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Appendix

Summary International Reports, July 1990-June 1991

July 1990-June 1991

The 3rd East Asia-Pacific Conference on Structural Engineering and Construction, Shanghai, China, April 23-26, 1991

A Study on Shear Strength of Reinforced Concrete Beam without Shear Reinforcement

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Most of the prediction methods of shear strength of reinforced concrete beam without shear reinforcement are based on empirical way. This is because there is difficulty in prediction of shear crack propagation as well as stress state of concrete in shear span. In this study a nonlinear finite element method (FEM) is applied to predict the shear strength. Models for stress transfer near shear crack tip (tension softening model) and at distance from shear crack tip (aggregate interlocking model) as well as a bond model are implemented in the FEM. Effects of those models on concrete stresses in shear span, in other words shear strength of beam, are carefully examined. On the other hand, shear crack displacement as well as concrete stresses near shear crack are measured by applying an optical instrument (laser speckle method). Comparing the measured displacements and stresses with those calculated in the FEM, reliability of the models adopted in the FEM is discussed.

ACI Fall Convention, Philadelphia, Pennsylvania, USA, November 11-15, 1990

Displacements at Shear Crack in Beams with Shear Reinforcement under Static and Fatigue Loadings

Hussein Mokhtar HASSAN, Sabry A. FARGHALY and Tamon UEDA
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Reinforced concrete beams with vertical or inclined, and plain and/or deformed stirrups of various reinforcement ratios and diameters are tested under static and repeated loadings. Opening and shearing displacements along shear cracks as well as stirrup strains and concrete deformations along stirrups are measured. Effects of bond characteristics, ratio and diameter of stirrup on slip and crack displacement in the direction of stirrup are disclosed. Based on the test results, a method to predict opening displacement of shear crack under static and fatigue loadings is presented. It is found that the predicted values agree with the test results.

IABSE Colloquium on Structural Concrete, Stuttgart, Germany, April 10-12, 1991

Shear Strength of Prestressed Concrete Beams without Shear Reinforcement

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Strengths of shear compression failure in prestressed concrete beams can be predicted by the finite elements method analysis, in which a main shear crack is modelled as a discrete crack. Compression failure of concrete in the maximum moment region causes shear failure of the beams. A narrower compression zone is considered to make the shear strength less than the flexural strength. Force transferred along the main shear crack slightly affects the shear strength of the beam.

IAHR ICE SYMPOSIUM ESPOO, FINLAND August 20-23, 1990

Apparent Friction Coefficient between Steel and Ice Under High Contact Pressure

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The coefficient of friction between a steel plate moved in a horizontal direction while pressed vertically at a high contact pressure against a thin block of fresh water ice restrained against volumetric expansion at both sides was investigated. First, the settlement of the plate into the ice under conditions of high contact pressure and the yield strength of the ice were measured; then the dependence of apparent friction coefficient on ice temperature, contact pressure and settlement were determined.

Finally, apparent friction force was resolved into its components of actual friction force and bulldozing force.

The 3rd International Symposium on Cold region Development Edmonton, Canada June 16-21, 1991

Abrasion of Bridge Piers due to Ice Movement

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Abrasion from the movement of river ice must be considered during the design of concrete bridge piers in regions where rivers freeze in winter. Therefore, it is very important and useful for the design of concrete bridge piers in very cold regions to determine the amount of ice-concrete sliding abrasion. The authors have carried out systematic experiments and observetion of old bridge piers.

Finally a method for estimating the abrasion amount on concrete bridge piers due to the movement of fresh-water ice sheets was determined.

The 3rd International Symposium on Cold region Development Edmonton, Canada June 16-21, 1991

Design Methods for Intake Pipes in Culture Fisheries in Cold Regions

Takashi TERASHIMA and Naoki NAKAZAWA
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Toshihiko YAMASHITA and Hiroshi SAEKI
Department of Civil Engineering, Hokkaido University

Recently, the needs of culture fisheries are increasing in the northern part of Japan because of the restrictions on open sea fishery areas. For the design of the facilities for fish culture in cold regions, the influence of waves, water temperature and ice all have to be considered. Finally, design methods for intake pipes in culture fisheries in cold regions were proposed.

The 3rd International Symposium on Cold region Development Edmonton, Canada June 16-21, 1991

Determination of Compressive Strength and Static Elastic Modulus of Sea Ice by a Vibration Method

Hiroshi SAEKI, Norihiro Oritani and Toshihiko YAMASHITA
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Katsuhito GOTO
Penta Ocean Construction Co., Ltd.

It was concluded that the uniaxial compressive strength and the static elastic modulus may be determined from only the dynamic elastic modulus. There is no dependence on the temperature, salinity, or ice growth direction. Finally, the total weight of the equipment used for the test, namely the electric ice drill, ice cutter, dynamic elastic modulus meter, electric generator, and hand tools, was~170kg. Because of the low weight of the testing equipment, this method to measure the uniaxial compressive strength and the static elastic modulus of sea ice is recommended for its convenience for work in ice fields under severe climatic conditions.

The 3rd International Symposium on Cold region Development Edmonton, Canada June 16-21, 1991

A New Storage System for Agricultural Products, Hokkaido, Japan

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In the northesn part of Hokkaido, pack ice drifting south from the coastal areas of the USSR can force harbors to close from January until April. The accumulated degree days reaches almost 800 to 1100 degree days on the OKhotsk Sea side during winter. The low temperature and the sea ice close to the harbors causes considerable disadventages to agriculture and fisheries which are the main industries in this region. This paper presents the results of studies to improve these conditions by considering a new storage system using cold region technology.

The 3rd International Symposium on Cold region Development Edmonton, Canada June 16-21, 1991

Durability of Coated Steel in Sea Ice Regions

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Polyethylene and polyurethane coatings are now widely applied to steel piles. In sea ice regions, these coatings are subject to ice attack and experience ice forces, abrasion and adfreezing. However, these actions on coatings have yet to be clarified. Adhesion strength of these coatings by sea ice was found to be the smallest among concrete, uncoated steel and other coatings.

The 3rd International Symposium on Cold Region Development Edmonton, Alberta, Canada, June 16-21, 1991

Present State of Utilization of Public Open Space and Their Future Development

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This research sought to answer how effective public open spaces are, how they influence activities of people in the city center, and what determines the design and planning of public open spaces in city center in cold and snowy regions. The following aspects were considered: 1. composition of the space; 2. how it was used; 3. evaluation and awareness of the value of space; and 4. the way it was managed.

The objective of the study was to gather information in order to develop guide lines for future planning of open spaces or space for public use in winter cities.

The research was carried out on ten public open spaces in downtown Sapporo. Information gathering included: surveying the site; observation of the activities of people; and questioning the people using the space. The data was then analyzed according to the three different concepts of space: districts, blocks and sites.

The 3rd International Symposium on Cold Region Development Edmonton, Alberta, Canada, June 16-21,1991

A Comparative Study on the Types of Public Space Utilization in Residential Area

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The research reported here was concerned with common spaces in planned residential estates with detached houses. The analysis and study was conducted from the following viewpoints: 1. the use and typical daily outdoor activities; 2. the contribution to the organization of the local community and an evaluation of its effectiveness; 3. the influence on the local/neighbouring environment; 4. the influences and affects the awareness of the inhabitants had on the living environment.

Also considered was what future space structure of residential areas in cold and snowy regions should be undertaken and how.

The research sites were the 0-asa housing estate, Ebetsu City, Bannaguro, suburb of Sapporo City, and Midorigaoka, Asahikawa City. At each site, the common space was evaluated with respect to its value at eliminating through traffic, and segregating vehicles and pedestrians. The research was conducted through observation and questionnaires.

The 3rd International Symposium on Cold Region Development Edmonton, Alberta, Canada, June 16-21, 1991

Safety of Pedestrian Walking Areas in Winter

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Research has been conducted on pedestrian accidents following slipping and falling on icy winter streets in Sapporo. The data comprises records of the ambulance service of the Sapporo Fire Bureau regarding people injured in accidents following a slip and fall with subsequent hospitalization during the winter from 1984 to 1989.

The total number (947) of injured people comprised 501 males and 446 females. The average number of injured persons per day, calculated by dividing the number of hospital patients

by the number of days, was 1.9 patients/d.

When the data were grouped by age, it can be said that aged people are more likely to be injured by an accident following a slip and fall, especially females. When the data were classified by which part injured, the type of injury following a slipand fall on winter street differs according to sex.

Symposium on Recent Interplate Seismicity Studies. Perth, Western Australia. 5-7 September 1990

A Study on Microzonation of Perth Basin, Western Australia, Through Microtremor Measurements. —A pilot survey and its preliminary analysis.—

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A bilateral project between Australia and Japan was set up in 1989 to investigate seismic amplification during earthquakes. Perth, Western Australia, was chosen for the first of these investigation due to its rapid development in recent times, its geological setting on the Perth Basin and its proximity to one of the most active seismic zones in the country. As for the first step of this project, a pilot measurement of microtremors was carried out in January 1990. Two observation lines were set up and point by point measurements were carried out. One is 25 km length traversing the basin east to west to grasp general trend and the other one is 3 km crossing downtown area north to south to clarify local geological conditions. Through spectral analyses of measured microtremors records, it was found that spectral amplitude on deposit sites are several times larger than that of the baserock reference site. This relation of amplification on deposit sites have been pointed out in our previous studies in Japan and US and this time results promise an applicability of microtremors measurements on microzonation problems.

Symposium on Recent Interplate Seismicity Studies. Perth, Western Australia, 5-7 September 1990

Preliminary Results of the Microzonation of the Perth Metropolitan Area Using Microtremor Spectral Ratios

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In the Perth Basin, Western Australia, a bilateral project between Australia and Japan was started to make new microzoning maps using microtremor spectral ratios. A full scale survey was carried out succeeding to the pilot survey. Simultaneous recordings of microtremors were made over most of the metropolitan area of Perth, using a 3 km grid as a basis and a hard rock reference site throughout. Spectral ratios were computed at each site using this reference as standard. Attenuation functions for these microtremors ratios were estimated using three simultaneous recorded earthquakes and the results were plotted and contoured. Using these results it was estimated that previously established earthquake risk estimates underestimated expected ground amplitude by up to a factor of two. It was also found that the spectral ratio contours, appeared to correlate well with various geological surfaces.

International Symposium on Safety of Urban Life and Facilities Lessons Learned from the 1989 Loma Prieta Earthquake November 1-2, 1990,Tokyo, Japan

Newspaper Analysis on Socio-Economic Effects due to the 1989 Loma Prieta Earthquake

Hitomi O. MURAKAMI and Hiroshi KAGAMI

This paper evaluates long-term socio-economic effects of the 1989 Loma Prieta earthquake (M7. 1, 61 dead, 3000 injured) by examining San Francisco Chronicle which covers the damaged region. Earthquake related articles are selected for the 2 months following the quake and classified by the topic. The results of the 1988 Nepal-India earthquake and of the 1985

Mexico earthquake are compared.

