Sites for Void Nucleation

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Electron irradiation and in-situ observation of defect structure development in Fe-13Cr-14Ni alloy were performed with H-1300 high voltage electron microscope. In this material, vacancy clusters are stably formed and grow during the electron irradiation although their size are much smaller than that of interstitial clusters. However, by the observation in higher magnification, the type of vacancy clusters can be identified even for those smaller ones, and an effective role of stacking fault tetrahedra as favourable sites for void nucleation was revealed in the temperature range at which both tetrahedra and voids coexist.

11 th International Congress on
Electron Microscopy, Kyoto,
Aug. 31-Sep. 7, 1986

Observation of Defect Clusters in Masked Thin Foil Cu Irradiated with He⁺ Ion

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In ion-irradiated materials, high concentration gradients of both the induced point defects and implanted ion atoms along the depth direction are introduced near the ion range. With the method for defect structure observation such as a sectioning technique, a complex situation of point defect processes arises from the diffusion of point defects to the neighboring depth. In order to avoid this and to observe the phenomena occurring at each depth, irradiations with two over-lapped wedge-shaped thin foils were performed. We use the foil at ion incidence side as a mask and the other as a specimen.

Wedge-shaped specimens and masks were prepared from 99.999 % Cu by electro-polishing. 500

keV He⁺ ion irradiation up to a fluence $8.3 \times 10^4 \text{He}^+/\text{cm}^2$ at a flux $2.8 \times 10^{12} \text{He}^+/\text{cm}^2 \text{ sec}$ was performed at room temperature with 2MeV Van de Graaff accelerator of Japan Atomic Energy Research Institute. Observation of defect structures was carried out with JEM-200CX.

International Conference on
Vacancies and Interstitials in
Metals and Alloys, Berlin, Sept.
14-19, 1986

**Lattice Vacancies in Nickel Introduced
by Electron Irradiation, Quenching
and Cyclic-Deformation**

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Four series of experiments by high voltage electron microscopy have been performed to detect the motion behaviour of lattice vacancies in nickel. The annihilation of electron radiation-induced interstitial clusters by the motion of simultaneously introduced vacancies, the variation of the nucleation of interstitial clusters by the presence of vacancies introduced by quenching from a high temperature, the same scheme of experiment on deformation induced vacancies, and the measurement of the vacancy mobility from the interstitial loop growth at vacancy mobile high temperatures. Vacancy motion temperature has been assigned consistently from all the four methods, with the activation energy of a single vacancy 1.25 eV and approximate value of 0.75 eV for a divacancy.

11 th International Congress on
Electron Microscopy, Kyoto,
Aug. 31-Sep. 7, 1986

**Observation of Defect Structures
In 14 MeV D-T Fusion Neutron Irradiated Pure Metals**

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The understanding of the initial cascade damage structure and the process of defect structure evolution in metals produced by 14 MeV D-T neutrons is essential for the development of the first wall materials in future fusion reactors. A large amount of data has been accumulated, but only a few are reliable judging from the recent most developed electron microscopy. A demonstration is made for the improvement of the image quality of point defect clusters formed from cascade

damages in Au by a suitable adjustment of dark field conditions. The size distribution of stacking fault tetrahedra in Ni is also shown. One can recognize the combination of the weak beam technique with a high performance instrument is now approaching the atomic size resolution of defect clusters.

11 th International Congress on
Electron Microscopy, Kyoto,
Aug. 31-Sep. 7, 1986

\pm G Stereo Method for the Determination of Sign of Dislocations

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In cyclically deformed metals with small strains, highly accumulated dislocations are not distributed homogeneously but they form densely agglomerated zones, surrounding or separated by the area almost perfectly free of dislocations. The difference of crystallographic orientation of the adjacent dislocation free area are suspected to be extremely small, in spite of the fact that such a large number of dislocations are found between the areas.

Now the question is why there is no orientation difference in spite of such a large number of dislocations. Densely agglomerated dislocations should be composed of equal numbers of dislocations with opposite signs. Here, the method we named as " \pm g stereo method" was proved to be very efficient for characterizing the sign of Burgers vector of each dislocation embedded in the complicated dislocation structure.

International Conference on
Vacancies and Interstitials in
Metals and Alloys, Berlin, Sept.
14-19, 1986

**Detection of Space- and Time-Wise Fluctuation of
Point Defect Reactions by the Observation of
Small Vacancy Clusters
Under Electron Irradiation**

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Direct observations of small clusters are made which demonstrate the existence of space- and time-wise fluctuations of point defect reactions in copper under electron irradiation with a high voltage electron microscope. They are identified as vacancy stacking fault tetrahedra with the size of less than 2 nm. They show persistent appearance and disappearance keeping their averaged population unchanged during a steady irradiation. Their average life time is about 5 sec at 50°C and shorter at higher temperatures. Their average number density has a strong dependence on temperature and also on irradiation beam intensity. Kinetics and stochastic type of analyses are made and the relevance of the observed phenomena in the random reaction is discussed.

11 th International Congress on
Electron Microscopy, Kyoto,
Aug. 31-Sep. 7, 1986

**Deformation Structure Observation Correlated to the Deformation
Behavior in D-T Fusion Neutron Irradiated Gold and Nickel**

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The mechanical property change with defect structures formed by D-T fusion neutron irradiation at temperatures from 293 to 563 K was investigated for Au and Ni.

The development of the deformation structure in Au was observed to proceed in two stages. The first stage, for the initial deformation up to a few percents elongation, was the development of the dislocation channel structure. The second stage was different by the irradiation fluence. The much more closely spaced channels were formed for higher fluence, and for lower fluence the dislocation channels were replaced by the newly appeared fine cell structures, and channels became to be invisible. These results correspond to the change of the slope of stress strain curves with fluence.

36th CIRP General Assembly,
Jerusalem, Israel, 18-19 Aug.
1986

**Development of Numerical Contouring
Control Electric Discharge Machining
(NCC-EDM)**

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A Numerical Contouring Control Electric Discharge Machining (NCC-EDM) system, based on Profile Electrode, Contouring NC data and Multi-axis NC discharge machine, was developed. This system makes it possible to generate 3-dimensional curved surfaces efficiently, configured by a combination of cross section profiles and its axial motion. In order to generate NC data for NCC-EDM, an Automatic Programming System (APSET-2) was developed. NCC-EDM system has the following characteristics :

- 1) As the stock removal is performed as trepanning by using the profile electrode, high speed and low energy machining process is possible.
- 2) Regarding the machining of 3-dimensional swept surfaces which consist of cross sectional profile and axial motion, the shape of electrode is easily machined by using an NC wire discharge machine, and the data of axial motion is also easily produced by APSET-2.
- 3) A complex 3-dimensional mold cavity is produced by NCC-EDM without any complex male and female electrodes.

Fourth International Precision
Engineering Seminar, Cranfield,
U. K. 11-14 May 1987

Photoresist for Photochemical Machining of Alumina Ceramics

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The applicability of a cyclized polybutadiene rubber as a resist material for photoetching of alumina ceramic in phosphoric acid was studied. Stencil breakdown, change in the stencil thickness during etching, and etch factor were measured. It was found that this material post-baked at

temperatures as high as 300°C for 30 min provided good resistance to severe attacks by the acid at temperatures of up to 300°C. The effects of post-bake temperature, of etching temperature, of etching time, and of original slot width on etch factor were discussed.

IEEE Antennas and Propagation
Society International Sym-
posium and URSI Radio Science
Meeting, Virginia Tech, Black-
sburg, Virginia, June 15-19, 1987.

A Cylindrical Reflector Antenna Pattern Computation by Boundary Element Method

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An electromagnetic field analysis of a cylindrical reflector antenna by using BEM, the boundary element method, is presented. This work aims to investigate the validity of the approach for the antenna radiation problems and attempts to predict the overall azimuthal radiation patterns of a small offset cylindrical reflector antenna. It was found that the measured patterns of the experimental offset reflector antenna can be numerically predicted over the entire azimuthal angles even in the antenna shadow regions without paying any particular attention to the troublesome PO/GTD combination.

IEEE Antennas and Propagation
Society International Sym-
posium and URSI Radio Science
Meeting, Virginia Tech, Black-
sburg, Virginia, June 15-19, 1987

**Radiation Pattern Computation of an Open-ended Parallel-Plate
Waveguide Antenna with a Cylinder Near the Aperture**

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A study for predicting radiation patterns of a parallel-plate waveguide antenna with cylinders near the waveguide aperture is presented. This work aims to investigate the validity of BEM for two-dimensional scattering problems, and for a cylindrical reflector antenna radiation pattern computation at or beyond the shadow boundaries without the making the effort of combining the two fields obtained by PO (Physical Optics) and by GTD (Geometrical Theory of Diffraction). One of the noted features of this approach is that far/near-fields, or near-axis/wide-angle fields, is obtained by the result of a simultaneous equation, of which the dimension is determined by the maximum nodal number of the considered antenna system.

IUTAM Symposium on Ad-
vanced Boundary Element
Methods: Applications in Solid
and Fluid Dynamics, San
Antonio, Texas, U. S. A., April
13-16, 1987

**Transient Solutions of a Three-Dimensional Convective Diffusion
Equation Using Mixed Bounday Elements**

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It is well-known that it is very difficult to numerically solve a convective diffusion equation (CDE), when the convective term dominates. In a domain-type apporoache such a finite difference

and a finite element method, improved numerical techniques must have been developed, e. g., 'upwind scheme', in order to eliminate numerically unstable or spurious solutions.

Recently, the authors and other researchers have pointed out that the boundary element method, which is one of the boundary approaches, is one of the most powerful numerical methods to overcome this difficulty. Furthermore, the authors have developed a more effective boundary element method using mixed boundary elements (mixed BEM) in such a way as to be usable for a multi-dimensional CDE field problem. However, the investigation has been presented only for a steady-state problem. In this paper, boundary element solutions of a transient CDE in two and three dimensions are shown using the mixed BEM. A time-dependent fundamental solution with both the convection and diffusion effects of the adjoint CDE is introduced in this formulation, but the present formulation is basically available only in a special case of a steady and one-dimensional convection velocity. Transient solutions for each discrete time are compared with exact solutions. The dependence of their relative errors on time and space are shown. It is shown that the present method gives stable and accurate solutions as well as in a steady-state CDE problem.

1987 Electronic Materials Conference, University of California, Santa Barbara, CA, U. S. A., June 24-26, 1987

The Effects of Spatially Distributed Interface States on a Compound Semiconductor MIS C-V Characteristics

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We present a comprehensive analysis of the effects of spatially distributed interface states on compound semiconductor MIS C-V characteristics. The experimental result obtained on the Al_2O_3 /native oxide double-layer/InP MIS structure was reproduced remarkably well by the present theoretical calculation.

Our previous admittance analysis and CCDLTS measurement of van Staa et al have shown that the interface states are spatially distributed around the interface. This paper reports the effect of this spatial distribution on the MIS C-V characteristics for the first time. The effect of an electric field in the distributed region and its effect on the emission and capture time constant of the states are also taken into account in the present theoretical analysis.