Regarding the contents of articles, the SFC emphasizes indirect damages such as transportation, economic problem, human life, human behavior and contains less articles of general damage and casualties compared to other earthquakes. Attenuation of articles of SFC depicts the log-linear relation and it took 17 days for the number of articles to reduce half of the initial number. This period is similar to that of Nepal-India earthquake and is much shorter than the other major earthquakes. The impact of the Loma Prieta earthquake on society seems to be rather moderate. Continuing articles on specific topic tells developing and fading pattern of indirect effects. Examples of housing problem and transportation are shown and discussed.

The 9th Symposium on Earthquake Engineering Roorkee, India December 14-16, 1990

Pattern of Casualty Occurrence due to the 1988 Earthquake in the Nepal-India Border Region

Hitomi O. MURAKAMI, Teizo FUJIWARA, Tadanobu SATO, and Tetsuo KUBO

Based on the field survey results and damage statistics after the 1988 Nepal-India border earthquake, we examine pattern of human casualty occurrence. Structural vulnerability of local dwellings are depicted in relation with seismic intensity and compared with other building types. Lethality of dwelling collapse to the occupants is another important factor to affect number of fatality in earthquakes. Dwellings in Nepal and Blihar are found to be weak in earthquake resistance, but less lethal to the occupants than most masonry dwellings in the world.

The 9th Symposium on Earthquake Engineering Roorkee, India December 14-16, 1990

Main Causes of Building Damage Done by the 1988 Nepal-India Earthquake

Teizo FUJIWARA, Tadanobu SATO, Tetsuo KUBO and Hitomi O. MURAKAMI

The earthquake we investigated took place in the Nepal-Bihar border region in the early morning of 21 August 1988. In this paper, the intensity of ground motion near the epicentral area was discussed in terms of assumed fault parameters and geological condition of the sur-

face layer and the results of laboratory tests done on liquefied sand specimens as well as questionnaire responses. We also investigated major causes of the damage distribution of building structures by considering the intensity of ground motion, soil condition, types and stories of buildings, populatiion, etc.

Technical Exhibition of the Martin Centre for Architectural and Urban Studies, Cambridge University, UK. 12-18, July 1990

A Parameterless Scale of Seismic Intensity (Ψ; PSI)

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A methodology for defining a unified intensity scale is developed that will allow compilations and comparisons of various earthquake damage data on a statistical basis. The assumption is employed that the vulnerability function for any building type, or the relation between a percentage of any type of damaged buildings and intensity of ground shaking, can be described by only two parameters—mean and standard deviation—using a normal distribution function. The methodology defines the vulnerability function of any building type relative to other building types without referring to any existing seismic intensity scale. By referring to the most common and standardised building types like brick masonry, the seismic performance of any building type in different regions or countries can be compared and incorporated on this scale.

A case study using 30,000 building data during the 1980 Campania earthquake in Italy is carried out. Vulnerability functions for four building types are derived for five damage categories. The effectiveness of PSI scale is proved by comparing MSK scale.

Workshop On Modelling Earthquake Casualties for Planning and Response. Pacific Grove, California, USA. 4-6 December 1990

Survival Modelling of Trapped people in Earthquakes

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This study attempts to qualify the factors that affect the entrapment, extrication and survivability of people in building collapse. As a broad factor that influences the overall casualty rate per building collapse 'the lethality ratio' of collapse is considered by comparing ratios from a small number of case studies. This is further elaborated in a search and rescue model where survival rate diagrams are proposed for estimating survival rate at a given time after the collapse of building. It is found that difference in the survivability of trapped victims by building type is well simulated in this model.

The 9th European Conference of Earthquake Engineering. Moscow USSR, 11-14 September 1990.

A Parameterless Scale of Seismic Intensity for Use in Seismic Risk and Vulnerability Assessment

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This paper is a summary of analysis carried out on the Martin Centre vulnerability database, which comprises some 7,000 buildings surveyed in 13 different earthquakes and an extensive compilation of published damage data. A continuous scale of seismic intensity is derived from the damage distributions which allows more accurate predictions of damage than the standard aggregation by intensity assignment using MM or MSK intensity scales. Using the Parameterless Scale of Intensity (Ψ PSI), predictions of damage can be made within 25 percentage points with 90% confidence. This compares with 75 percentage points using as-

signed intensity. PSI is correlated with instrumentally recorded ground motion and shown to correlate well with parameters of accerelation.

The 4th International Conference on the Conservation and Management of Lakes, "Hangzhou" '90, China Sept. 5-9, 1990

Run-Off of Particulate Phosphorus and its Effect on Algal Growth

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We analyzed the chemical forms of nutrients, especially particulate phosphorus compounds, and relating to them, determined the algal growth potential of river waters by bioassay. The rivers we researched are R. Ishikari (262km) and its tributaries in Hokkaido, Japan. The results are summarized as follows; (1) The particulate form is dominant in natural rivers. Especially, when the river is flooded, the rate of particulate phosphorus becomes high (Usually more than 95%). And it is found that the form distribution of phosphorus compounds which is specific in the source, usually dominated by dissolved form, becomes relatively homogeneous in the river by physical and biochemical action during the run-off. (2) Particulate phosphorus is well uptaken by algae as well as dissolved form. The regression equation between concentration of particulate phosphorus (PP) and AGP (SS) of suspended matters is described as follows: AGP (SS) (C mg/l)=257pp (mg/l)−0.22 ($r=0.90$) It shows that approximately 70% of particulate phosphorus can be used for algal growth because the ratio C/P is 260. As the river water increases, uptake rate become a little lower. (3) When it rains, much amount of particulate nutrient is flowed out as water increases. For the prevention of this flow-out, it is necessary to control the ground surface.

The 3rd International Symposium on Cold Region Development Edmonton, Canada June 16-21, 1991

Water Quality of Forest River during the Snow Melting Period.

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Obayasi Corporation
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Geological Survey of Hokkaido

Water quality of River Ogawa of Sapporo city, Hokkaido, was analyzed from the data taken every day from September, 1986 till August, 1988. (Watershed: 11km^2, Length: 7.0km, Average water flux: about 0.8m^3/s) In this report, we focused the specific behaviors of nutrients during the snow melting period. Results are; (1) Water run-off by melting snow was recognized in early April till late May. The rate of water load during this season is about 60% of yearly flux. The rate of nutrients loads are surpassed that of water (60%). (2) Most of nutrients of this period were scrubbed out from soil and some of them were eluted out from accumulated matters. (3) During snow melting period, nitrogen flew out mainly in dissolved form and phosphorus in particulate one. Nitrate dominated among dissolved nitrogens. (4) Mean water quality of this period indicates meso-eutrophic condition. (5) Run-off patterns of chemical components during the snow melting period which were arranged by $L=c \cdot Q^n$ (L: chemical component load, Q: water flux, c, n: constant) showed nearly the same tendency as that through the whole year. (6) Others.

The 6th International Symposium on Okhotsk Sea & Sea Ice Mombetsu, Hokkaido, Japan February, 3-6, 1991

Characteristics of Suspended Solids in Sea and Lake Ice

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Ice of the sea and the lakes contains various suspended solid components. Suspended solids are liable to wear away structures in the water and to effect albedo. The suspended solid itself is the indicator of environmental pollution. We measured the contents and diameters et al, of ice in the sea and the lakes in natural state of Hokkaido. In the lakes, the contents of suspended solids near the shore are large and the diameters are large as to be fine sand. The influence of roaddusts is observed. Meanwhile drift ices with a large quantity of sand and with a small quantity of silt and clay exist at a time at the same point. The drift ices seem to have contained the solids of the shore on the process of their formation and moving.

The 4th International Conference on the Conservation and Management of Lakes "Hangzhou'90", China Sep. 5-9, 1990

Evaluation of Water Quality of Several Lakes in Japan and the Yunnan Province in China using Trophic State Indexes Derived from Several Parameters

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Our previous work (Aizaki et al., 1981) reported the trophic state Index (TSI) was closely related with other trophic status, such as chlorophyll-a, Secchi disk transparency, total phosphorus, SS dry weight, particulate organic carbon and nitrogen, total nitrogen and total number of bacteria. Namely, after the conversion of each parameter to TSI number, these parameters are easily comparable with each other in the same level.

In the present study, the characteristics of water quality of several lakes in the Yun-nan Province and Japan were analyzed using the rader-chart of TSI numbers derived from several parameters. Lake Kasumigaura in Japan, Lake Dianchi, Erhai and Chirow in the Yun-nan Province were surveyed in 1988 and 1989, and the data were analyzed. The TSI numbers ranged from 27 to 59 in Lake Erhai, from 70 to 89 in the river mouth region of Lake Dianchi, from 58 to 76 in the central part of Lake Dianchi and from 59 to 86 Chirow. The TSI numbers in Lake Kasumigaura ranged from 38 to 63 in the winter period. The characteristics of water quality of these lakes were examined by the comparison among these values.

The 5th International Conference on Indoor Air Quality and Climate July 29-August 3, 1990 (Toronto, Canada)

Perceived Air Quality and Physiological Function

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We have designed and have been performing the experiments to examine the effect of sensory indoor air quality on human physiological function and to afford physiological basis to perceived air quality index in our air quality test chamber.

Measuring items of physiological function were 1) EEG power spectra, 2) heart rate & heart rate variability, 3) facial skin temperature and 4) EMG power spectra. The subjects were eight Japanese males. The odorous objects were five kinds of fundamental odorant, containing skatole and isovaleric acid. In addition 2-propanone and 1-butanol, which have been adopted to adopted to reference gases in the psychometric study of percieved air quality, were examined.

The results from the four simultaneous physiological measurements showed that both central and autonomic nervous system were affected by most of the odorants and that some kinds of odorant had an effect on afferent motor control system. We discussed the relationship between perceived air quality index and physiological function.

The 5th International Conference on Indoor Air Quality and Climate July 29-August 3 (Toronto, Canada)

Statistical Models of Multicomponents of Indoor Air Quality

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We made simultaneous measurements of multicomponents of indoor air quality in Japanese houses, composed of three fabric types; wooden, concrete-block and reinforced concrete houses.

Measuring items were 1) air temperature, 2) air humidity, 3)carbon monoxide, 4) carbon

dioxide, 5) suspended particulate, 6) airbone bacteria, 7) airbone fungi and 8) radon daughters. In addition 9) radon was measured with integrating monitor method in the representatives of each fabric type.