The commonly observed complicated behavior of MIS C-V curves including hysteresis, which depends on the bias sweep rate as well as on the bias sweep swing and its direction, is remarkably well reproduced by the present analysis. The complication is shown to be caused by the difference between the capture and the emission processes of the interface states, which is a direct consequence of the spatial distribution of the interface states.

Hysteresis in C-V curves gives rise to anomalous state density distribution when Terman's method is used to determine it. The present analysis can be used to obtain the correct state

distribution by fitting the theoretical C-V curve to the experimental one. By this determination procedure, it is found that the interface states distribution is U-shaped in energy with its minimum point at about 0.4 eV from the conduction band edge.

Extended Abstracts of the 18th
Conference on Solid State De-
vices and Materials, Tokyo,
Japan, August 20-22, 1986

Disorder Induced Gap State Model for Anomalous C-V Carrier Concentration Profiles at Epitaxially Grown Interfaces

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Anomalous depletion/accumulation (D/A) carrier concentration profiles were observed at GaAs/GaAs and InGaAs/GaAs MOVPE regrown interfaces prepared under various growth and processing conditions. Based on a detailed C-V and DLTS study, a disorder induced gap state (DIGS) continuum due to interface crystalline disorder rather than specific discrete deep levels is proposed to be held responsible for the anomalous D/A profile and Fermi level pinning.

Society of Photo-Optical Instru-
mentation Engineers Bay Point
Symposium on Advances in
Semiconductors and Semi-
conductor Structures, Baypoint,
Florida, March 22-27, 1987

Characterization of Interfaces Formed by Interrupted OMVPE Growth

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Properties of GaAs and InGaAs/GaAs epitaxial interfaces formed by interrupted OMVPE regrowth are studied, using C-V, I-V, DLTS, cross-sectional TEM and RBS techniques. Various types of anomalous depletion and accumulation carrier concentration profiles are observed at regrown interfaces prepared under various growth and processing conditions. Based on detailed experiments, a new generalized model for regrown epitaxial interfaces is proposed and discussed which involves the formation of gap state continuum as well as adsorption enhanced incorporation

of shallow donor/acceptor impurity atoms. The introduction of gap state continuum is explained by the recently proposed disorder induced gap state (DIGS) model in which crystalline disorder within a few monolayers of the regrown interface region gives rise to state continuum, leading to the observed anomalous carrier profiles.

Proceeding of Fourth International Conference on Molecular Beam Epitaxy, University of York, England, September 7-10, 1986

**Effect of a Coincident Pb Flux During MBE Growth
on the Electrical Properties of GaAs and AlGaAs Layers**

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The effect of a coincident Pb flux during molecular beam epitaxial growth on the electrical properties of undoped GaAs and Si doped $\text{Al}_x\text{Ga}_{1-x}\text{As}$ layers is investigated. In undoped GaAs, the concentration of electron traps is decreased with the Pb flux. In the case of Si doped $\text{Al}_x\text{Ga}_{1-x}\text{As}$, the Pb flux is shown to reduce the incorporation rate constant of Si. From the carrier concentration profile, the incorporation rate constant of Si for both AlGaAs with or without Pb flux are determined for the first time.

14th Annual Conference on the
Physics and Chemistry of Semi-
conductor Interfaces, Salt Lake
City, U. S. A., January 27-29,
1987

**Electronic and Micro-Structural Properties of Disorder Induced Gap States
at Compound Semiconductor-Insulator Interfaces**

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In order to clarify the structure and properties of a disordered semiconductor layer which forms the basis of the recently proposed DIGS model, the electronic and micro-structural properties of the compound semiconductor I-S Interfaces (InP, GaAs, AlGaAs, InGaAs) are studied using C-V, ICTS, PCTS, cross-sectional TEM, RBS and XPS/UPS techniques. Based on the experimental results, a detailed model of the disordered crystal region and a graded amorphous region are proposed. In these two regions, disorder-induced gap states (DIGS) are distributed both in energy and space.

The model can reproduce the observed hysteresis behavior remarkably well, and can explain the observed anomalous thermal and optical transient behavior. The measured location of the charge neutrality point E_{H0} of the DIGS continuum with respect to the valence band maximum (VBM) agree well with the theoretical locations of the hybrid orbital energy based on sp^3s^* tight binding theory for various semiconductors.

Proceeding of 18th International
Conference on the Physics of
Semiconductors, Stockholm,
Sweden, August 11-15, 1986

**Theory of Schottky Barrier Formation
Based on Unified Disorder Induced Gap State Model**

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Schottky barrier formation is explained by a disorder induced gap state (DIGS) continuum produced by metal deposition whose charge neutrality point is given by the hybrid orbital energy E_{H0} . Deviation of Fermi level from E_{H0} results in a dipole which screens the metal electro-

negativity. A linear theory for barrier height is developed, and chemical trends are discussed.

Proceeding of 2nd China/Japan
Seminar of Physical Metallurgy
on Physical Metallurgy,
Kunming, China, Sept. 25-27,
1986

The Behaviors of Alloying Elements on Void Formation and Segregation in Fe Based Alloys under Electron-Irradiation

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The behaviors of void formation and radiation-induced compositional change were studied on the basis of results by a HVEM irradiation and EDS analysis. Voids were nucleated at a given temperature range not only in pure Fe but also Fe-substitutional elements except P and Cr based alloys. After electron irradiation, solutes segregation (enrichment and/or depletion) was recognized in the irradiation area including grain boundaries of each alloy. Oversized elements S, Mn, P and Mo were depleted but Cr was enriched at dislocation loops, while the undersized Ni elements were enriched at dislocation loops. In the Fe-based ternary alloys the size effect was effectively operative for segregation phenomena.

Proceeding of 13th International
Symposium on Effects of Radi-
ation on Materials, Seattle, U. S.
A., June 23-25, 1986

The Behavior of Solute Segregation and Void Formation in Fe-Cr-Ni and Fe-Cr-Mn Steels during Electron Irradiation

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The relative swelling behavior of Fe-Cr-Mn and Fe-Cr-Ni alloys during electron irradiation is shown to be different from that observed in neutron irradiations. This difference appears to be a consequence of the different diffusion behavior of nickel and manganese in response to the operation of the inverse kirkendall effect. The vacancy gradients driving the diffusion in these experiments are generated not only by the foil surfaces and the electron-generated radial displacement gradient

but also by high angle grain boundaries deliberately centered in the middle of the electron beam. This procedure allows for the relative diffusional characteristics of each element to be observed by EDX measurements across the grain boundary. The influence of helium and minor solutes on swelling was also studied in these experiments but yielded no behavior atypical of that observed in neutron irradiation studies.

Proceeding of XIth International Congress on Electron Microscopy, Kyoto, Japan, Aug. 31-Sept. 7, 1986

Cavity Formation in Stainless Steels by means of HVEM/Ion-Accelerator Dual Irradiation

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HVEM of 1300 kV was linked up with 300 keV linear accelerator for dual irradiation experiments. The Electron irradiated area was about 2 microns in diameter and the damage rate was 2×10^{-3} dpa/sec under the usual conditions. The details of the facility will be presented in this conference. Ferrite/martensite stainless steel (9Cr-2Mo), austenitic stainless steel (SUS 316) and Ni were irradiated by three methods and the irradiation were performed in the same grain of the specimen to 20 dpa at 570-770 K. Accelerating voltage of electron and He⁺ were 1000 and 100 keV, respectively. Dual irradiation was carried out under the condition of 0-200 He/dpa.

The development of damage structures showed the general pattern of dislocation loop formation followed by the growth and then cavities were formed. In the development of loop structures, the pre-injection of helium and dual irradiations caused the suppression of loop growth and increased its number density. On the cavity formation, the effect of helium was confirmed in the nucleation and growth process. In contrast, the dual irradiation produced relatively large cavities with high number density and the threshold dose increased up to about 5 dpa, and also bimodal cavity distribution can be observed around 670 K. The effect of helium concentration in the dual irradiation can be detected with several ppm/dpa, which tended to be saturated with the concentration. These results indicate that the helium injected during dual irradiation enhances the cavity nucleation process without suppression of its growth.

Proceeding of XIth International Congress on Electron Microscopy, Kyoto, Japan, Aug. 31-Sept. 7, 1986

A Study of the Effects of Alloying Elements on Radiation-Induced Segregation in Fe-Cr-Based Alloys

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It has been shown that solutes segregation occurs during irradiation at defect sinks such as grain boundary so that the phase stability of stainless steel is often influenced as a result of compositional changes. A similar irradiation-induced phenomena have been observed for Fe-Cr-Mn alloys, but the details of the segregation process and different effects between Ni and Mn solute have not been clarified. Therefore, it is of interest to investigate the effects of alloying elements and the replacement of Ni with Mn in austenitic steels which are expected as materials for fusion reactors.

This behavior of radiation-induced segregation at grain boundaries and the void nucleation were studied for three Fe-Cr-X (X-Ni, Mn and W, V as minor elements) alloys through in situ observation under a high voltage electron microscope (HVEM), and using 200 kV TEM/STEM electron microscope with EDS.

In Fe-15Cr-30Ni alloy, voids were easily nucleated at relative lower doses in the overall temperatures examined. For Fe-15Cr-15Mn containing 2%W and V, suppression of void nucleation was definitely recognized. The same suppression effect was also observed in Fe-15Cr-20Mn alloy. Thus, by replacing Ni with Mn as a major element void nucleation was effectively retarded.

Due to irradiation at various temperatures, the changes of solutes concentration were also recognized near grain boundaries. Remarkable segregation of Ni and depletion of Cr were caused near the grain boundaries, and the amount of the compositional changes became larger with the increase in irradiation temperature. On the other hand, the segregation became less remarkable for Fe-Cr-Mn alloy systems.

Thus, it is obvious that for alloys with low void nucleation and its growth the segregation tends to be retarded.

Proceeding of XIth International Congress on Electron Microscopy, Kyoto, Japan, Aug. 31-Sept. 7, 1986

Dual Irradiation Facility of HVEMK/Ion Accelerator

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High voltage electron microscope (HVEM) and ion-accelerator have been in use and HVEM has been linked recently to an accelerator as a new dual irradiation facility of the HVEM/accelerator for the in-situ observation of dual irradiation.

This facility consists of three parts; HVEM, the accelerator and the ion-beam interface. The accelerator used was a 300 keV linear accelerator equipped with a hot PIG ion source. He⁺ ions were divided by an analyzing magnet after the acceleration.

This facility allows for irradiation with three different methods; (1) simple electron irradiation, (2) electron/helium dual irradiation and (3) electron irradiation after pre-injection. These results will be reported in another study of this conference.

Proceedings of 2nd China/Japan Seminar of Physical Metallurgy on Physical Metallurgy, Kunming, China, Sept. 25-27, 1986

Void Swelling and Radiation-Induced Segregation Behavior in Electron Irradiated Fe-Cr Base Alloys

Ben-Fu HU, Heishichiro TAKAHASHI and Taro TAKEYAMA

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Void formation and radiation-induced segregation in Fe-15%Cr-20%Mn, Fe-15%Cr-15Mn-2%W-2%V and Fe-15%Cr-30%Ni alloys were investigated by electron irradiation (HVEM) and X-ray microanalysis (EDX).

The void swelling occurred in all specimens irradiated at 623-723 K, but in Fe-Cr-Mn alloys void swelling markedly decreased in comparison with the Fe-Cr-Ni alloy.

Fe-Cr-Mn alloys exhibited good swelling resistance. Especially in Fe-Cr-Mn alloy modified by W and V void swelling was effectively suppressed.

The W, V modified alloy showed a small amount of segregation. It was shown that the effective point defect concentration strongly decreased. Consequently, the void swelling was strongly suppressed.

Proceedings of 2nd China/Japan
Seminar of Physical Metallurgy
on Physical Metallurgy,
Kunming, China, Sept. 25-27,
1986

**Effect of Helium on Cavity Formation in Stainless Steel
by Means of Electron/He-Ion dual Irradiation**

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The effect of helium on cavity formation in austenitic and ferritic stainless steels was investigated by electron/He-ion dual irradiation. From the results it was indicated that the helium continuously injected during dual-beam irradiation enhances the nucleation of subcritical cavities without suppressing the conversion to bias-driven cavities.

IASTED International Confer-
ence on High Technology in the
Power Industry, Bozeman, MT.,
U. S. A., August 20-22, 1986

**Fundamental Research on Integrated Security Monitoring
and Control (ISMAC) Systems-Contingency Analyses
and Preventive Control Strategies-**

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*Division of Power Systems Research
EPRI of Kirin Province, Chang Chun, Kirin, China

The integrated security monitoring and control (ISMAC) systems investigated herein consist of two basic functions: a global preventive security control function, and on-line security monitoring and individual emergency control function. Each function involves two tasks: the determination of a global preventive control strategy and a contingency selection for the former, and contingency

analysis and determination of individual emergency control strategies for the latter. This paper discusses particularly two of these four tasks, i. e., the contingency analysis and the global preventive control strategy.

IASTED International Conference on High Technology in the Power Industry, Bozeman, MT., U. S. A., August 20-22, 1986

**Optimal Allocation of Small Dispersed Energy Storage Systems
for the Purpose of Optimizing the Power Flows
in Electric Power Systems**

Jun HASEGAWA, Keiichiro YASUDA, Ken-ichi NISHIYA and Eiichi TANAKA
Department of Electrical Engineering
Hokkaido University, Sapporo 060, Japan

This paper describes a method to determine the optimal allocation of small dispersed energy storage systems for the purpose of leveling the power flows in electric power systems. A new allocation index is defined, which shows how the power flows on each transmission line are leveled throughout the operating period of storage systems. Then, a fast approximate algorithm based on relaxing the integer constraints on variables is established.

The proposed method is summarized : (1) the problem is solved as a normal integer quadratic programming problem relaxing the integer constraints on variables ; (2) these solutions are transformed into integer values using the sensitivity of the allocation index.

Applying the proposed method to the model system, it is observed that : (1) the power that flows on each transmission line are leveled by the optimal allocation of the energy storage systems throughout their operating period. (2) the proposed algorithm is accurate and fast ; moreover, the number of energy storage systems scarcely affects the computation time required for the algorithm.

The 2nd Pacific Area Statistical
Conference, December 10-12,
1986, Tokyo, Japan

An Analysis of Sociometric Data by MDS in Minkowski Space

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The multidimensional scaling method for the asymmetric dissimilarity data is discussed. As a model of a space which has an asymmetric distance, two-dimensional Minkowski space is treated. A class of asymmetric distance function in this space is offered. Nonmetric MDS and minimum dimensional analysis is applied to the sociometric data and the optimal distance function and the configuration of the individuals were determined.

The 2nd Japan-China Sympo. on
Statistics, Nov. 4-10, 1986,
Fukuoka, Japan

On the Statistics Based on Entropies of Order α and Their Characteristics

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and Michiaki KAWAGUCHI
Division of Information Engineering
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Sapporo, 060 Japan

In this report, the hypothesis testing and the estimation on the finite discrete distributions using the dispersion and divergence based on the entropies of order α are discussed.

The ordinary likelihood ratio tests and the maximum likelihood estimations are given by the statistics which correspond to the entropy of order 1, i. e. Shannon's entropy. We will show that, in general, there exists the statistics which are the more powerful test and/or the smaller variance estimator for the finite samples than the statistics based on $\alpha=1$.

The XIIIth International Biometric Conference, 27 July-1 August, 1986, Seattle, Washington USA

**Multidimensional Scaling for Asymmetric Dissimilarities
by a Generalized Metric**

Yoshiharu SATO and Michiaki KAWAGUCHI
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Hokkaido University
Sapporo, 060 JAPAN

The object of this paper is to obtain determine the optimal point configuration in a suitable space in such a way that the observed asymmetric dissimilarities are represent by the distances between a pair of given points. As a model of the asymmetric distance, the Minkowski distance function is treated. A class of asymmetric Minkowski distance function in offered. Under a suitable criterion, the best model of the asymmetric distance function is chosen from among the elements of that class.

1987 International Geoscience
and Remote Sensing Symposium
(IGARSS '87)

**Diagnosis of Under-Snow Radar Images by Three-Dimensional
Displaying Technique In a Holographic Imaging Radar**

Yoshinao AOKI, Yuji SAKAMOTO and Yoshinari TAKAHASHI

A technique to diagnose images obtained by under-snow radar is proposed, where three-dimensional radar images are displayed on a two-dimensional CTR scope of a computer by the gray-level coding technique. The radar discussed in this paper is a holographic imaging radar and the azimuth information of objects is obtained by ordinary holographic technique, whereas the depth information is obtained by a frequency-sweep technique. An experiment was conducted with microwaves from 8 GHz to 10 GHz frequency to visualize radar images of objects such as a container filled with anti-freeze water, metallic cans and a mannequin covered with silver foil which were buried under accumulated snow in winter. Discussion on the diagnosis of the numerically reconstructed radar images was done by changing the point of view of the screen on the CTR scope. The experimental results show the proposed technique is promising in constructing a practical system of under-snow radar.

A Calligraphic Character Generating and Brush Writing System

Yoshinao AOKI and Chong-ming SHI

This paper introduces a calligraphic character writing system in which the generated characters are really written out on paper by a writing brush. The data base is made by means of new method in which features of different style of calligraphic characters can be extracted with a uniform algorithm. We constructed a robot for writing generated characters and the problems introduced by adopting a brush and their solutions are also discussed. In particular, because of the softness and friction against paper of the brush head, the postponement of the brush touch may be caused and we solve it by developing a special compensation method. It turns out that, because the writing process is much similar to that of one's writing, the aesthetic perception and momentum as well as some intrinsic properties of calligraphy can be better demonstrated. In addition, an experimental result based on several styles of characters is described.

The 2nd Japanese-Sino Sapporo-Shenyang International Conference on Computer Applications (Sapporo Sep. 1986)

Rapid Proceeding and Recovery of Solid Generation by Stacked Frame Buffers

Ban GUO, Tsuyoshi YAMAMOTO and Yoshinao AOKI

Fast proceeding and recovering in solid modeling design is an important aid for users of CAD systems. A stacked frame buffer algorithm for solid modeling is proposed. This buffer is constructed as a multiframe array whose cells are maintained in an order according to priority of procedure linked to each pixel in terms of X and Y elements on the image plane, so that the cell contents may describe the visibility of current objects as well as the history of visible ones through the modeling process. The algorithm directly processes image data in the display buffer as it runs and recovers step-by-step. Using this method, users can dynamically manipulate their solid synthesis designs and modeling environments, so that the problems of rapidly recovering from inadvertent operating errors and immediately modifying objects in the CAD process are solved.

The 2nd Japanese-Sino Sapporo-Shenyang Intersational Conference on Computer Applications

A Method For Locating a Vanishing Point by Uing the Hough Transform Properties

Kunio ONODA, Rokuro MATSUSHIMA and Yoshinao AOKI

A method for locating a vanishing point in a perspective scene of a straight passage is proposed. The position of the vanishing point is used to control an automonus mobile robot. The scene inputed with a TV camera is digitized and the slant edges are extracted by filtering. These edges contain several lines toward the vanishing point. To locate the point the Hough transform is used, which is a parametric transform between the image plane and the parameter plane and has the following properties: (1) Points lying on the same straight line in the image plane correspond to curves through a common point (ρ_j, θ_j) in the parameter plane, (2) Points lying on the same curve in the parameter plane correspond to lines through a common point (x_0, y_0) in the image plane, where in this case the common point is the desired vanishing point and is located by determining the apporoximated curve for the set of (ρ_j, θ_j) by the least square method. The advantage is that the calculating speed is fast.

The 2nd Japanese-Sino Sapporo-Shengyang International Conference on Computer Applications

A Tactile Imaging System by Using the CT Reconstruction System

T. KAWASHIMA, T. NAKAMURA and Y. AOKI

This paper proposes a two-dimensional tactile sensing system which utilizes a piezo-optical transduction mechanism and a CT reconstruction algorithm. In this system, a pressure distribution is converted into a light attenuation projection patterns by a dotted silicon rubber sheet. The two-dimensional pressure distribution is calculated from a projection patterns by the back-projection algorithm of a computerized tomography. Experimental results show that the sensor reconstructs the pressure pattern at 16x16 sensing sites with fewer detectors. The merits and performance of the sensor are presented.

Fifth International Conference
on Antennas and propagation
ICAP 87 30 March-2 April 1987
York, U. K.

Detection of Objects Buried in Snow Using Microwave Holography

Yuji SAKAMOTO, Katsuhiko TAJIRI,
Takaya SAWAI and Yoshinao AOKI

In this paper, we propose a reconstruction method of 3D imaging by using multi-frequency holography, and apply the method to recognize 3D shapes of objects buried in snow. An experimental system using X-band microwave is conducted. Image reconstruction is accomplished mathematically by a computer and the image is displayed on a CRT with a specially designed circuit. In field experiments, having obtained 3D images of metallic cylinders and a mannequin buried in snow, it was shown that the method has a potentiality to indicate the position and identify the shape of the targets in the snow layer.

The Second Japanese-Sino
Sapporo-Shenyang International
Conference on Computer Appli-
cations September 27-30, 1986
Sapporo, Japan

Detection of Objects Buried in the Snow Cover Using Microwaves

Yuji SAKAMOTO, Katsuhiko TAJIRI,
Takaya SAWAI and Yoshinao AOKI

We have carried out a study on detecting objects buried in snow by radar. In this paper, we discuss three-dimensional (3D) imaging of objects buried in snow using multi-frequency holography. We propose a reconstruction technique of 3D imaging by using multi-frequency holography, and apply the method to recognize 3D shapes of the objects buried under a snow cover. An experimental system using X-band microwave is conducted. Image reconstruction is accomplished mathematically by a computer and the image is displayed on a CRT with a specially designed circuit. In a field experiment, having obtained 3D images of metallic cylinders and a mannequin buried in the snow shows that the method has a potentiality to indicate the position and identify of the targets in the snow layer.