We have been perfoming the measurements since 1986. We got about one thousand of data. we have constructed statistical prediction models of multicomponents of indoor air quality using SAS in Hokkaido University Computing Center.

THERMASTOCK'91 The 5th International Conference on Thermal Energy Storage Scheveningen, May 13-16, 1991 The Netherlands

Experiments and Calculations of Long Term Heat Extraction and Storage to Vertical Ground Pipes

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The amount of heat extraction and storage by using ground source heat pump system were estimated through experiments and numerical calculations.

Experiments were conducted on long-term ground heat extraction and storage using vertical concentric steel pipes which were 20 meters long and ϕ60mm in diameter and kept at a temperature of 0℃ or 30℃. The rates of heat storage and extraction were about 407W and 170W per pipe at the end of each period, respectively.

Computer programs were developed. Results of calculation corresponded with results of experiments very well. We also calculated annual decrease of heat extraction rate and soil temperature. We found that the annual capacity of extraction did not change for a single pipe but decreased for multiple pipes. It was necessary to recharge the heat in summer at least during one month with the low temperature at 20℃ for multiple pipes.

THERMASTOCK'91 The 5th International Conference on Thermal Energy Storage Scheveningen, May 13-16, 1991 The Netherlands

Fundamental Experiments and Calculations of Heat Extraction and Storage by Latent Heat of Soil

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Fundamental experiments were performed to investigate influences on the thermal conductivity and the thermal resistance between tube and soil by freezing and thawing when we use the direct expansion coupled heat pump system. Two kinds of apparatuses were made in a laboratory and two kinds of soils, sand and volcanic ash, were adopted in this study. The performance of the thermal conductivity did not change after freezing and thawing, though hysteresis was observed. There was no significant increase of the thermal resistance on the tube surface after repetition of phase change. We also developed a computer program to simulate heat and moisture movement under the various conditions including freezing and thawing. In the case of phase change presence of unfrozon water was taken into the consideration. We verified the validity of this model and the results of calculations were in good agreement with the experimental data.

International Symposium on Active Control of Sound and Vibration, Tokyo 1991

An Experiment of Active Noise Control in Three-Dimensional Space

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In this study, the potential ability of active noise control of broadband noise in three-dimensional space has been investigated experimentally. In order to control the three-dimensional space, the JMC method was applied mostly. Through the experiments, it was attempted to include the filtered-x LMS algorithm to control the system adaptively. The experiments reported herein were performed with noise generated by a first sound source in an anechoic room. A second sound source was a tripole sound source with cardioid radiation characteristics. Experimental result indicates that the approximation of the Huygens' secondary source by the tripole sound source is a good method to control a three-dimensional space.

The 5th US Ventilation Symposium West Virginia University 3-5 June 1991

A New Technique of Determining the Methane Content In-Situ

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and The University of Utah UT, U. S. A.

The presence of methane gas in mines creates hazards of explosions, fire and suffocation. Under certain conditions the occurrence of methane also poses a danger of gas and coal outbursts. Consequently, prevention of gas and coal outbursts in coal mines requires a sound knowledge of methane gas occurrence in mine workings. However, the direct method of determining methane content of coals developed by the U. S. Bureau of Mines is time and labor consuming for measurement, a new transportable methane tester was developed for Japanese coal mines. The instrument automatically measures emission gas from coal samples in the underground and also records and stores the data. Back on the surface, the tester can be connected via a RS 232 port to a PC computer for methane content estimation. Details of this technique are described here. Results on methane content determined in Japanese and U. S. western coal seams are discussed, as well.

The 3rd international symposium on rock fragmentation by blasting Brisbane Australia, Aug. 26-31, 1990

Properties of rock blasting

Hisao HONMA
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Every text book for blasting in Japan says that Hauser's law can be applied for practice. But recently it came true that there is no histordcal record about him and no actual datum of his own or other's to testify.

Experiments were carried out and showed the new informations different from Hauser's. The conclusions obtained in this study are as follows.

In crater test using mortar material, funnel ratio is independent of explosive amount and ranges from 2.5 to 4.5 in proportion to rock strength and burden. The standard ratio 1, reported by Hauser, can not be observed in any instances.

The high strengh mortar in boulder blasting can be broken more easily and thrown further than the low strength one. These above mentioned are all different from Hauser's theory.

The 5th Conf. on Acoustic Emission/Microseismic Activity in Geologic Structures and Materials, The Pennsylvania State University June 11～13, 1991

Application of The Acoustic Emission Monitoring Rod to Landslide Measurement

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The new device for landslide measurement, the acoustic emission monitoring rods, were designed specially and applied practically. The acoustic events from the installed rod could be converted into the sliding displacement or the sliding rate. Moreover, the depth of sliding surface could be determined by on the dimensional source location analyses. Consequently, it became possible to determine the sliding displacement, the sliding rate and the depth of sliding surface accurately in a short term. In comparison between the landslide mesurement methods by means of the acoustic emission monitoring rod and the pipe strain gauge, the former method was more reliable than the later.

The 1st ASME and JSME Fluids Engineering Conference Portland, Oregon, USA June 23-27, 1991

Numerical Calculation of Velocity and Concentration Distributions and Presuure Loss of a Solid-Liquid Flow

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In order to acquire fundamental data for the simulation of a solid-liquid flow, flow properties of two-phase flows in a horizontal pipe were calculated using the velocity and concentration profiles of the solid phase measured with conductive probes and the pressure loss of the mixture. These properties are the momentum diffusion coefficients for the mixture, the solid and the liquid phase, the specific interaction forces, the slip (axial separation) velocities between the liquid and the solid phase, and the velocities of the liquid and the mixture phase.

Based on the flow properties of the solid phase and slip conditions at the pipe wall, the

mass diffusion and the momentum equation of the solid phase have been solved to obtain the velocity and concentration profiles of the solid phase and the pressure loss.

Proceedings of the 1st Japan-China Symposium on Slurry Transportantion Technology Changsha China November 1-3, 1990

Hydraulic Backfilling of Fly Ash

Kuniomi ASAKURA, Iwao NAKAJIMA
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The objective of the present work is to provide the basic data for the hydraulic backfilling of fly ash to the goaves of a coal mine.

The experiments carried out are the flow property of fly ash slurry, that of the slurry containing coarse waste, and excessive pressure osillations due to the discontinuous fly ash slurry column falling down the vertical pipe.

The fly ash slurry can be expressed as a Newtonian fluid at concentration up to 45vol.% and as a Bingham Plastic fluid over 45vol.%.

The fly ash slurry containing coarse solids gives rise to the reduction of pressure loss at high velocity region.

The pipe vibration due to the discontinuity of slurry column can be avoided by the calculation based on the flow properties proposed.

The 2nd World Congress Particle Technology Kyoto, Japan September 19-22, 1990

Research on the Production of Zirconia Micro-Spheres by Using the Methods of Agglomeration in Liquid

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Techniques of agglomeration in liquid were used to produce zirconia micro-spheres with diameters less than 500 μm. The critical amount of bridging liquid, proper selection of suspending media and suitable agitation intensity have been shown to be essential in forming dense and highly spherical agglomerates. By using paraffin type organic liquids with high interfacial tension, low density, low dielectric constant and low viscosity in a weak agitation environment, micro spherical ensembles were formed even without the addition of bridging liquid. Under turbulent conditions, agglomeration in non-aqueous and in aqueous liquid requires proper bridging liquid addition. Acoustic emission and laser attenuation were demonstrated to be effective tools for monitoring the process of agglomeration in liquid.

The 11th International Coal Preparation Congress, Tokyo, October 22-25, 1990

Fundamental Studies on the Production of Super Clean Coal —Mineral Distribution Analysis and Development of Aggregative Flotation Column—

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This paper presents fundamental studies on the production of super clean coal. The first part consists of characterization of mineral matters in six coal samples. The second involves the development of an advanced coal cleaning apparatus. Mineral matters were grouped into A, consists mainly of quartz, B of pyrite, C, mainly of clay minerals and D of Fe-rich minerals. By grinding the coal, A, B and D groups were easily liberated but C group minerals often remained attached to the coal particles. The effectiveness of gravity separation prior to

fine grinding was confirmed. An aggregative flotation column which is effective for fine particles was developed. This is characterized by aggregate formation, fine bubble generation and column flotation. Flotation results of the aggregative flotation column showed superior performance than the conventional column or any other physical coal cleaning process.

International Conference on Column Flotation, Sudbury, Canada, June 2-6, 1991

The Application of Fuzzy Logic to Control Concentrate Grade in Column Flotation at Toyoha Mines

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The application of fuzzy logic to control concentrate grade in zinc cleaning column flotation was studied. The rules of thumb for the operating practices were obtained by interviewing operators. There are many manipulated variables in the column flotation, but the initial strategy of the operators to control the concentrate grade is by adjusting the air flow rate. The fuzzy controller was developed based on this main rule of thumb and limiting rules for the tailings grade were added. A more stable and higher concentrate grade was obtained. The total recovery was also satisfactory.

The 4th Symposium on Natural and Industrial Arsenic, Tokyo, JAPAN, 25 November 1989

Distribution of Arsenic in the Natural Environment (Part II), with Emphasis on Thermal Waters from the Point of its Origin

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As reported before (1987, arsenic is ubiquitous in the atmosphere, hydrosphere, predosphere, lithosphere and biosphere of the earth. Considering the origin of arsenic, arsenic from thermal waters through lithosphere is most important. Arsenic concentration data are summarized in relation to temperature, pH and other chemical compositions. Mass of discharge of

arsenic from geothermal plants and hot springs is also discussed.

Furthermore, from the point of environmental problem, removal of arsenic in thermal waters is mentioned.

The 2nd International Congress on Condition Monitoring and Diagnostic Engineering Management, Brunel University, U. K. 16-18 July 1990

An Expert System with Circulating Notice for Emergency in Underground Coal Mine

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Sapporo, 060 Japan

An expert system capable of circulating notices to send/receive letters and pictures in facsimile has been developed in order to consult human experts in case of unexpected accidents in underground coal mines. It is shown that, as information with graphic transmits the features more exactly than linguistic expression, human experts can direct the countermeasures for the accidents provided that the condition of the disaster is not changed widely during the response of the expert.

International Symposium on Mineral Exploration : The Use of Artifichal Intelligence, Tokyo, 29 October-2 November 1990

Delphi Approach Using Fuzzy Sets Reasoning To Assist Rock Identification

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Hokkaido University, Sapporo, Japan
Ryoichi KOUDA,
Geological Survey of Japan, Tsukuba, Japan

A part of a classification method that is used with knowledge engineering was introduced by drawing an example from classification of collected unknown specimens.

A resemblance order of a candidacy rock to a collected unknown specimen was determined

with the following four methods: 1) similar-prior comparison method, 2) fuzzy pattern distinction method, 3) elimination method and 4) delphi method.

It was shown that a collected unknown specimen was classified to the same rock name by either of these four methods. But the resemblance orders showed to be different. It is expected that a clue to clarify similar differences can be obtained by tracing the process of determination in the method.

Furthermore, an example of the processing of an ambiguous nature with various determination results was explained by using delphi method by introducing a certainty factor. It was shown that the delphi approach to assist rock identification was available to get reasonable results under ambiguous conditions.

International Symposium on Mineral Exploration: The Use of Artificial Intelligence, Tokyo, 29 October-2 November 1990

An Application of Expert Systems for Resource Exploration

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Ryoichi KOUDA,
Geological Survey of Japan, Tsukuba, Japan

A dependency diagram that makes a local resources rule from local resources fact was prepared. For a characteristic expression of a local content, proper nouns and relative display of positional expressions are remarked. It is expected that geologist, human expert of geology, use all the information induced from the proper noun of object area for reasoning of geologic property in the area. For him the proper noun of the area means the file name for data concerning geological information in his imagination. In order to do the same processing by a computer, it is necessary for an expert system to judge the terminology including proper nouns and technical terms. Such system will become the powerful tool with the process that makes resources rule automatically a computer process from the description of resources fact.

The 5th US Mine Ventilation Symposium, West Virginia University U. S. A., 3-5 June 1991

Mine Ventilation Control by Using a Transition Diagram of Airflow Rate

Yuusaku TOMINAGA and Yuuichi UMEKI
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Sapporo, 060 Japan

Macroscopic characteristics of complicated network is studied for ventilation control in a mine. The principal results in the study are; 1) It is shown that distribution of branches which increasing of aerodynamic resistance effects airflow rate in the specified branch such as coal face and/or advancing is considered as a property of each ventilation network. 2) Combination of regulator in two separated branch has wide capability to keep constant values of airflow rate in the specified branch. 3) Ventilation transition diagram that is one of application of macroscopic characteristics of a network is introduced. Existing range of airflow rate in the specified branch is shown as a parameter in the ventilation transition diagram that coordinates are airflow rate in the branches with regulator. 4) It is shown that ventilation transition diagram is available to control ventilation in real time in case of decision of evacuation route. 5) Ventilation transition diagram is one of important information when an user answers the question from an expert system on consultation about ventilation control.

The 6th International Iron and Steel Congress, Nagoya, JAPAN, October 21-26, 1990

Analysis of Fraction Solid and δ-γ Transformation During Solidification of Statically Undercooled Molten Carbon Steels

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Solidification behavior of undercooled molten carbon steel was examined by using a index of fraction solid. The specimen was statically undercooled by a original method which was established by authors. The fraction solid was estimated by coupling a heat balance equation and thermal histories of the specimen and environment near the specimen. The nucleation of primary δ phase from the undercooled molten metal and the subsequent δ-γ transformation process were also investigated by using the fraction solid.

As a result, the fraction solid in the top of the primary recalescence increased with increasing undercooling. The fraction solid at the start of second recalescence, i. e., the start of peritectic reaction, was almost constant although the degree of primary undercooling increased, but reduced when the initial carbon content increased.

International Conference on Grain Growth in Polycrystalline Materials Rome, Italy, June 18-21, 1991

Effect of Grain Size Distribution on Grain Growth

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The dominant parameter which controls the grain growth in a material has been said to be temperature. However, the grain size distribution should also influence the growth rate, because the driving force of the grain boundary movement is the size difference between the adjacent grains. In this work, this effect on the growth rate was investigated by means of a computer simulation.

The results showed that the difference in the initial grain size distribution brought about the different behavior in the increasing process of the mean grain size, in spite of the same initial mean size and the same rate constant. The grain size distribution changed during the process, although it gradually converged on the steady state distribution which was independent of the initial distribution.

The growth rate dD/dt was able to be summarized as follows.

$$dD/dt = k\ (154Va - 5.76Ku - 11.4)\ /D^{1.2}$$

where, Va is the variation coefficient and Ku is the kurtosis of the grain size distribution.

The 1st ASME-JSME Fluid Engineering Conference June 23-27, 1991 Portland, U. S. A.

Simulating Deformation of Non-Circular Vortex Rings

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Deformation of a pseudo-elliptic vortex ring with circulation Γ was studied by a three-dimensional vortex blob method which included the viscous diffusion of vorticity. The circumference of the vortex ring consisted of two parallel line segments connected at both ends by

two semicircles of the same radius R, the length of the major axis being denoted by L. The cross section of the vortex ring was represented by 25 vortex blobs with overlapping cores, while the circumference of the vortex ring was divided into a number of such sections. Numerical calculations were performed for the aspect ratios $L/(2R) = 2.0-12.0$, the initial core radius $\sigma_{cs} = 0.20R$, and Reynolds number $\Gamma/\nu = 1500$, ν being the kinematic viscosity. The cut-and-connect process was found during the deformation, yielding four fundamental patterns of deformation which depended on the aspect ratio. Details of the cut-and-connect process demonstrated merits and problems of the vortex blob method. These results may be useful to understand the initial development of non-circular jets.

The 1st ASME-JSME Fluid Engineering Conference June 23-27, 1991 Portland, U. S. A.

Constitutive Equations for Conducting Magnetic Fluids

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A new complete set of equations for conducting magnetic fluids are obtained using the micropolar theory and the thermodynamical method based on the free energy and the dissipation function. The constitutive equations considering both viscoelasticity and internal freedom satisfy the principle of material frame indifference. The concrete expressions of basic equations for conducting magnetic fluids are given. It is shown that the magnetization is dependent on the magnetic field and its change in time, and the angular velocity of suspended particles. Furthermore, the electromagnetic pressure is independent of the dissipative parts of the magnetization and the electric polarization.

International Conference on Experimental Fluid Mechanics June 17-21, 1991 Chengdu, China

Three Dimensional Vortical Structure in a Lid-Driven Square Cavity

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The aim of this study is to investigate experimentally the three-dimensional vortical structure in a lid-driven square cavity. The cavity had a square cross-section of H× H and a length L in the spanwise direction. The lid of the cavity was moved at speed U, inducing vortical motions in the cavity. The aluminum flakes, dye and a sheet of laser light were used to get details of the structure of the vortical motion. Experiments were carried out at several Reynolds numbers based on U and H in a range between 250 and 5000. The aspect ratio L/H of the cavity was changed from 1 to 12 to find its effect on the vortical structure. The fully developed vortical structure was found to be characterized by " cell " structure aligned in the spanwise direction. The cell structure consisted of a pair of vortex rings and secondary vortices. The spanwise length of the cell structure depended on the Reynolds number but was independent of the aspect ratio L/H if this ratio was lrager than approximately 3.

Third European Turbulence Conference July 3-6, 1990 Stockholm, Sweden

Deformation and Splitting of Noncircular Vortex Rings

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A vortex-dynamics simulation has been made on the deformation of a pseudo-elliptical vortex ring which consists of two parallel line segments of the same length connected by two semicircles of the same radius R, the aspect ratio L/(2R) being between 2 and 20, L being the major diameter. The deformation has four fundamental patterns depending on the aspect ratio : the periodic axis switching ; the splitting into two vortex rings after the axis switching ; the spilitting into two vortex rings without the axis switcing ; the splitting into three vortex rings without the axis switching. The period of the axis switching and the time when and the position where the splitting occurs are obtained as functions of the aspect ratio and the core radius.

IUTAM Symposium on Separated Flows and Jets July 9-13, 1990 Novosibirsk, USSR

Structure and Control of Separated-and-Reattaching Flow Zones at the Leading Edge of Blunt Bodies

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The leading-edge separation bubble of a blunt circular cylinder was excited by a sinusoidally oscillating jet issued from a thin slit along the separation edge. Reynolds number was 1.32×10^5. Single-frequency and bimodal forcings were studied. The single-frequency excitation yielded a minimum reattachment length at a particular frequency f. This most effective frequency was approximately one-sixteenth of the initial Kelvin-Helmholtz frequency and eight times the frequency of shedding of large-scale vortices from the reattachment region. The reattachment length was dependent on the phase lag for the bimodal excitation where the forcing was with the frequencies f and f/2 and with the same amplitudes.

The 2nd Japan-Soviet Union Joint Symposium on Computational Fluid Dynamics August 27-31, 1990 Tsukuba, Japan

Vortex Dynamics Simulations on Interacting Vortex Rings

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Reported in this paper are two vortex dynamics simulations; the deformation of a pseudo-elliptical vortex ring which consists of two parallel line segments of the same length L connected by two semicircles of the same radius R; the interaction of several circular vortex rings arranged on the surface of regular polyhedrons. The deformation of the pseudo-elliptical vortex ring has four fundamental patterns depending on the aspect ratio L/(2R): the periodic axis switching; the splitting into two vortex rings after the axis switching; the splitting into two vortex rings without the axis switching; the splitting into three vortex rings without the axis switching. The interacting circular vortex rings give rise to the energy spectrum similar to the Kolmogorov -5/3 power law at a stage where the interaction proceeds to a certain extent.

International Workshop : Novel Experiments and Data Processing for Basic Understanding of Turbulence, October 8-10, 1990 Kasumiga-ura, Ibaraki, Japan

Vortex Interaction and Kolmogorov Spectrum

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An inviscid vortex dynamics simulation of interaction of several circular vortex rings produced the power spectrum which had the Kolmogorov -5/3 power law. The enstrophy spectrum had the 1/3 power law in the same wavenumber range. It was suggested that a uniform spatial distribution of high-vorticity regions is essential to have the -5/3 power law. The length scale of energy-containing eddies was obtained as the reciprocal of a wavenumber at which the energy spectrum attained a dominant peak, while the Kolmogorov length scale was defined as that of a wavenumber at which the enstrophy specrum attained a dominant peak. Five invariants of inviscid vortical motion were maintained constant within tolerable deviations from the corresponding initial values until vorticity tends to diverge.

The 2nd KSME-JSME Fluids Engineering Conference October 10-13, 1990 Seoul, Korea

Response of a Blunt-Plate Separation Bubble to Imposed Disturbances

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This paper describes results of an experimental study on response to externally imposed disturbances of the leading-edge separation bubble of a blunt plate at a Reynolds number 1280. The disturbances were introduced by a trailing-edge flap oscillating with constant angular velocities. The velocity perturbation near the leading edge was sinusoidal within a limited range of the forcing frequency. The reattachment length was found to decrease with increasing level of the perturbation, and with increasing frequency of the perturbation when the velocity perturbation was sinusoidal. For random velocity perturbations, the reattachment length was approximately a unique function of the perturbation level. The r. m. s. longitudinal velocity in the separation bubble for strong perturbations amounted to as high as 50% of the

main-flow velocity while that for the unperturbed flow was less than 30%. Shear-layer vortices enhanced by the sinusoidal disturbances were demonstrated by flow visualization.