The 2nd Japanese-Sino Sapporo-Shenyang International Conference on Computer Application (1986)

A Calligraphic Character Generating and Brush Writing System

Chong-Ming SHI, Yoshinao AOKI and Kunio ONDA

This paper introduces a calligraphic character writing system in which the generated characters are actually written on paper by a robot holding a writing brush. The data base is made by means of a new method in which the features of different styles of calligraphic character can be extracted with a uniform algorithm. Besides, we actually constructed a robot for writing generated characters and the problems arising by adopting a brush are also discussed. In particular, because of the softness and friction against paper of the brush head, the postponement of the brush touch may be caused and we solved it by developing a special compensation method. In addition, an experimental result based on several styles of characters is described. It was found that, since the writing process is similar to the brush movement by man, the aesthetic perception and momentum as well as some intrinsic properties of calligraphy can be better demonstrated.

Presented at EUROCAL '87,
June 2-6, 1987, Karl-Marx University,
Leipzig, GDR

REDUCE 3.2 on iAPX 86/286 Based Personal Computers

Tsuyoshi YAMAMOTO and Yoshinao AOKI
Department of Information Engineering, Hokkaido University

In this paper, we report the architecture of LISP kernel which is specially designed for iAPX86/286 CPU families and REDUCE 3.2 on it. At present, iAPX86/286 is a standard CPU for most personal computers and it has become important to implement a standard algebraic processing system in such machines. We chose REDUCE 3.2 as a standard algebraic processing system because it is available as a source code and, of course, it is in wide use. However, REDUCE 3.2 is originally developed on IBM mainframes, so that it is too cumbersome for PCs. We developed a special LISP kernel for iAPX-86/286 which has a capability to load and execute all facilities of REDUCE 3.2. The basic structure of LISP kernel and performance evaluation on standard PCs are reported.

Presented at 15th Acoustical
Imaging Conference, Halifax,
Canada, July, 1986

Arc Back-Projection with an Efficient Computation for Ultrasonic Reflection Mode Tomography

Mashiki IKEGAMI, Tsuyoshi YAMAMOTO and Yoshinao AOKI
Department of Information Engineering, Hokkaido University

In this paper, we proposed an improved algorithm to reconstruct cross-sectional images from ultrasonic B-mode signals or echo-grams. The algorithm is based on backward-projection. However conventional algorithms can not be used to reconstruct images properly because each signal in the echo-gram must be back-projected along the arc which indicates the points of the same distance from the position where the echo has recorded. In the algorithm proposed, we introduce a back-projection along the arc using the polar coordinate system.

Furthermore, we proposed improved computation technique using this table look up method. Computer simulations and experimental results are reported and it was shown that the method proposed gives a better reconstructed image than the conventional back-projection algorithm for refraction mode tomography using ultrasound.

The 2nd Japanese-Sino Sapporo-
Shenyang International Confer-
ence on Computer Application

An Algebra System for Calculating the Fraunhofer Diffraction Pattern

Ke Juan PENG and Yoshinao AOKI

This paper presents a system, written in LISP, which will provide a useful tool for an algebraic calculation of the Fraunhofer diffraction patterns. There are two objectives for designing the system. The first is to provide an easy way for synthesizing apertures. The second is to provide a computer algebra system for calculating diffraction patterns. To attain this goal, we separated the processing of the calculation into two phases: defining an aperture and generating the pattern. In the defining phase, we either define an aperture by its geometric measurement or synthesize an aperture from other apertures that may be already defined in the definition table. In the generating phase we calculate, simplify and display the pattern formulas. Eight classes of apertures are considered as the elementary apertures, and eight formulas to calculate their patterns were built in the system, together with five transformation formulas to synthesize apertures.

The 12th International Congress
on Acoustics, Toronto, Canada,
July, 24-31, '86

Experimental Analysis on Variability of Speech Spectrum of a Speaker over Time

K. NAGATA, H. MURAKAMI and K. SAIKAWA

The word uttered even by the same speaker hardly represents the same spectrum time patterns when the speaker utters the same word at the different times. This variability causes the increase in error rates in the automatic verification of speakers.

This paper has investigated the main cause of this variability. The short-term LPC analysis was used to estimate the transfer functions of the vocal tract and glottal waveforms from vowel sounds. Estimates are not perfect, but are adequate for these experiments. The 52 vowel segments of utterances over one year were analyzed by LPC analysis. According to the experiments, it was found that the variability on the transfer functions of the vocal tract is generally dominant.

International Magnetism confer-
ence April 14-17, 1987, Tokyo,
Japan

Fast and Stable Non-Linear Converging Method

Y. KANAI, T. ABE, M. IZUKA and K. MUKASA

In this paper, a non-linear converging method in the finite element analysis for magnetic field problems are proposed. Two types of materials with different saturation characteristics are considered. One has a gradual saturation characteristic and is called gradual saturation, the other has a quick saturation characteristic and is called quick saturation. A simple model, in which the value of magnetic flux density B for the applied magnetic field H can be evaluated analytically, was used for the numerical calculation. It is known that for materials with gradual saturation, the Newton-Raphson method is efficient for non-linear converging. For the materials with quick saturation there are some examples in which it does not work so well. Conditions for the Newton-Raphson method to be applicable are studied both theoretically and numerically. A new fast and stable iterative method with some sort of relaxation is proposed. Using some numerical examples, it is shown that the fast and stable convergence in the numerical analysis for material with not only gradual saturation but also that with quick saturation is obtained.

First Optoelectronics Conference (OEC '86), Tokyo, Japan, July 29-31, 1986

Graded-Core Stress-Applied Polarization-Maintaining Fibers

Kazuya HAYATA, Masanori KOSHIBA and Michio SUZUKI
Department of Electronic Engineering, Faculty of Engineering,
Hokkaido University,
Sapporo 060, Japan

Various refractive-index profiles of single-mode fibers have recently been proposed in order to extend the degree of freedom for their design. The most representative examples are the so-called dispersion-shifted single-mode fibers, whose dispersion is zero near $1.55 \mu\text{m}$, for use in a long-span, large capacity optical transmission systems. On the other hand, single-mode fibers which can maintain a state of polarization, i. e. polarization-maintaining fibers, are extensively studied by many researchers for use in coherent optical communication systems and/or fiber-optic sensing devices.

In this paper, to extend the degree of freedom for the design of the polarization-maintaining fibers and to obtain preliminary data for the realization of dispersion-shifted polarization-maintaining single-mode fibers, we propose stress-applied polarization-maintaining fibers with a graded-core profile and investigate their polarization-mode properties taking α -power refractive-index profile as an example.

Second Japanese-Sino Sapporo-Shenyang International Conference on Computer Application, Sapporo, Japan, Sep. 27-30, 1986

Finite-Element Solution of Planar Inhomogeneous Waveguides for Magnetostatic Waves

Yi LONG, Masanori KOSHIBA and Michio SUZUKI
Department of Electronic Engineering, Faculty of Engineering,
Hokkaido University,
Sapporo 060, Japan

A numerical approach based on the finite-element method is described for the solution of planar inhomogeneous waveguides for MSW modes. The approach to MSFVW, MSBVW, and MSSW modes of ferrite thin films with α -power magnetization profile is presented. The influences of the magnetization profile on the delay characteristics of these MSW modes are examined by using the microcomputer PC-98XA.

The 59 th Annual Meeting of the
Korean Chemical Society,
February 1987, Seoul, Korea

“Recent Advances of Organic Synthesis Using Vinylic Boranes” (Invited Lecture)

Akira SUZUKI

A general and convenient method for stereo- and regioselective synthesis of conjugated alkadienes, alkenynes, arylated alkenes, and other olefinic compounds was presented. The reaction of (E)- or (Z)- 1-alkenyl (disiamyl) boranes, or 2-(E)-1-alkenyl-1, 3, 2-benzodioxaboroles and (Z)-1-alkenylboronates with either (E)-or (Z)-alkenyl halides in the presence of a catalytic amount of tetrakis (triphenylphosphine) palladium and bases such as sodium alkoxides gives the corresponding (E, E), (E, Z)-, (Z, E)-, and (Z, Z)-conjugated alkadienes stereo- and regioselectively. The reaction proceeds through retention of the configuration of both the starting alkenylboranes and haloalkenes.

The 4 th Japan-China-US Sym-
posium on Organometallic Che-
mistry and Catalysis, September
1986, Tsukuba

“Haloboration Reaction and its Application to Organic Synthesis” (Invited Lecture)

Akira SUZUKI

B-Bromo-or B-iodo-9-borabicyclo[3.3.1]nonane (B-X-BBN) and other haloboranes such as BBr_3 react with 1-alkynes through Markovnikov cis-addition of the X-B moiety to $C\equiv C$ bonds. The haloboration occurs chemoselectively at the terminal $C\equiv C$ bonds, but not at the internal $C\equiv C$, terminal and internal $C=C$ bonds. The haloboration adducts thus obtained are valuable intermediates to afford various organic compounds stereo- and regioselectively in good yields.

The 100 Anniversary Meeting of
the Discovery of Fluorine,
August 1987, Paris, France

“Hydrogen Fluoride-Organic Base Solutions as Useful Fluorinating Agents”

Norihiko YONEDA, Tsuyoshi FUKUOKA and Akira SUZUKI

Solutions of anhydrous HF-organic base were investigated in the fluorination of organic compounds. In the fluorination of alkenes, solutions of 14-23 wt % of melamine in hydrogen fluoride surpass other amine-hydrogen fluoride reagents, including the Olah's reagent (30 wt % of pyridine in hydrogen fluoride), with regard to its preparation, handling, activity, and post-treatment.

1987. International
Dissolving and Specialty Pulps
Conference March 24-27
Hotel Intercontinental Geneva
Geneva, Switzerland

(1 $\bar{1}$ 0) Molecular Sheet Structure of Cellulose

J. HAYASHI
Professor, Department
of Applied Chemistry,
Faculty of Engineering
Hokkaido University
Sapporo, 060 Japan

J. NAKAGAWA and S. ASANO
Senior Research Chemists
Kurare Corporation
Central Research
Institute
Kurashiki, Japan

It has been suggested that (1 $\bar{1}$ 0) plane of cellulose crystallite is a sheet plane of molecular chains. But there is no decisive evidence pointing to the independent behaviour of the molecular sheet as one body. In this work, it was revealed that crystallites of cellulose regenerated from a solution of cellulose xanthate and that it was formed by stacking up the sheet plane. The crystallite size of [1 $\bar{1}$ 0] direction had a relatively large value in the early stage of growth and no change with a growing time was seen. And the size of [1 $\bar{1}$ 0] direction increased with the time. In the presence of zinc sulfate in a coagulating bath, (1 $\bar{1}$ 0) of cellulose crystallite is oriented well to rayon and cellophane surface. The mechanism of the uniplanar orientation of (1 $\bar{1}$ 0) by zinc sulfate was studied. Zinc sulfate in a bath met with alkali in viscose in the course of spinning or cellophane film, and temporarily formed an oriented plate crystallite of basic zinc sulfate on the surface of the fiber or the film. And crystallites of cellulose grew epitaxially on the surface of the plate crystallites of the basic salt putting the plane of the molecular sheet of cellulose.