The 3rd International Conference on Circulating Fluidized Beds, Nagoya, Japan, October, 15-18, 1990

Flow and Heat Transfer Simulation in Circulating Fluidized Beds

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*** Xi'an Jiotong University, China

A computer program is developed to analyze two-dimensional coupled radiative and convective heat transfer in a circulating fluidized bed boiler (CFBB). Based on bulk-density distribution obtained by solving one-dimensional gas and particle two-phase flow equations, radiative heat transfer in CFBB is analyzed by using a revised Monte Carlo method. Convective heat transfer between furnace walls, gas and particles are also considered by using the Martin's model. The temperature profiles of gas and particles, and the wall heat flux distributions are obtained. Results agree well with Johnsson's experimental data. The effects of particle diameter on the bulk density and heat transfer in CFBB are also studied.

International Conference on Power and Energy, Beijing, China October, 22-26, 1990

Latent Heat Recovery from Vapor in Effluent Gas of Boiler to Increase the Efficiency

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Convection and condensation heat transfer coefficients are measured on horizontal tubes in an air flow with a temperature of 130 °C and a water vapor content of 10-60wt%. By using the results, analyses are made on the performance of a latent heat recovery heat exchanger installed in boiler flue gas flow. Following results are obtained: 1. Heat- and mass-transfer coefficients are formulated as functions of the Raynolds number and the intensity of the condensation. 2. When the water vapor concentration in the main flow is increased from zere to 60 wt%, the heat- and mass-transfer coefficients become approximately doubled. 3. In the heat exchanger, total transferred heat is increased by 40-110% after the initiation of condensation of water from flue gas. 4. Boiler efficiency is increased by 5-7% by using the heat exchanger as an economizer.

ASME/JSME Thermal Engineering Joint Conference, Reno, U. S. A., March, 17-22, 1991

Transmittance of Radiative Energy Through Three-Dimensional Packed Spheres

K. KUDO, H. TANIGUCHI, Y. M. KIM
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W. J. YANG
University of Michigan, U. S. A.

The transmittance of radiative energy through a volume of randomly packed spheres is determined by means of a Monte Carlo method. The results are compared with experimental measurements. A computer program is developed for random arrangement of equal-diameter spheres in a packed bed with arbitrary packing density. It is disclosed from the results that: (i) The low packing density layer adjacent to the side walls causes an increase in the radiative

transmittance within the bed beginning at a location two- to three-diameter depth from the surface of the radiation entrance. (ii)The transmittance through randomly packed bed is larger than the one through regularly packed bed except for the case of higher absorptance and larger value of layer thickness. (iii) Analytical results of transmittance agree well with experimental measurements.

The 2nd European Conference on Industrial Furnaces and Boilers, Algarve, Portugal, April, 2-5, 1991

Radiative Heat Transfer in a Circulating Fluidized-Bed Boiller Furnace by a Monte Carlo Method

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*** Tsinghua University, China
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Radiative heat transfer in a circulating fluidized-bed boiler (CFBB) furnace is theoretically studied by a modified Monte Carlo method. The radiative contribution including a scattering effect can be treated by the Monte Carlo technique, while the convective component can be analyzed by Martin's model for treating heat transmission between suspended particles and furnace walls. Two computer programs are employed in this study. One simulates thermal behavior in a two-dimensional CFBB furnace model which consists of a flue gas with suspended particles. Another one evaluates the bulk density distribution in the furnace. Numerical results are obtained for the gas-particle temperature difference, and the gas temperature and heat flux distributions in the furnace. The theoretical prediction agrees well with experiment. The effects of system geometry and size on thermal behavior in the furnace model are determined.

Diagnostics and Modeling of Combustion in Internal Combustion Engines, Kyoto, Japan, September 3-5, 1990

Calculations of Ignition Lags for Methane-Air Mixtures by Chemical Kinetics

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One of the major alternative fuels, methane, is of increasing interest for use in combustion equipments. In this paper, precise and time-efficient calculations of ignition lags and oxidation processes in a wide range of methane-air mixtures were determined with a comparatively small number of chemical kinetic reactions in the usual combustion ranges. The influences of each chemical reaction on time-resolved species concentrations were also determined. A spcific concentration of OH radicals resulted in the onset of spark knocking or autoignition in a spark-ignition engine, almost independent of engine operating conditions such as spark timing, compression ratio, and equivalence ratio. As a result, autoignition and ignition lags can be predicted precisely and easily by focusing on the concentration of OH radicals calculated with the chemical kinetic reactions.

SAE International Congress and Exposition, Detroit, Michigan, February 25-March 1, 1991

The Influence of Fuel Properties on Diesel-Soot Suppression with Soluble Fuel Additives

Noboru MIYAMOTO, Hideyuki OGAWA, Zhixin HOU, and Masahiko SHIBUYA
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Diesel soot suppression effects of catalytic fuel additives for a range of fuels with different properties were investigated with calcium naphthenate. A single cylinder DI diesel engine and a thermobalance were used to determine the soot reduction and its mechanism for seven kinds of fuels.

Experimental results showed that the catalytic effect of the fuel additive was different for the different fuels, and could be described by a parameter considering cetane number and kinematic viscosity. The fuel additives reduced soot more effectively for fuels with higher cetane number and lower kinematic viscosity. This result was explained by soot oxidation characteristics for the different fuels. Oxidation of soot with the metallic additive proceeds in two stages: stage I, a very rapid oxidation stage; and stage II, a following slow or ordinary

oxidation stage. The degree of soot oxidation in stage I increased with calcium additive content, and was more remarkable for fuels with higher cetane number and lower kinematic viscosity.

The 2nd International Marine Engineering Conference 1991 Shanghai, China, June 3-7, 1991

Diesel Soot Reduction with Catalytic Fuel Additives

Noboru MIYAMOTO, Hideyuki OGAWA, and Zhixin HOU
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Experiments on a large number of soluble fuel additives were systematically conducted to determine diesel soot reduction characteristics. It was found that calcium and barium were the most effective soot suppressers. The fuel additives reduced soot more effectively for high excess air factors, strong gas turbulence, and fuels with higher cetane number and lower kinematic viscosity.

The oxidation of trapped diesel soot containing the catalytic metals were characterized through thermogravimetric analysis with a thermobalance. With the metal-containing soots, the ignition temperature is substantially reduced, and it follows a two-stage oxidation process. The first stage of oxidation is catalytically promoted by metal additives, resulting in enhanced reaction rates and reduced activation energies. Soot oxidation in the rapid first stage increases with metal content. Soots oxidation in the rapid first stage increases with metal content. Soots containing barium and calcium are oxidized most rapidly due to the larger reduction during the first stage. The degree of oxidation in the first stage was more remarkable for soots from fuels with higher cetane number and lower kinematic viscosities.

Conference on Mechanism of Non-Uniform Combustion Tokyo, September 10-11, 1990.

Structure of Diffusion Wake Flame Behind a Bluf-Body

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The structure of propane diffusion flame at the shearing layer between the main flow and the recirculation zone has been experimentally investigated. High speed direct photographs

and instantaneous Schlieren photographs have been taken and temperature fluctuation and gas concentration have been measured. A new combustion diagnostics using flame color developed by the authors, which is able to estimate spacial local equivalence ratio, has been applied to this flame. From the results, it was understood that the flame has the regular vortex structure at the shearing layer. The vortex is made of two layers of hot burnt gas and rich mixture. Combustion occurs inside the vortex and proceeds from burnt gas layer to the mixture layer. When combustion occurs inside vortex the selective diffusion of oxygen from mixture to burnt gas would occur and local equivalence ratio at the flame front would become richer as the vortex moves downstream.

The 13th Annual Energy -Sources Technology Conference and Exhibition New Orleans, Louisiana January 14 -18, 1990

Reduction of Smoke and NOx Emissions by Active Turbulence Generated in the Late Combustion Stage in D. I. Diesel Engines

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K. YAMANE
Kyoto University
Kyoto, Japan
M. XU
Zhen jiang Shipbuilding Institute
Jiangso Province, People's Republic of China

The purpose of this study is to achieve simultaneous reduction in smoke and NOx emitted from diesel engines. Generally, there is a trade-off between smoke and NOx emissions, and a simultaneous reduction in both is difficult to realize.

Generating strong turbulence late in the combustion period was produced to enhance smoke oxidation without disturbing the initial combustion stage where NOx formation is dominant. The turbulence was generated by jets of burned gas from an auxiliary chamber installed in a direct injection diesel engine. For the reduction of NOx, exhaust gas recirculation (EGR) was combined with the strong turbulence in the combustion chamber at a slightly retarded fuel injection timing.

The experiments were very successful to reduce particularly smoke, and also NOx. Thermal efficiency was improved at full loads. The paper describes the effect for various operating conditions and combustion chamber configurations.

Diagnostics and Modeling of-Combustion in Internal Combustion Engines, Kyoto, Japan, September 3-5, 1990

Theoretical and Experimental Study on Combustion Similarity for Different Size Diesel Engines

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The paper presents a theoretical study on combustion similarity in differently sized diesel engines and the partial experimental validation of the theory.

The theoretical consideration shows the possibility of combustion similarity, and the similarity conditions are identified. To verify the theoretical predictions, similarity in fuel jet distribution was obsenved in a model apparatus, and also comparisons of thermal efficiency, heat release rate, and emissions were made for engines varying from 260 to 400mm in bore size. The results showed good agreement with the theory.

International Off-Highway & Powerplant Congress and Exposition Milwaukee, Wisconsin September 10-13, 1990

The Microcrystal Structure of Soot Particulates in the Combustion Chamber of Prechamber Type Diesel Engines

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To clarify the microcrystal structure of soot particulate in the combustion chamber, we examined sampling methods which freeze the reaction of sample specimens from the combustion chamber and collected the soot particulates on microgrids. We investigated the microcrystal structure with a high resolution transmission electron microscope.

The results were: the particle size distribution and the microcrystal structure of the soot particulates is little different for the cooled freezing method and room temperature sampling. The typical layer plane structure which characterizes graphite carbon is not observed in the exhaust of diesel engines, but some particulates display a somewhat similar layer plane struc-

ture. The structure of soot particulate is a turbostratic structure as the electron diffraction patterns show polycrystals. The soot particulates in the combustion chamber is similar to exhaust soot particulates. In the initial stage of combustion, the particulate shows similar layer planes, but after the heat release there is no clear layer plane structure.