Cellucon '86 Wood and Cellu-
losics July 14 th-18 th, 1986
Wrexham, Wales, UK.

Crystalline Polymorphism of Cellulose Triacetate

Mitsuo TAKAI, Keiji FUKUDA, Mituhiro MURATA and Jisuke HAYASHI
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Sapporo, Hokkaido, 060 Japan.

It was proved that cellulose triacetate (CTA) I can be formed completely by the heterogeneous acetylation of prehydrolyzed Fortisan of cellulose II as well as cellulose I when the swelling in the pretreatment media is low. In connection with the crystalline structures for cellulose I and cellulose II reported recently, the general concept of the dependency of CTA on the cellulose structure, namely that CTA I is formed from cellulose I and consists of a parallel structure, and CTA II from cellulose II and is of an antiparallel structure, is contradicted. Transformation of CTA I to CTA II can be obtained by superheated steam treatment with the retention of the fibrous form. This transformation was examined by treating both poorly ordered (amorphous) and well-ordered (crystalline) CTA I with steam. The former is almost completely transformed from CTA I to CTA II, but the latter showed about 40 % conversion from CTA I to CTA II. In addition, it is more difficult to obtain the transformation from bacterial CTA I to CTA II by the same treatment. Nevertheless CTA I from cellulose II of mercerized bacterial cellulose is easy to transform to CTA II with the treatment, regardless of the crystallinity of CTA I. It may be associated not only with the effect of superheated steam on swelling, but also with the different patterns of hydrogen bonding between ramie and bacterial celluloses.

Cellucon '86 Wood and Cellu-
losics July 14 th-18 th, 1986
Wrexham, Wales, UK.

The Mechanism of Transformation to Cellulose II to I

— Mercerization of Bacterial and Valonia Cellulose —

Jisuke HAYASHI and Yoshihito YAGINUMA
Faculty of Engineering, Hokkaido University, Sapporo, 060, Japan

On bacterial and valonia cellulose membranes, it is very difficult to transform to cellulose II from I by mercerization. It has been recognized that the reaction proceeds slowly because of their high crystallinity. It was found that in only 3 minutes Na-cellulose I was formed completely on bacterial cellulose and partially on valonia cellulose. The regenerated cellulose from the complete Na-cell I were mixtures of cellulose I and II. The ratio of II increased with the reaction time and reached 100 % at 360 to 1200 hr. In our previous work it was found that there were Na-cell I₁ and I₁₁ and the former was able to regenerate cellulose I. And we proposed the hypothesis that Na-cell

I_I and cellulose I, and Na-cell I_{II} and cellulose II have the same skeletal chain conformation, respectively. The polymorphs and derivatives from cellulose I can revert to cellulose I as far as they maintain the conformation of I. The Na-cell I in this work should be the mixture of Na-cell I_I and I_{II}.

1987. International Oxygen Delignification Conference June 7-11 San Diego, USA

Alkali-Oxygen Pulping of Rice Straw

Kunio TOSAKA and Jisuke HAYASHI

Faculty of Engineering Hokkaido University North 13 West 8 Sapporo, 060 Japan

Sodium hydroxide was added to rice straw in it following three manners and oxidized in an autoclave by oxygen gas of 1-5 kg/cm² at 80°-120°C for 60 min.

(a) Rice straw was soaked in a solution of 1-3 % NaOH at 20°-120°C for 10-180 min., then the sample was squeezed to attain a weight of twice the original rice straw.

(b) By spraying, 3-6 % NaNaOH was added to rice straw up to 10-40 % of the weight of the rice straw, this was allowed to stand for 0-240 min, at 20°-60°C.

(c) Rice straw was pretreated in water at 100°C for 60 min. After squeezing the rice straw to weight of twice the original the reice straw itself, alkali solution was added by spraying as mentioned in method (b).

The pulp obtained at high screened yield of 44.2-49.9 % showed good paper strength, 4.2-7.3 km in breaking length, 2.0-4.5 in burst factor, 48-75 in tear factor and high brightness of 45.5-67.0 %.

1987. International Oxygen Delignification Conference June 7-11 San Diego, USA

Enzymatic Saccharification of Grasses Pretreated by Oxygen Oxidation

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For the enzymatic sacchrification of grasses, pretreatment methods based on delignification by alkali-oxygen oxidation were studied.

These treatments were especially effective for grasses. 10g of grasses were immersed in a solution of 0.5-3.5 % NaOH at 20°C for 1 hr and squeezed to 30 g, and then oxidized with oxygen of 5 Kg/cm² at 40°~120°C for 1 hr.

By the oxidation with 3.0~4.0 % of the added NaOH based on the weight of raw materials at 80°C or with 6 % of the added NaOH at 60°C, bagasses were delignified about 80 % of the original lignin. By these pretreatments, the digestibilities of bagasses with "cellulose ONOZUKA R-10" were promoted to about 90 % from 20 % of the control. The same pretreatment was carried out by the oxidation with 2 % of the added NaOH and Oxygen of 0 Kg/cm² at 80°C, the digestibility was 84.0.

1st Soviet-Japanese Seminar on
M e c h a n o c h e m i s t r y ,
Novosibirsk, U.S. S. R. August
21-23, 1986

Thermal Characterization of Near-Surface of Oxides by Emanation Thermal Analysis

Tadao ISHII
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Hokkaido University, Sapporo 060, Japan

Emanation thermal analysis (ETA) using a surface impregnation method with ²⁶⁶Ra parent isotope was applied to the thermal characterization of the near-surface of iron oxide and aluminum oxide powders with various preparation histories. The effects of the heating and grinding treatments on the characteristic ETA peaks were complicated, but the ETA technique was an interesting tool for the study of the thermal behaviour of the powders under the working state at high temperatures.

Sino-Japanese Joint Symposium
on Calorimetry and Thermal
Analysis, Hangzhou, China,
Nov. 5-7, 1986

Application of Emanation Thermal Analysis to Inorganic Materials

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The usefulness of emanation thermal analysis (ETA) was examined in the study of the thermal behaviour of the near-surface of oxide powders, iron oxide and aluminum oxide, under the working state at high temperatures. Further, the surface reactivity of the powders for the solid solution formation was measured by means of ETA on the systems iron oxide-aluminum oxides (1 : 1 molar

ratio) in the range 25-1450°C under a controlled temperature program of 10°C/min in N₂-flow atmosphere.

Sino-Japanese Joint Symposium
on Calorimetry and Thermal
Analysis, Hangzhou, China,
November 5-7, 1986

**Thermoanalytical Study on the Reactivity of Amorphous Aluminas Prepared
by the Thermal Decomposition of Aluminum Chloride and Nitrate**

Takeshi TSUCHIDA, Ryusaburo FURUICHI and Tadao ISHII
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The physicochemical properties and reactivity of amorphous aluminas, Al₂O₃ (Cl) and Al₂O₃ (N), which were prepared by thermal decomposition of AlCl₃ · 6H₂O and Al (NO₃)₃ · 9H₂O at 600°C for 2-300 hr, were investigated by means of TG, DTA, X-ray diffraction, SEM and IR. The reactivity of Al₂O₃(Cl) for ZnAl₂O₄ formation was higher than that of Al₂O₃(N) and was influenced by the content of residual chlorine in Al₂O₃(Cl). The rate of ZnAl₂O₄ formation followed the Avrami-Erofeev equation in the ZnO-Al₂O₃(Cl) system and the Jander equation in the ZnO-Al₂O₃(N) system.

11 th IUPAC Symposium on
Photochemistry, July 27-Aug. 1,
1986, Lisbon, Portugal

**A New photorearrangement of a steroidal α , β -Unsaturated
Cyclic Ketone Oxime involving an Intramolecular Stereospecific
Transfer of the Hydroxyimino Proton**

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The pathway for a novel stereospecific photochemical rearrangement of a steroidal α , β -unsaturated oxime into a steroidal isoxazoline in protic or aprotic solvent is advanced on the basis of the deuterium labeling studies etc. The pathway of the rearrangement involves an intra-

molecular diastereospecific transfer of the hydroxyimino proton to form a cationic intermediate followed by the formation of an intermediary olefinic nitrile oxide by an ionic cleavage and its intramolecular 1, 3-dipolar addition. The present rearrangement appears to be the first case of the intramolecular photoinduced protonation of a C=C bond involving a proton transfer via 5-membered transition state.

The 1st International Symposium on Electroorganic Synthesis, Oct. 31-Nov. 3, 1986, Kurashiki, Japan

Remote Acetamidation of Steroids By Anodic Oxidation

M. TOKUDA, T. YAMASHITA and H. SUGINOME
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University, Sapporo 060, Japan

Anodic oxidation of 5 α -cholestan-3 α -yl esters with a carbonyl or a m-iodophenyl group in their 3 α -substituent in acetonitrile containing 0.1 LiClO₄ at a controlled potential gave the corresponding 6 α -acetamidated cholestanyl esters in 7-26 % yields, together with the esters carrying two or more acetamide functions.

The 1987 International Congress of Membranes and Membrane Processes, June 8-12, Tokyo, Japan

Effect of Cholesterol Analogues on Phase Transition and Micropolarity in Lipid Bilayer

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University, Nagasaki 852, Japan

**Department of Chemical process Engineering,
Hokkaido University, Sapporo 060, Japan

It is well known that 3 β -OH group of cholesterol plays an important role in the phospholipid-cholesterol interaction. We investigated the effect of cholesterol and its analogues on the fluidity and packing in the lipid bilayer membranes from several aspects of the phase transition energy (ΔH)

from DSC and the fluorescence depolarization and emission spectra from fluorescence spectroscopy. The results indicated that the direct interaction or the indirect interaction *via* specific hydrogen bonding between the polar head group of lecithin and 3β -OH of cholesterol is not necessarily required for the stabilization of lipid bilayer membranes.

Asian Pacific Confederation of
Chem. Eng., Singapore, 13-15
May 1987

Prediction of Self-Heating of Hazardous Particulate Matters
— Simulation of Ignition Temperature and Induction Period —

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While a cylindrical deposit of combustible dust is exposed to the environment at a constant ambient temperature, the thermal behavior is described by the equation in terms of heat conduction including heat generation. First, the equation is solved numerically by using the finite element method for cork dust, whose physical and chemical properties are known, to confirm if the calculated ignition temperature and induction time are in good agreement with the experimental data currently reported by Leuschke. Second, all of the variables involved with the basic equation are reduced to some dimensionless groups, so that the numerical relationships among the dimensionless groups can be simulated. A nomogram is then proposed to readily determine the ignition temperature from the physical and chemical properties of a given dust and the size of deposit.

The 3rd Japan-Belgium
Binational Seminar on Polymer
Science, Sapporo 060 JAPAN
1986

**Characterization of Polyethylene Polymerized by Mechano-
chemically Treated Alumina-catalyst**

J. SOHMA and M. TABATA
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Mechano-chemical polymerization initiated by a milled alumina was found by us¹⁾. Recently we found that mechano-chemically pretreated alumina initiated polymerization of ethylene and molecular weights of polyethylene produced by this method distributed very widely from 10^2 to 10^8 . Characterizations of polyethylenes extracted with conventional solvents were tried by both IR and

NMR methods. Both measurements indicated that both branched polyethylene of low molecular weight and actually non-branched polyethylene of high molecular weight were simultaneously produced. The degree of branching of produced polyethylene seemed to be continuously distributed from very high to none. Soluble polyethylene was nearly 50 % of total products and the other half remained on the alumina surface. ^{13}C -NMR spectra from solid samples was observed by the CP-MAS method before and after the extraction. A spectrum observed after the extraction appeared as a sharp single line, which means no presence of branching and carbon atom bonded to alumina. No observation of carbon atom bonded to alumina is interpreted as either no bonded carbons. Either case suggests us that nearly fifty percent of the produced polyethylenes have an extremely high molecular weight, probably higher than 10^8 .

1) N. KUROKAWA, M. TABATA and J. SOHMA, J. APPL, Polym, Sci. **25**, 1209 (1980).

ICSM '86 The 8 th International
Conference on Science and
Technology of Synthetic Metals,
Kyoto. 1986

Electron Spin Resonance Studies of Magnetic Defects in Polyphenylacetylene

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Faculty of Engineering, Hokkaido University, Sapporo 060 JAPAN

The electron spin resonance (ESR) study on free radicals observed in polyphenylacetylene (PPA) was performed in detail in order to know whether or not the spin concentration was increased by not only heat treatment but also doping and to interpret the conducting mechanism of this polymer. Reddish PPA-R polymer ($M_w = 30,000$) was obtained by using WCl_6 as the catalyst in toluene at 0°C . The ESR spectrum of the PPA-R showed a singlet absorption ($g = 2.0026$ and $\Delta H_{\text{msl}} = 12\text{ G}$).¹⁾ It was found that the increment of the spin concentration was induced by heat treatment of the polymer. Although the intensity change was irreversible below 80°C the increase was irreversible at temperatures higher than 80°C and on up to 250°C . Doping of the PPA-R with I_2 , IBr and ICl as electron acceptor induced the increase of spin concentration. The iodine monochloride acted as the strongest oxidation reagent. The ESR spectrum observed after doping with the ICl and at -196°C was interpreted in terms of the Dysonian line shape. Based on the line shape observed we concluded that the PPA-R by doping with a small amount of the ICl was induced from insulator to conductive material, that is, a metallic state.

1) M. TABATA et al., The 23 rd ESR symposium, Kanazawa 1984.

International Conference on
Holography Applications,
Beijing, China, July 2-5, 1986

Hologram Filters for Optical Image Processing

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In optical image processing, a hologram filter often plays an important role as a spatial filtering element which spatially modulates or transforms the input object into the output image.

We review the recent development of hologram filters for optical image processing. Designing and fabricating techniques of the hologram filters are discussed, and the applications of the filters to optical image processings are shown, which include image operation, image restoration, matched filtering, image transformation and wavefront conversion.

International Conference on
Holography Applications,
Beijing, China, July 2-5, 1986

Optimum Holographic Disk Scanners with Bow-Locus Corrections

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Hokkaido University, Sapporo 060, Japan

Laser beam scanning has increased in importance as a recording device. The scanning line of disk-type rotating holographic grating has an unwanted curved scan locus. Such applications require flat-field straight line scanning.

This paper provides a design of a holographic scanning method with a diode laser to correct for bow-scanning locus and to reduce the aberration due to a recording-readout wavelength shift. The design of the scanner based on a ray-tracing and iterative optimization techniques such as the damped least-squares (DLS) method allows for a bow-free scan at wide scan angles.

Non-Crystalline Semi-
conductors '86, Balatonsze'plak,
Hungary, 16 September, 1986

**Pressure-structural and optical studies
of glassy chalcogenides**

Keiji TANAKA

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Hokkaido University, Sapporo 060, Japan

Over the past several years it has been amply demonstrated that pressure experiments provide valuable information regarding electronic and structural properties of chalcogenide glasses. Most of these experiments are performed by using diamond-anvil cells, which make generation of purely hydrostatic pressure up to 100 kbar possible. Pressure-induced changes in optical absorption edges, photoluminescence spectra, Raman scattering spectra, X-ray diffraction patterns and sample dimensions have been studied.

These results indicate that the chalcogenide glass is composed of covalent molecular clusters held together with weak intermolecular forces of the van der Waals type. Hydrostatic compression decreases the intermolecular distance, and enhances distortion and cross-linking of the clusters. (Pressure effects are, thus, much more drastic in chalcogenide than in tetrahedral materials.) The structural changes bring about the red-shift of optical absorption edges and decrease the slope of the Urbach tails.

This paper will review the pressure studies, with particular focus on compositional variations of the pressure dependence and on photoinduced structural changes under pressure.

Proceedings of the International
Symposium on Shape Memory
Alloys, Guilin, China, 6-9 Sep-
tember, 1986

**Composition Dependence of the Transformation Behavior at
Moderate Temperature in Cu-Zn-Al Shape Memory Alloys**

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The morphological and structural changes are examined in Cu-Zn-Al SM alloys with various compositions during the isothermal treatment at moderately high temperatures. In alloys with a smaller electron atom ratio, e/a , the typical bainite plate with 9R structure is formed at comparatively lower temperatures from 450 to 500 K. At temperatures from 500 to 600 K, the structural change 9R \rightarrow fcc takes place inside the plate where the trace of phase boundary becomes

wavy. At higher temperatures from 550 to 700 K, the rod α is transformed directly from the matrix. As e/a increases, the individual bainite plate formation is suppressed and instead the precipitation of γ_2 phase dominates ahead of the plate formation. The electron diffraction analysis shows that the bainite has a disordered structure when e/a is small but the ordering proceeds as e/a increases. The mechanism of the bainite formation is discussed on the basis of the above results as well as the macroscopic shape change so far observed during the isothermal treatment at moderately high temperatures.

Proceedings of The International Conference on Martensitic Transformations (1986) pp. 631-636, The Japan Institute of Metals, Nara, Japan, 26-30 August, 1986

Considerations Applied to the Structural and Morphological Change On the Growth of Bainite Plate in Cu-Zn-Al Alloys

K. TAKEZAWA and S. SATO

The following distinct features are revealed by electron microscopy on the growth of bainite plate in Cu-Zn-Al alloys: (1) The bainite has a disordered structure. (2) The thin plate bends at the border site between the heavily faulted and defect-free regions in the plate. (3) The habit trace of 9R bainite plate bows out where the 9R transforms to fcc. (4) Dislocations exist on the habit plane and special strain contrasts appear periodically in the matrix corresponding to these dislocations. These results suggest that the slip dislocations play a role on the growth of bainite plate. Accordingly in this study, a calculation is performed by using the phenomenological theory of martensitic transformation to discuss the growth mechanism of the bainite plate. A possible slip deformation is introduced in addition to the faulting as the lattice invariant shear and the lattice distortion matrix is calculated under the condition of invariant plane strain. The results interpret the observed bending of habit traces as well as the change in the habit plane index so far reported. Moreover, it is understood that the bainitic process is a single reaction even though the structural change takes place in two steps.

Proceedings of The International Conference on Martensitic Transformations (1986) pp. 625-630, The Japan Institute of Metals, Nara, Japan, 26-30 August, 1986

A Mechanism of the Bainitic Transformation in Cu-Zn and Cu-Zn-Al Alloys

K. TAKEZAWA and S. SATO

The macroscopic shape change due to the bainitic transformation in Cu-Zn-Al alloys is carefully measured under applied stress during isothermal heating at moderate temperature. The amount of the shape change is as large as that due to the martensitic transformation, such as in SM, RSM or PE. The variation of the shape strain fits in one of the theoretical curves of Austin-Ricketts equation, despite the fact that the transformation involves two structural changes, B2→9R→fcc. A detailed examination is made on the morphological and structural change in the process and consequently the following mechanism of the bainite formation is proposed: (1) The bainite with 9R structure nucleates martensitically at a site where the concentration of solute atom is reduced through a directional diffusion caused by the stress field around some irregularities in the matrix crystal. (2) At the tip of 9R bainite plate, the stress concentration again produces the directional diffusion which accelerates the growth of the plate. (3) Because fcc is stable at the treatment temperature, the structural change, 9R→fcc, occurs during the growth of 9R by the faulting process accompanying with a slip deformation.

The Eighth International Heat Transfer Conference, San Francisco, U. S. A., August 17-22, 1986.

An Experimental Study on Intensive Condensation of Potassium

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The objective of the present study is to examine the behaviour of metal condensation, including intensive condensation far removed from equilibrium. In the present experiment, highly accurate measurements of condensation rate, condenser surface temperature and vapour pressure were made possible. In addition to the techniques for these measurements, the vacuum distillation method was

utilized to ensure that the results were not affected by the presence of non-condensable gases. In addition, the conformity in the vapour flow field of the present experiment to the analysis to be compared was also assured.

Measurements were made in a vapour temperature range from 553 K (23 Pa) to 633 K (223 Pa). It was found that the present results which were thought to provide the most reliable data for condensation of a metal are in agreement with the recent analytical study of Labuntsov and Kryukov, and that the condensation coefficient of metal is very close to unity.

Proceedings of the Ninth International Conference on MHD Electrical Power Generation, Vol. 2, Tsukuba, Nov. (1987), pp. 847-855.

Formation of Magnetohydrothermal Waves and Their Stability Limits

Naoyuki KAYUKAWA
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Conditions of interactions between perturbations in the electrothermal fields and those in the hydrodynamical flow field were discussed by examining a 3-D dispersion relations calculated from the linearized MHD equations for a laminar unbounded plasma. The dispersion relation for coupled electrothermal and hydrodynamical waves was obtained in the electrode boundary-layer region, and the stability limits were obtained. It is shown that the critical wave number well predicted the periodic arc-spot patterns on anode upstream edges observed in a Faraday-type MHD channel working with a shock-heated equilibrium plasma.

Proceedings of the Ninth International Conference on MHD Electrical Power Generation, Vol. 2, Tsukuba, Nov. (1986), pp. 449-458.

SFC-Type MHD Generator Performance

Naoyuki KAYUKAWA, Shun-ichi OIKAWA and Yoshiaki AOKI
Hokkaido University, Sapporo, 060 Japan

This paper describes some experimental results recently obtained in a shock-driven MHD generator with a two-dimensionally shaped B-field configuration (SFC-Type). The data include the power density dependence upon the magnetic field, the voltage distribution and the voltage drops in boundary-layers, the arc-spot observation by a high speed camera, and the post-test inspections of arc-spot traces on the anode and the cathode. The same items were examined under the condition of a uniform B-field configuration (UFC-Type) with the same plasma conditions, and both data were compared and discussed.

Proceedings of the Ninth International Conference on MHD Electrical Power Generation, Vol. 2, Tsukuba, Nov. (1986), pp. 439-448.