The 3rd International Conference on Technology of Plasticity, Kyoto, Japan July 1-6, 1990

Non-Steady State Deformation of Thick Cylinder during Upset Forging

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The non-steady state deformation of thick cylinder during axial compression is dependent on the ratio of height to outer diameter, the thickness of the wall, and the friction at the interface between the die and the workpiece. In this study, a numerical method based on the rigid plastic finite element method has been developed to simulate this deformation. The geometrical changes containing the local buckling at inner wall, the folding both at the inside and the outside corners of interfaces, and nonlinear load-displacement relationships of thick cylinder during compression were obtained from the simulation by this method. The experimental results of Aluminium (JIS A1050-H14) have the good agreement with the simulation.

KSME/JSME Joint Conference on Fracture and Strength '90, Seoul, Korea, July 6-7, 1990

Numerical Simulation of Mechanical Ratchetting of SU304

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In this paper, ratchetting of axial strain obtained from the superposition of a tensile stress and cyclic shear straining are shown for 304 stainless steel with many sets of combination of tensile stress and shear strain amplitude. Using the constitutive equation proposed by authors, this ratchetting is simulated and discussed in detail in comparison with the experimental results.

KSME/JSME Joint Conference on Fracture and Strength '90, Seoul, Korea, July 6-7, 1990

Strain-Optic Laws of Cellulose Acetate during Creep and Creep Recovery

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To confirm the practicality of the model analysis during visco-elasto plastic deformation, the time dependent photomechanical properties of cellulose acetate were examined by means of the uniaxial creep test under a constant stress and the creep recovery test after removal of stress. Consequently, the fringe order as well as the strain of cellulose acetate can be represented by a viscous-viscoelastic model proposed by Findley, in which both of them are divided into four components; elastic, plastic, time-dependent nonrecoverable viscous and time-dependent recoverable viscoelasticity component. The relation between viscoelastic strain and viscoelastic fringe order are equivalent to that between plastic strain and plastic fringe order, all of which do not depend on stress, temperature and time on the contrary. Therefore, the strain distribution of cellulose acetate during creep and creep recovery can be determined directly by the value of fringe order measured.

The 1st World Congress of Biomechanics, California, U. S. A. August 30-September 4, 1990

A New Design for the Artificial Intervertebral Disc

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The objective of this study is to represent a new designed artificial intervertebral disc to reconstruct both the stability and the mobility as the human functional spinal unit.

This model consists of two bioactive ceramic plates and a intervenient rubber-link material. Glass-ceramic containing apatite and wollastonite was chosen for the plates in contact with bone, because it could form a strong chemical bone with osseous tissue, and had relatively higher mechanical strength than other bioactive cermamics. On the other hand, a medical grade silicone polymer was selected for an elastic material lain between two plates, because it

had good biocompatibility and suitable stiffness for the intervertebral disc.

In conclusion, the structure composed of glass-ceramics containing apatite and wollastonite and medical grade silicone polymer was effective for the artifical intervertebral disc.

The 1st World Congress of Biomechanics, California, U. S. A. August 30-September 4, 1990

Finite Element Analysis of Stress Distribution in Whole Lumbar Spine

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A clarification of the mechanical causes of low-back pain required a knowledge of the states of stress and strain throughout the lumbo-sacral spine. Since a purely experimental approach cannot provide this information, the analytical model studies to supplement measurements are necessary. The purpose of this study is to analyze the states of stresses in intervertebral discs of the whole lumbar spine by quasi three dimensional finite element method.

The results show the backward tensile stress was concentrated in the posterior parts of annulus fibrosus at L4/5 and L5/S1. This may be causes of disc herniation in the lower lumber spine.

The 1st World Congress of Biomechanics, California, U. S. A. August 30-September 4, 1990

Stress Distribution of Lumber Intervertebral Discs after Spinal Fusion and in Spondylolysis

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Authors had proposed a finite element model of the whole human lumbar spine to carry out computational simulation under flexion movement. In this paper, in order to investigate the

stress state in lumber intervertebral discs not only after spinal fusion but in spondylolysis, as two clinical problems, this model of the whole lumber spine was applied to stress analysis under flexion and extension.

As a result, it was conformed that the stress level at posterior region of intervertebral disc in vicinity of fusion was higher than that of non-fusion under flexion with pure moment and shear force. In addition, the stress level of the upper intervertebral disk (L4/5) of vertebra with spondylolysis was much higher than that of other discs. Therefore, these results could gives a biomechanical explanation to the clinical results.

The 4th IUTAM Symposium Creep in Structures Cracow, Poland September 10-14,1990

A Hybrid Constitutive Model for Cyclic and Creep Defromation

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This paper shows the fact that back stress in cyclic plasticity plays an important role to describe the creep and relaxation behavior of SUS304 type stainless steels at room temperature following cyclic preloading if the evolution of kinematic back stress in simulated from the hybrid constitutive equations. Consequently, the experimental results of creep during cyclic loading could be described by the so-called Bailey-Norton law, if the effective stress is defined as stress measured from the current center of yield surface, i, e, kinematic back stress.

The Japan International Tribology Conference, Nagoya, Japan October 30-November 1, 1990

Elastic-Plastic Finaite Element Analysis of Rolling-Sliding Contacts of Steel Coated by Ceramics

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Friction and wear of the contact surface during rolling and sliding should be predicted precisely and then controlled well to develop a so-called high-technology in the industry. It is

worth while to note that recently the materials are coated with ceramics to decrease the damage undergone in rolling and sliding contact. However, the effect of coating with ceramics on wear has not been examined enough. In this paper, an attempt is made to analyse the behavior of the inelastic deformation of S20C and SKD11 coated with SiC during rolling-sliding under a contact pressnure sufficient to cause yielding using a finite element method. The effect of ceramics-coating on the deformation and the distribution of stresses and strains in rolling-sliding contact is demonstrated from the view-point of the thickness of ceramics-coating layer and the strain hardenig of the substrate material.

The 2nd International Symposium on Fusion Nuclear Technology. Karlsruhe, Germany, June 2-6, 1991.

Development of a Robot System for Miniaturized Tensile Tests

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Miniature specimen techniques of mechanical tests for fusion reactor materials research have been developed for reducing the hazard of the radiation from irradiated specimens, and the effective utilization of limited volume of irradiation facilities. Recently, mechanical testings are needed for irradiated specimens with high radio-activity and their number increases with the development of research works. Although the specimen sizes are small, their radio-activity will become too hight to handle with hands and also specimen sizes are too small to handle with a conventional manipulator, even though controlled by a skilled operator. In the present work, a robot system controlled by a micro-computer is developed. This system is designed to accommodate a miniaturized tensile specimen and is composed of a specimen feeder, a manipulating robot, a simulated tensile testing fixture and a micro-computer for controlling the system. All the testing procedures are performed quickly and safely without any skill. It was confirmed that the constant precision of testing can be obtained with the present robot system. The improvement of this system is still in progress.

IEEE 1990 Industry Applications Society Annual Meeting, Seattle, U. S. A., October 7-11, 1990

Design and Characteristics of Active Power Filter Using Current Source Converter

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This paper describes a current source active power filter. It features a simple PWM method, superior current control capability, easy protection and high reliability compared with a voltage source counterpart. An active filter system composed of an active filter (AF) and a second-order high pass filter (HPF) is proposed. Combining them, excellent total filter performance with a low switching frequency is obtained. Initially, a real time PWM control method of the current source converter is introduced. Then, design criteria of AF and HPF, i. e. the carrier frequency of AF, the component values of HPF and the inductance value of a DC reactor, are presented. Finally, compensation characteristics are demonstrated by experiments.

IEEE 1991 Power Electronics Specialists Conference, M. I. T., Cambridge, U. S. A., June 24-27, 1991

A Pulse Frequency Modulated PWM Scheme for Sinusoidal Inverters

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This paper describes a PWM pulse pattern optimization method using pulse frequency modulation (PFM). The new PFM technique is aiming at not only reducing the magnetic acoustic noise of driven motors but also at improving the performance of sinusoidal inverters. The PWM pulse patterns are basically controlled so that the time-integral function of the output voltages in the space vector notation may draw a circular locus. In addition to this, the pulse frequency, practically the sampling frequency of PWM, is also controlled so that the performance index (PI) , which represents the degrees of achieved objectives, may be minimized. In this paper two PIs, one for minimizing the distortion of output currents and the other for minimizing the torque pulsation of driven motors, are employed. Finally, the method is implemented using a single-chip microprocessor, and the experimental results demonstrate its validity.

IEEE Industry Application Society Annual Meeting, Seattle, USA, Oct. 7-12, 1990

The Advanced Speed Regulator System for Brushless Motor

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A new motor drive method and a new control system designing method to improve the performance of the permanent magnet type brushless motor are presented. Three types of driving method, which are vector control, field weakening and field strengthening, are proposed. By using these driving methods, the advanced motor speed regulator performance such as the efficiency optimized control and the quick speed response are obtained.

The simulations and the experiments are performed and the usefulness of the proposed PM motor control system is confirmed.

IEE Japan-IAS '91 Annual Conference of Industry Applications Society, Sapporo, Japan, Aug. 27-29, 1991

Optimal Repetitive Control and Its Application for PWM Inverter

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A new control technique, named Optimal Repetitive Control, for the power electronics system is presented. This control law which has both novel features of the optimal control and the repetitive control is applied for the PWM inverter to obtain sinusoidal output. The required pulse pattern for the PWM inverter can be calculated by the proposed control method even if the system is connected with nonlinear load, such as the condenser input type rectifier load. The effectiveness of this control technique is confirmed by the simulation and the experiment.

Info-Japan 90 Tokyo, Japan,
Oct., 1990

Vocabulary-Based Logic Programming

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We will show, in this paper, (1) the importance of introducing a vocabulary to knowledge-based systems, (2) how we can define basic nouns, and adjectives in a knowledge-based system, (3) how we can build our vocabulary using these basic words without referring to the underlying knowledge-based system, and (4) how we can describe rules and facts of the underlying knowledge-based system through the use of our vocabulary. A vocabulary defined in a way as described in this paper has compositional truth-theoretic semantics. This enables us to build our vocabulary starting from a small set of basic words that are defined as primitive objects or constraints in the underlying knowledge base. Systems that share a vocabulary can communicate with each other using their vocabulary although they have different underlying conceptual models.

Pacific Rim International Conference on Artificial Intelligence '90 Nagoya, Japan, Nov., 1990

Introducing a Large Vocabulary into Prolog

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In this paper, we will show a method of introducing a large vocabulary as used in natural language into a logic programming language Prolog. This introduction has provided Prolog with new capabilities such as the conceptualization of objects and constraints as words, the word construction to define new phrases, and the vocabulary building by giving new names to some of the composed phrases. We call the language thus obtained the Vocalog language, the **voca**bulary-based **log**ic programming language.