Three-Dimensional Calculation of Large Scale SFC-Type MHD Generator

Shun-ichi OIKAWA, Yoshiaki AOKI and Naoyuki KAYUKAWA
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Three-dimensional electrical and hydrodynamical characteristics of an MHD generator with Shaped B-Field Configuration (SFC-Type) were analyzed by solving parabolized Navier-stokes equations coupled with the generalized Ohm's law and the Maxwell equations. The magnetic Field in SFC-Type was two-dimensional, since the Bz-component was reduced within the cold boundary layers in order to reduce electrical losses coupled with the Hall effect. The finite element method (FEM) was used for analyses in the duct cross-section and the Crank-Nicolson method to analyze the axial variations. Results were compared with those of the conventional MHD generator. It was concluded that the suppression of the Hall current density in the electrode boundary layer in the SFC-Type made the secondary flow weaker and the anode boundary-layer separation was less likely to occur than in the UFC-Type.

X World Congress of Cardiology
Washington, D. C., U. S. A. Sep-
tember 14-19, 1986

In Vivo Measurement of the Sclerotic Change and Viscotic Properties of the Human Aorta

Takashi IMURA, Katsuyuki YAMAMOTO, Toshiya SATOH,
Katsushi KANAMORI, Tomohisa MIKAMI and Hisakazu YASUDA
Dept. of Cardiovascular Medicine, School of Medicine
and Res. Inst. of Appl. Electricity, Hokkaido University

To measure the visco-elastic properties of the in vivo human aorta, a new echo tracking device linked to cross sectional echography was developed. Pulsatile diameter change (ΔD) and diameter (D) of the abdominal aorta were noninvasively measured in 75 subjects (20-89 years) with this ultrasonic device, the accuracy of which was in the order of 10^{-3} mm for ΔD , and around 0.5 mm for D . Pressure strain elastic modulus (E_p) and viscous loss modulus ($\omega\eta$), and phase were calculated with a computer from ΔD , D , and blood pressure obtained by the auscultatory method and catheter tip micromanometer. Mean E_p value was 2.1×10^6 dyne/cm². E_p was significantly increased with age ($p < 0.001$). The regression equation relating E_p to age was $E_p = (-0.72 + 0.058 \times \text{age}) \times 10^6$ dyne/cm² ($r = 0.73$). Mean $\omega\eta$ value ($n = 14$) was 1.83×10^6 dyne/cm², which was obtained from the area of the hysteresis loop in the pressure-radius relationship. Mean phase was 0.087 radian. The phase did not increase with frequency. **CONCLUSION**: The sclerotic change of aorta progressed with age, moreover, the change was marked in more elderly subjects over the age of 60 years.

Ninth Annual Meeting of the
Bioelectromagnetics Society
Portland, Oregon, June 21-25,
1987

New Techniques for Measurement of ELF Electric Field and Induced Current With the Living Human Body.

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Research Institute of Applied Electricity, Hokkaido University, Sapporo, 060 Japan.

In the study of biological effects of ELF electric field, an accurate measurement of the field on the human body surface and that of the current induced inside a human body are essential. However, there seems to be few techniques available which are suitable for the measurement with a human body. Two techniques were developed which enable us to measure the surface electric field and the induced current. They are; using a flexible and thin sensor, and covering the body surface with a conductive layer leaving the point of measurement uncovered. Using these tech-

niques, the following advantages are obtained which are useful particularly in the measurement with a living human body under high voltage transmission lines. They are ; (1) the electric field at the curved surface such as the nose, a finger, an eye, etc. can be measured. (2) The upper and lower limits of true electric field is obtained, i. e. the field strength is estimated with a known error boundary. (3) The current induced in various parts of a human body can be measured without surgical invasion or amputating the body. The effectiveness of these techniques was verified with a human model of axial symmetry made by a conductor. Then they were applied to a living human body standing under high voltage transmission lines. The measured exposure levels can be compared with the physiological thresholds for safety assessment. For example, the induced current measured with a living human eye without enucleation was found to be three orders lower than the threshold of the electrical phosphene.

The First Congress of Asian
Federation of Societies for
Ultrasound in Medicine and
Biology June 22-25, 1987
Tokyo, Japan

Noninvasive Measurement of Arterial Elasticity Using Ultrasonic Displacement Meter Linked to Echographic Equipment

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We have developed a system for measuring noninvasively the regional elastic properties of the artery. This system is composed of a newly developed ultrasonic displacement meter, a modified echographic equipment and a personal computer. The ultrasonic displacement meter is linked to the echographic equipment ; therefore, we can select and monitor the measured site by cursors on an echographic image. Phase locked loops of the displacement meter track the movements of anterior and posterior walls of the artery, and measure its pulsatile diameter changes. From pulsatile diameter change, mean diameter and pulse pressure, the pressure strain elastic modulus E_p is computed. The system can also calculate regional pulse wave velocity from pulsatile diameter changes simultaneously measured at proximal and distal sites of the artery.

E_p and pulse wave velocity were measured along the carotid, iliac and femoral arteries and the abdominal aorta. The above parameters concerning arterial elasticity increased progressively with distance to the peripherals. The relationship between E_p and pulse wave velocity showed a good agreement with the well-known theoretical law. In addition, age-related increase in E_p of the abdominal aorta was found in another series of measurement on 20 to 89 year-old subjects. We conclude that our system demonstrates the feasibility of noninvasive detection of atherosclerotic

change.

Carbon '86, Baden-Baden, West
Germany, 30 June - 4 July 1986

**Studies on the Formation of Carbon Microbeads by
means of High-Temperature and High-Pressure
¹H-NMR and ESR**

T. YOKONO, K. MURAKAMI, S. SHIMOKAWA, E. YAMADA
and Y. SANADA

Faculty of Engineering, Hokkaido University, Sapporo 060 Japan

The formation of carbon microspheres from pitch (aromatic hydrocarbon)/paraffin (aliphatic hydrocarbon) system has been studied using high-temperature and high-pressure ¹H-NMR and ESR. Broadening of the ¹H-NMR spectra at high-temperature was found to be closely correlated with the rheological phenomenon resulting from the formation of carbon spheres. A drastic increase in free radical concentration during the formation of carbon spheres was also observed.

From the results of the combination of high-temperature and high-pressure NMR and ESR, the mechanism of carbon microspheres formation was discussed.

Carbon '86, Baden-Baden, West
Germany, 30 June - 4 July 1986

**Hydrogen Donor (Da) and Acceptor (Aa) Abilities of
Coal and Pitch (II)
- ESR Study of Coal and Pitch Doped with Iodine -**

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Optical anisotropic texture of coke depends profoundly upon the amount of hydrogen donor and acceptor abilities of coal and pitch as starting materials.

We found from ESR measurements that spin concentration of coal and pitch doped iodine is closely related to the mesophase development during carbonization. Change of spin concentration of coal and pitch with the addition of iodine is discussed.

Carbon '86, Baden-Baden, West
Germany, 30 June - 4 July 1986

**Hydrogen Donor (Da) and Acceptor (Aa) Abilities of
Coal and Pitch (I)**

- Coalification and Carbonization Paths
in the Da-Aa Diagram -

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*Facultad de Ciencias, Universidad Nacional de Colombia

Characterization of pitches and coals was assessed by using the diagram of hydrogen donor and acceptor abilities. Using this diagram, the reaction pathways of carbonization, coalification, oxidation and hydrogenation of pitch and coal can be easily characterized.

Electron donor property of pitches was evaluated from iodine pitch interaction with ESR technique. Pitch doped iodine showed an increase of radical concentration.

The relation between the hydrogen donor and the electron donor properties is discussed.

Australian Coal Science 2, New-
castle, Australia, December 1-2,
1986

Advances of Coal Characterization in Japan

- Review of Contributions of Japanese Scientists to the
Understanding of Australian Coals -

Yuzo SANADA

Faculty of Engineering, Hokkaido University, Sapporo, 060 Japan

The parameters derived from NMR and ESR methods measured at working temperature and pressure are useful for the understandings of characterization of coal. These methods can be applied to the research areas of coal liquefaction and coke manufacturing. New concepts on hydrogen transfer and electron transfer have a potential for advancement of coal chemistry.

World Congress III of Chemical
Engineering, Tokyo, Japan 21-25
September 1986

On the Regime of Fast Fluidization

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Synopsis

The regime of fast fluidization was characterized by two velocities, U_{FF} and U_{DT} , defined on the basis of new data from measurement of the static pressure distribution in a 0.10 m i.d. riser of circulating fluidized bed apparatus under a wide range of the circulating solid flow rate controlled independantly of the gas velocity. The former characteristic gas velocity, U_{FF} , is the minimum velocity to keep the solid circulation rate at a steady level while the latter, U_{DT} , the velocity below which a gap appears in the pressure drop along the height when the gas velocity is reduced from those for the dilute transport regime. In the state of fast fluidization thus defined, the presence of densely packed cluster of solid particles was ascertained near the center core part of the riser by means of flow visualization.

World Congress III of Chemical
Engineering, Tokyo, Japan 21-25
September 1986

Studies of Segregation/Mixing in Fluidised Beds of Different Size Particles

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Synopsis

Binary, tertiary and quaternary systems of different size particles of equal density were fluidised in a 0.15 m diameter column with a porous, perforated plate and bubble cap distributors and thus segregation patterns were obtained.

It was shown that the behaviour of binary systems of equal density and unequal size is similar to that found with a density difference. For higher order systems, highly complex segregation patterns resulted when expressed as a mass fraction of components. However, if expressed as a function of Sauter mean diameter, simpler patterns emerged, similar to those for binary systems. As a result, an analogous mixing index and take-off velocity could be defined and correlations for these parameters were presented. It was also shown that perforated plate and bubble cap distributors give rise to significantly improved mixing compared to a porous plate at the same gas velocity.

World Congress III of Chemical
Engineering, Tokyo, Japan 21-25
September 1986

**Effect of the nature of parent coal on the Changes in Structure and Intrinsic
Reaction Rate during Coal Char Gasification by CO₂ and H₂**

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**Coal Mining Research Center

2-10 Jinbo-cho, Kanda, Chiyoda-ku, Tokyo 101

Synopsis

Systematic experiments of coal char gasification were carried out in a high pressure TGA apparatus. Chars obtained from thirteen different kinds of coals were gasified by CO₂ or H₂ at temperatures of 1073K to 1273K and under pressures of 0.4 to 3.0 MPa. The BET surface area and carbon structure of the deashed-char residue from gasification were determined at various char conversions.

Dependencies of the apparent initial rate of gasification on pressure were different for different chars and gases and varied with conversion. During gasification the surface area of char increased rapidly at the initial stage and decreased after attaining a maximum value. Thus, the intrinsic reaction rate on the basis of char surface area decreased with conversion in all cases. Carbon structure of char also varied with the conversion. The (002) graphite peak in X-ray diffraction spectrum grew appreciably at the final stage of gasification of some kinds of chars.

Asian Chemical Congress '87
Seoul (ASCHEM SEOUL) June,
1987, Seoul, Korea

Joining of Magnesia to Nickel and Mutual Diffusion in the System NiO-MgO

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The joining of magnesia to nickel metal at the temperatures from 1473 to 1673 K was studied. A preoxidized or nonoxidized nickel specimen was placed on a block of magnesia and was bonded with each other at the experimental temperatures for 3.6 to 144 ks in air. The fracture strength of the joining parts was measured by three-point-bending tests. The micro-structures of the diffusion layers and fracture surfaces were observed by EPMA, SEM and EDX. The best adhesion of the joining parts was observed. The fracture strength of the joining parts ranged from 30 to 70 MPa.