In Vocalog, objects and constraints are generically represented as nouns and adjective respectively. These words may be combined to define new phrases by word constructors, which denote new objects or new constraints. Naming function allows us to define new words as names to the composed phrases. This mechanism provides us with vocabulary-building facilities. Therefore, vocabulary-based programming allows us to define objects and constraints in reusable forms that are easy to maintain.

International Conference on *Multimedia Information Systems '91* Singapore, Jan., 1991

A Synthetic Dynamic-Media System

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The Intelligent Pad system developed at Hokkaido University is a mind tool system that provides us with an overall integrated open environment for intellectual activities. It represents everything as a pad or a sheet of paper. Multimedia documents, multimedia office tools, server systems like database systems and mail systems, and application programs are all represented as pads.

Pads are all persistent. Different pads are associated with different functions such as word processing, image editing, line drawing, tabulation, graph drawing etc. Pasting of pads on another pad defines a new pad that has both an arbitrary layout of fields and a new function composed of the constituent pads.

For the management and retrieval of all kinds of pads, the IntelligentPad system provides four different visual management facilities, i.e., (1) visual catalogs of pads, (2) hypermedia networks, (3) form bases, and (4) pad bases.

The IntelligentPad system provides fundamental and primitive facilities for a systematic approach to CSCW (Computer Supported Cooperative Work). Among them are the mailing of pads, shared copies of pads, and the field pad. Any pad can be sent as a pad mail to other IntelligentPad systems through a network. It also allows us to send a shared copy of an arbitrary pad as a pad mail. Shared copies of the same field pad with some pads on it provide users at different sites with shared workbenches, on which they can not only share the states of these pads but also share all the events such as key strikes and the paste/peel operations on these pads.

IASTED International Conference on High Technology in the Power Industry, Tainan, Taiwan, China March 4-7, 1991

Optimal Operation of Electric Energy Storage Systems Considering Rate Constraints on Generator Power Outputs

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A new method for deciding daily operating strategies of newtype energy storage systems is developed including rate constraints on generator power outputs. In addition to load leveling of power systems, economic operation of the storage systems should be considered from the viewpoint of quick responce for energy input and output. This problem is referred to as the socalled dynamic load dispatching, which has already studied for short-range scheduling of generating units. For daily operation of thermal units and a storage system, the proposed method which minimizes the total fuel cost is based on the succcessive approximations dynamic programming so as to treat various constraints easily. Numerical examples using a model system clarify the difference of operational patterns of the storage system from the conventional optimization results.

IASTED International Conference on High Technology in the Power Industry, Tainan, Taiwan, China March 4-7, 1991

On-Line Preventive Control Strategy under Urgent Condition in Power Systems

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This paper presents a solution algorithm for " preventive control under urgent conditions " which is implemented when the probability of outages becomes high temporarily because of weather conditions, etc. Load transfer, starting-up of a stand-by generating unit and MW interchange of DC intertie as well as adjustments of control parameters existing in a power system (e. g., generator MW output, generator voltage magnitude) are considered as control variables for eliminating constraint violations of post-contingency state variables. Since for-

mulation and optimization are based on the P-θ and Q-V decompositions, the control strategies are calculated fast and efficiently. The effectiveness of the proposed algorithm is ascertained through numerical examples for model power systems.

The 3rd. Symp. on Expert Systems Application to Power Systems, Tokyo-Kobe, JAPAN, April 1-5, 1991

Fuzzy Decision Making of Deicing Countermeasures Against Snow Accretion on Transmission Lines

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A method choosing the most effective one among a set of deicing countermeasures against snow accretion on transmissinon lines is formulated by a multiple alternative, multiple attribute decision problem based on fuzzy sets. An decision making algorithm is investigated, which evaluates the utilities of alternatives with linguistic variables and provides decision results in the form of natural language. Computation formulae for algebraic operation of fuzzy numbers are proposed, too. The proposed algorithm is examined by an example of evaluating deicing countermeasure.

The 10th International Conference on Conduction and Breakdown in Dielectric Liquids (10. ICDL) Gronoble, France, September 10-14, 1990

Photoelectric Current in Cryogenic Liquid Mixtures

S. NAKAMURA, Y. SAKAI, Li XU and H. TAGASHIRA

Binary mixtures of liquid nitrogen, liquid methane, and liquid argon with various mixing ratios were produced by cooling down the binary mixed gases directly in a measurement cell. The boiling temperature, enthalpy change for vaporization, and steady state photoelectric current were measured in the liquid mixtures. The relation between the saturation vapor pressure and the liquid temperature obeyed Clapeyron-Clausius equation. The photoelectric current in the binary mixtures increased with the field strengths between those in the component liquids.

The electron mobility estimated in the mixture of liquid nitrogen and liquid argon in the framework of Thomson's model increased exponentially with increasing the mol fraction of argon.

The 10th European Sectional Conference on the Atomic and Molecular Physics of Ionised Gases (ESCAMPIG 90) Orleans, France, August 28-31, 1990

Transport Coefficients Defined by Arrival Time Spectra of Electron Swarms in Gases

H. DATE, S. YACHI, K. KONDO and H. TAGASHIRA

A method of analysis for the parameters deduced from the arrival time spectra (ATS) of electron swarms in gases is presented. The method makes it possible to calculate the swarm parameters defined as the space derivatives of the moments of the arrival time of electron density distribution. The method is applied to deduction of the electron energy distributions and swarm parameters in krypton gas by utilising the spherical harmonic expansion for solution of the Boltzmann equation. Good agreement between the parameters deduced from the presest analysis and Monte Carlo simulation is obtained.

The 10th European Sectional Conference on the Atomic and Molecular Physics of Ionised Gases (ESCAMPIG 90) Orleans, France, August 28-31, 1990

Electron Swarm Parameters in HCl/Xe/Ne and HCl/Xe/He: Boltzmann Equation Analysis

Y. SAKAI, S. SAWADA and H. TAGASHIRA

For the analysis of self-sustained gas discharges in rare gas halide excimer laser media, it is important to consider the secondary electrons generated through metastable atoms. However, the conventinal studies have not considered them in Boltzmann equation analysis. In this article the swarm parameters in HCl/Xe/Ne and HCl/Xe/He mixtures for various E/N and electron density are analyzed using a Boltzmann equation in which 1) Penning ionization, 2) cumulative ionization and 3) ionization between two metastable atoms are considered properly, in addition to direct electron impact ionization.

The 10th European Sectional Conference on the Atomic and Molecular Physics of Ionised Gases (ESCAMPIG 90) Orleans, France, August 28-31, 1990

Monte Carlo Simulation of a Self-Sustained F_2/Ar/He Discharge

H. AKASHI, Y. SAKAI and H. TAGASHIRA

In this paper a self-consistent simulation model of F_2/Ar/He discharges with preionization is presented. The spatial growth of the electron swarm and the positive ion concentration, and the variation of the electric field and potential with time are calculated by Monte Carlo simulation. It is found that the spatial distribution of the field and the potential accelerate electrons in the direction of the middle of the gap. This effect seems to act as a stabilizer of maintaining large volume discharge.

Symposium on The Physics of Ionized GASES (SPIG-90) Dubrovnik, Yugoslavia, September 3-7, 1990

Transport Coefficients Defined by Arrival Time Spectra of Electron Swarms in Methane Gas

H. DATE, S. YACHI, K. KONDO and H. TAGASHIRA

A method of analysis for the electron swarm parameters deduced directly from the arrival time spectra (ATS) of electron swarms in gases is presented. The method is applied to deduction of the electron energy distributions and swarm parameters in methane gas at relatively high E/Po values by utilizing the spherical harmonic expansion for solution of the Boltzmann equation, and with focus on the drift velocity, W_m, defined by ATS, and V_a for the steady state experiments are compared with the center of mas drift velocity W_r, the conventional time-of-flight drift velocity, and the mean electron drift velocity M_v. Difference of the values between them is recognized significantly at high E/Po values.

The 12th International Conference on Boundary Element Method, Sapporo, Japan, Sept. 24-28, 1990

Field Analysis of MPD Thrusters Using the Boundary Element Method

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MPD (magnetoplasmadynamic) arcjet thruster is one of the electric propulsion systems. This paper presents the numerical simulation of the electromagnetic field of the two-dimensional MPD arcjet thrusters, using the boundary element method (BEM) with a simple iteration scheme. In the analysis, the governing equations of MPD phenomena can be reduced to the induction equation with a convective diffusion term. We solve this equation to obtain the magnetic fields and the distribution of the current density and the Lorentz force for the flared -type MPD thruster using BEM. The conclusions are summarized as follows: (1) With increase of the flow velocity, current channels are extended to down stream region and the current gradually concentrates on the cathode tip. (2) The Lorentz force distribution does not depend on the velocity.

The 12th International Conference on Boundary Element Method, Sapporo, Japan, Sept. 24-28, 1990

Boundary Element Solutions to Potential Problems in the Helically Symmetric System

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The Laplace equation is solved using boundary element methods in the helically symmetric system. After the differential surface element and the normal differential operator are derived in the general curvilinear coordinates, a boundary integral equation is introduced in the twisted coordinates in which the system is reduced to the two-dimensional model. Moreover, the boundary element solution is compared with the perturbed solution for a simple mathematical model and the numerical solution is proved to be valid.

The 12th International Conference on Boundary Element Method, Sapporo, Japan, Sept. 24-28, 1990

Mixed Boundary Element Solutions to Three-Dimensional Convective Diffusion Equations for High Péclet Numbers

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It is very important to solve the convective diffusion equation accurately in physics and engineering. We have shown that the boundary element method gives stable and accurate solutions of the convective diffusion equation without using especial numerical schemes. In this paper, for higher Péclet numbers, we study the characteristics of the mixed boundary element solutions of the three-dimensional steady-state convective diffusion equation.

The 12th International Conference on Boundary Element Method, Sapporo, Japan, Sept. 24-28,1990

A Mesh Generation Scheme Based on Boundary Element Method

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In this paper, we describe a mesh generation scheme to obtain the numerical model of a physical problem. We consider one to one correspondence between the coordinates of the physical domain and the potential in the transformed domain, and solve potential problems by the boundary element method, so that the numerical model is obtained. The present scheme is applied to generate the meshes around the discharging head of an electric propulsion system and of the region between the earth and a high voltage transmission line. As a result, we find that, in order to obtain the suitable numerical model, we should consider how we distribute the potential in the transformed domain by using the boundary conditions.