The mutual diffusion coefficients in the system NiO-MgO were determined from the concentration-distributions of the joining parts obtained with the aid of EPMA analysis. In order to determine the mutual diffusion coefficients, the Boltzmann-Matano method was used. The mutual diffusion coefficients represented by

$$D = 4.3 \times 10^{-9} \exp(-186000\text{J}/RT) \text{ m}^2\text{s}^{-1}$$

As results of analyses, the molar fraction of oxygen was nearly constant for the whole portion of diffusion layers. Since there were no net flux of oxygen atoms, a one-for-one interchange of cations must occur.

Sino-Japanese Joint Symposium
on Calorimetry and Thermal
Analysis Hangzhou, China
November 3-8, 1986

Thermoanalytical Study on the Catalytic Effect of α -Fe₂O₃ on the Thermal Decomposition of KClO₄

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The catalytic effect of α -Fe₂O₃ on the thermal decomposition of KClO₄ was studied by TG and DTA methods. The ferric oxides were prepared from FeC₂O₄·2H₂O and FeSO₄·7H₂O by calcining them in flowing air. DTA and TG results showed that the addition of α -Fe₂O₃ led to an acceleration effect on the solid-state decomposition of KClO₄. The acceleration effect increased

with a decrease in the preparation temperature and an increase in the mixing ratios of the oxide. The activation energies E_s and E_1 , which correspond to the energies for solid-state decomposition and liquid-state decomposition, were estimated from TG results. The value of E_s was found to change with the preparation temperature and the mixing ratio of α - Fe_2O_3 in contrast to E_1 value.

Fourth International Conference
on Water Chemistry of Nuclear
Reactor Systems, October 13-17,
1986, Bournemouth, England

Laboratory Study of Dissolution of Magnetite in Solutions Containing Chelating Agents

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In connection with chemical decontamination technology, a study of dissolution of magnetite in EDTA or citrate solution with different pHs were carried out. The dissolution rates reached a maximum value at pH 2 with EDTA, and at pH 4 with citrate. This means that there are optimum pH in the chemical decontamination with these chelating agents. It was found that these optimum pH coincide with the pH where the adsorption of anionic species of chelating agents on magnetite is maximum.

The 3rd Japan-China Bilateral
Symposium on Radiation
Chemistry. Changchun. 22-26,
June 1987

Formation and Reaction of Polymer Ions in Solution Studied by Pulse Radiolysis

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Formation and reaction of polymer anions in the solutions of poly (methyl methacrylate) (PMMA) and poly (4-vinylbiphenyl) (PVB) in hexamethylphosphorotriamide and 2-methyltetrahy-

drofuran were studied by ns pulse radiolysis. (1) In proper solvents solvated electron (e_s^-) reacted with PMMA and PVB to form corresponding anion radicals of polymers. (2) The rate constant depended on the electron affinity of the side chain of the polymers. (3) Absorption spectra of anion radicals of PMMA and its substituted analogues had a strong band at <300 nm and a weak one at 440 nm. The former and the latter were assigned to $\pi-\pi^*$ and $n-\pi^*$ transitions respectively. PMMA anion produced in HMPA disappears according to second-order kinetics. (4) Decay curves of PVB anion in MTHF consisted of a fast decaying component and a slowly decaying one. The former component may be ascribed to geminate-like recombination reaction in the domains where biphenyl groups of PVB are in close order owing to coiling of the polymer, while the latter is due to homogeneous reactions of ions or radicals escaped from initial geminate reaction in the solvent domain. (5) Electron transfer from PVB anion to pyrene and effect of ion-pairing with Na^+ were observed.

The 37th Meeting of International Society of Electrochemistry, Vilnius, USSR, August, 24-31, 1986

Anodic Passivation Films on the Titanium by Ellipsometry and Raman spectroscopy

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Laser Raman spectroscopy and ellipsometry were applied under in situ and ex situ conditions to the anodic oxide films formed on titanium at various potentials in neutral phosphate and acidic sulfate solutions. The Raman spectra reveal that the anodic oxide film is primarily composed of an anatase type of TiO_2 . From the relation between the Raman band intensity, film thickness, and surface morphology, it is likely that the film changes from an amorphous state to a crystalline state beyond a certain critical potential.

The Discussion Meeting of the
Bunsen-Gesellschaft für phys.
Chem. "Structure and Dynamics
of Solid/Electrolyte Interfaces",
Berlin, FRG, Sept. 2-5, 1986

IR Reflection and Raman Spectroscopies of the Anodic Oxide Films on Tungsten

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In order to understand the mechanism of the electrochromic reaction of hydrated WO_3 , the oxide formed on tungsten in sulphuric and perchloric acid solutions was studied by in-situ optical techniques. Ellipsometric measurements reveal that the optical property of the film changes from a transparent substance to a coloured substance at a potential of $E=0.50\text{V}$ (vs. RHE). The IR reflection absorption spectroscopy (IRRAS) shows that the anodic oxide film is strongly hydrated forming two types of OH bonds, one corresponding to the incorporated H_2O and the other to the OH bonded with tungsten ion. The Raman spectroscopy (RS) shows that the anodic oxide film is an amorphous form of hydrated tungsten oxide including a terminal W(VI)=O bond. The mechanism of electrochromic reaction is discussed on the basis of IR and Raman spectra which changes as the potential shifts from the transparent state to the coloring state. The electrochromic process may start with a reaction between the terminal W=O and the incorporated H_2O : $\text{W(VI)=O} + \text{H}_2\text{O}_{(\text{film})} + e \rightarrow \text{W(V)-OH} + \text{OH}^-_{(\text{film})}$. The $\text{OH}^-_{(\text{film})}$ formed reacts in the film with H^+ injected from the acid aqueous solution.

First Optoelectronics Confer-
ence (OEC '86) July 29-31, 1986,
Tokyo

Optical Fiber Sensors

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Optical fibers have been successfully fabricated for practical use in optical communications,

and their excellent properties are also recognized to be suited as sensors susceptible to physical and chemical parameters. The potential benefits of optical fiber sensors stem from their inherent immunity to electromagnetic interference, and electrically passive functions that are compatible with intrinsic safety requirements. In addition long distance transmission distances using fiber links are available for remote sensing. At the same time a highly intrinsic sensitivity is present from the intrinsic safety in chemically hazardous areas where a flammable atmosphere may be present. The current state of the art of optical fiber sensors was reviewed, and the trend in the development of fiber sensing technology was also outlined.

First Optoelectronics Conference (OEC '86) July 29-31, 1986, Tokyo

Accurate Birefringence Measurements of Single-Mode Optical Fibers by Two-Frequency Interferometry

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The beat length of a birefringent single-mode fiber is an important parameter that specifies the polarization maintaining ability of the fiber in which the orthogonal eigen-mode components HE_{11}^x and HE_{11}^y of the HE_{11} modes are propagated. In this paper is presented a novel method of its measurements by use of an orthogonally polarized two-frequency laser beam. The technique is basically dependent on the phase measurement of a heterodyne photocurrent signal whose phase is linear to the modal birefringence of the fiber.

The 4th International Conference on Solid-State Sensors and Actuators (Transducers '87)
June 2-5, 1987, Tokyo, Japan

Electric-Field Sensitive Optical Fibers With Radially Poled Piezoelectric Fluoroplastic Jacket

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An electric-field sensitive optical fiber utilizing a radially poled piezoelectric fluoroplastic jacket is used for application as an all-fiber optical phase modulator. The plastic jacket is a copolymer of vinylidene fluoride and trifluoroethylene [P (VDF₇₃/TrFE₂₇)], of 63 μm thickness, and is rendered radially piezoelectric by corona discharge poling. The response of induced phase shift due to an applied sinusoidal voltage of 190 Hz is measured to be 1.55×10^{-5} rad/(V/m) per meter of fiber. The optical performance of the jacketed fiber with coaxial electrodes is tested over a wide frequency range, from 20 Hz to 20 kHz.

First Optoelectronics Conference (OEC '86) July 29-31, 1986,
Tokyo, Japan

Piezoelectric P (VDF/TrFE) Copolymer Jacketed Optical Fibers for Electric-Field Sensor Application

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The characteristics of a piezoelectric copolymer jacketed optical fiber are presented. The jacket consisting of a copolymer of vinylidene fluoride and trifluoroethylene was rendered piezoelectric by corona poling. The performance of the fiber as an optical-phase modulator was demonstrated over a frequency range of 20 Hz-5 kHz. An electric field-induced phase shift of 1.5×10^{-7} rad/(V/m) per meter of fiber was measured in the low-frequency (axially unconstrained) region. Several resonance peaks in optical phase shift were observed and discussed in conjunction with piezoelectricity in polymer jackets.

Conference on Optical Fiber
Communication/International
Conference on Integrated Optics
and Optical Fiber Communi-
cation (OFC/IOOC '87) January
19-22, 1987, Reno, Nevada, U. S.
A.

**Polarization Noise From Forced Vibration in a Birefringent
Single-Mode Fiber Link**

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Fluctuations in the state of polarization (SOP) in a high-birefringence fiber system under forced vibration are studied in conjunction with angular misalignment and misaligned coupling into two connecting fibers. Computer simulation analysis taking into account fluctuations of the SOP and polarization mode coupling is also presented. A comparison of experimental plots with numerical results is made by assuming appropriate variances for these variables. From parameter-fitting we can estimate standard deviations for fluctuations of birefringent axes and linear retardance as well as variations of extinction ratio in a vibrating fiber line.

4th International Conference on
Optical Fiber Sensors 7-9
October, 1986, Tokyo, Japan

**Temperature- Or Strain- Insensitive Sensing
Based on Bending-Induced Retardations
in a Birefringent Single-Mode Fiber**

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Birefringence induced in a bent birefringent fiber depends on the bending direction. An opposite change in retardation proportional to the square of the curvature occurs in orthogonal bending directions of the principal axes of the birefringent fiber. Based on this property, two measurands concerned with temperature and bending can be separated in a sensor output. Bending a sensing part consisting of dual fibers with orthogonally arranged principal axes yields a pair of retardations varying in an opposite manner. This scheme allows for a temperature-insensitive bending sensing by using the difference between the two output retardations, since the temperature affects the retardations in the same manner. Moreover, an addition between them provides a

temperature sensing in which the bending effect is removed.

Third International Symposium
on Stratified Flows, California
Institute of Technology,
Pasadena, California, U.S.A.,
February 3-5, 1987

**Stability and Eigenfunctions of Disturbances
in Stratified Two-Layer Shear Flows**

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We numerically investigated the stability and eigenfunctions of disturbances in a stratified two-layer shear flow using the linear stability theory. The numerical results show that there always exist two unstable eigenvalues, and that neutral curves are closed in the (α, R_i) plane except in the inviscid case. Moreover it was found that there exists a critical Richardson number R_{ic} , and that the stability criterion can be represented as $R_{ic} \simeq 1.4$ for $20 < R_e < 1000$. The velocity fluctuation and Reynolds stress have maximum values not at the density interface but near the critical level.