The 12th International Conference on Boundary Element Method, Sapporo, Japan, Sept. 24-28, 1990

Axisymmetric Analysis of Boundary Plasma by Regular Boundary Element Methods

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In the analysis of the Debye shield phenomena for the boundary plasma, the governing equation can be reduced to the same modified Helmholtz equation as the linear Poisson-Boltzmann equation. Many authors have studied the equation by using domain type numerical methods in order to obtain the potential distribution of the plasma sheath. In this paper, we apply two numerical techniques in BEM to solve the axisymmetric modified Helmholtz equation. One of them is the regular BE analysis by using the fundamental solution of the axisymmetric modified Helmholtz equation. The other is the integral equation (IE) analysis in which we use the fundamental solution of the axisymmetric Laplace equation.

IABEM-90 Symposium of the International Association for Boundary Element Methods, Rome, Italy, Oct. 15-19,1990

An Iterative Boundary Element Analysis of Helically Symmetric MHD Equilibria

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Magnetohydrodynamic (MHD) equilibria, which must be obtained before analyzing the stability of fusion plasmas confined by magnetic fields, have been well-studied using various computational schemes especially in the axisymmetric systems. On the other hand, three-dimensional (stellarator) plasma configuration, which can be approximated as being helically symmetric in the limit of large aspect ratio, or large number of helical periods, has attracted considerable attention in recent years. Hence, it is necessary to develop effective and accurate computational schemes for calculating equilibrium configuration also in the helically symmetric systems. In this paper, we present an iterative scheme based on the boundary element method for calculating MHD equilibrium in the helically symmetric systems.

CEFC-90 The 4th Biennial IEEE Conference on Electromagnetic Field Computation, Toronto, Canada, Oct. 22-24, 1990

A Finite Element Analysis of TE Modes in Twisted Waveguides

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In this paper, we present a numerical scheme based on the finite element method for analysis of TE modes in twisted waveguides. TE modes in twisted waveguides with arbitrary cross-sections can be easily analyzed using the present scheme. In the following, we derive a variational form of the scalar Helmholtz equation in the twisted coordinates. Next, we study the accuracy of eigenvalues by the present scheme in comparison with those by Lewin's formula in twisted rectangular waveguides. Finally, we present dependence of TE mode distributions on the helical pitch and the shift of a guide wall from the origin using the present scheme.

The 4th Japanese-Sino Sapporo International Conference on Computer Applications, Sapporo, Japan, Oct. 27-30, 1990

An Analysis of Unbounded Region of Ion Flow Field Using BEM and MOC

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In ion flow fields surrounding high-voltage direct current (HVDC) transmission lines, we must deal with "open" boundaries in order to study the corona discharge. In general, there are two different approaches applied to consider the "open" boundaries in the numerical analysis. One of them is to use the fictitious boundaries instead of the "open" boundaries, so that we can consider an unbounded region as the closed one. In this case, it is desirable to set the fictitious boundary far away from the transmission line. We refer to this approach as the fictitious boundary (FB) analysis. The other is to use the image method, so that we can regard the ion flow field as the open field in the numerical analysis. Then, this approach is referred to as the open boundary (OB) analysis. In this paper, for FB analysis, we study the

dependence of the numerical accuracy on the above mentioned position. As a result, the most appropriate position for FB analysis is obtained. Moreover, in OB analysis, we study the ion flow problem using the same scheme as in FB analysis. In conclusion, it is shown that the results of the both analyses indicate generally good agreement.

The 4th Japanese-Sino Sapporo International Conference on Computer Applications, Sapporo, Japan, Oct. 27-30, 1990

Field Analysis of Ion Engines Using Boundary Element Method

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An ion engine is expected as the supporting propulsive device used for exploration of the universe and for artificial satellites. The trajectories of ions in the ion engines are analyzed as follows: We can obtain the trajectories of the ion particles by solving the Poisson equation, the current conservative law and the equation of motion as the governing equations. In the analysis, we have to consider the inhomogeneous term of the Poisson equation as the nonlinear charged density function of the potential. It is, therefore, necessary to develop the better and more accurate numerical technique for calculating the electric charge densities. In this paper, we introduce the method of characteristics into calculation for electric charge densities inside the nozzle. For the Child-Langmuir problem, we compare the values of the electric potentials, fluxes, and electric charge densities with those of the analytical solutions and evaluate the error of these values.

The 4th Japanese-Sino Sapporo International Conference on Computer Applications, Sapporo, Japan, Oct. 27-30, 1990

Boundary Element Analysis of Axisymmetric Poisson-Boltzmann Equation

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In the boundary element analysis of the Debye shield phenomena for boundary plasmas, we have the following problems: (1) The singularity of the fundamental solution on the boundary. (2) The difficulty of numerical evaluation of the fundamental solution which is written in the integral form. These problems influence seriously on the numerical analysis. In order to solve these problems, in this paper, we apply two numerical methods. One of them is the regular BE (R-BE) analysis in which we use the fundamental solution of the axisymmetric modified Helmholtz equation without considering the singularity. The other is the integral equation method (IEM) in which we use the fundamental solution to the axisymmetric Laplace equation. The axisymmetric Laplace equation is expressed in the analytic form. In the analysis, we examine how the accuracy of R-BE solutions is related to the distance between the boundary and the source point. Furthermore, we compare the accuracy of the conventional BEM solutions with the regular BEM and IEM solutions.

The 2nd Japanese-Polish Joint Seminar on Electromagnetic Phenomena in Materials and Computational Techniques, Oita, Japan, Jan. 22-24, 1991

Axisymmetric Analysis of Electromagnetic Fields Using Boundary Element Method

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In the boundary element analysis of axisymmetric electromagnetic fields, two types of general forms of the fundamental solutions are derived from the physical and mathematical approaches. In this paper, we show that the fundamental solution derived from physical approach coincides theoretically with that derived from mathematical one. Numerical characteristics of fundamental solution are discussed.

The 2nd Japanese-Polish Joint Seminar on Electromagnetic Phenomena in Materials and Computational Techniques, Oita, Japan, Jan. 22-24, 1991

Boundary Element Analysis of Electromagnetic and Flow Fields in MPD Thrusters

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Maxwell's equations describing the MPD (magnetoplasmadynamic) phenomena can be reduced to the induction equation with the convective diffusion term. We solve this equation for the flared-type MPD thruster with three types of the flow velocity distributions by using the boundary element method (BEM). As a result, we can summarize numerical results as follows:

(1) The current channels for the linear flow velocity distribution concentrate on the cathode surface more strongly than that for the constant one.

(2) The current and force densities in the region between the cathode and the anode are higher for the linear flow velocity distribution than for the constant one.

ISEM-Sendai, The International Symposium on the Application of the Electromagnetic Forces, Sendai, Japan, Jan 28-30, 1991

An Analysis of MHD Equilibria in Straight Stellarators Using Finite Element Method

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This paper presents a finite element analysis of the magnetohydrodynamic (MHD) equilibria in straight stellarators with bean-shaped cross sections. The equilibria are iteratively calculated under the condition of vanishing the net toroidal current over the whole plasma cross section. To calculate surface quantities, the finite element mesh is modified during the above iteration processes so that the layers of nodal points coincide with magnetic surfaces. The stream function, rotational transform and specific volume for a helically symmetric vacuum field with bean-shaped cross section are calculated by the present method and they are shown to be in good agreement with analytic values. Moreover, it is shown that the solutions by present method converge sufficiently fast even under the severe conditions under which convergent solutions can not be practically obtained by the Picard and Marder-Weitzner iteration methods.

BETECH 91, 6th International Conference on Boundary Element Technology, Southampton, UK, June 11-13, 1991

Boundary Element Analysis of Electromagnetic Fields in Helically Symmetric System

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This paper presents a boundary element analysis of electromagnetic fields in helical systems. A two dimensional integral equation is introduced from the scalar Helmholtz-type equation in the general curvilinear coordinates. An integral equation for helical systems is derived from the above equation using the twisted coordinates. The boundary element method based on the present formulation is applied to the analyses of potential fields in a helical column, electromagnetic fields in a twisted waveguide and magnetohydrodynamic equilibria in a helical vessel.

International IEEE Antennas and Propagation Society Symposium and North American Radio Science Meeting London, Ontario, Canada, June 24-28, 1991

Treatment of Scalar Potential Field with Lorentz Gauge Condition in Time Domain

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In the analysis of electromagnetic fields, the vector potential has important roles especially when sources exist. But, the formulation by the vector potential demands the consideration about the scalar potential fields based on the gauge conditions. This paper presents the time-dependent formulation of the scalar potential fields by use of the Lorentz gauge condition for the field with lossy medium. By defining the new equivalent voltage variable "F" derived from the gauge condition and the analogy to the velocity potential field, the scalr potential field can be expressed by the equivalent circuit corresponding to that of the vector potential field. This treatment realizes the unified analysis including both potential fields.

1991 IEEE Microwave Theory and Techniques Society International Microwave Symposium Boston, Massachusetts USA, June 10-14, 1990

Full Wave Analysis of Propagation Characteristics of a Through Hole Using the Finite-Difference Time-Domain Method

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A full wave analysis of the propagation characteristics of a through hole was carried out using the finite-difference time-domain method. The results were compared with measured values. Agreement between computed results and measured ones was excellent from DC to high frequencies. The frequency characteristics of radiation depends on the structure of the through hole, especially its rod diameter and microstrip connecting angle.

The 3rd International Conference on Formation of Semiconductor Interfaces, Italy, May 5, 1991

Formation Mechanism of Schottky Barriers on MBE Grown GaAs Surfaces Subjected to Various Treatments

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Al, Mg and Au Schottky barriers were formed on MBE grown (100) GaAs surfaces subjected to various treatments includiug chemical etching, ion etching, sulfur treatment and insertion of an ultrathin Si interface control layer (Si-ICL). They were characterized by the X-ray photoelectron spectroscopy (XPS), current-voltage (I-V) and capacitance-voltage (C-V) techniques. The XPS results indicated presence of an interfacial layer (IL) in each case. Although the behavior is far from the ideal Schottky limit, the barrier height showed dependences on the properties of ILs and the metal workfunction. Based on the disorder-induced gap state (DIGS) model, a theory including the effect of an insulator-like or semiconductor-like IL was developed. The theory explains the observed behavior reasonably well, showing

that the detailed nature of the IL is the key feature for the understanding and control of Schottky barriers.

The 3rd International Conference on Indium Phosphide and Related Materials, Cardiff, Wales, UK, Aplil 8-11, 1991

Surface Passivation Technology of In GaAs Using an MBE Si Layer Compatible with Standard Device Processing

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InGaAs lattice matched to InP is an extremely attractive material for high speed digital, analog and optoelectronic integrated circuits, since its mobility exceeds that of GaAs at room temperature and its energy gap matches with the wavelength for long wavelength optical communication. However, the air exposed surface of InGaAs is characterized by existence of high density surface states which causes firm pinning of surface Fermi level. Thus, establishment of a suitable surface passivation technology is necessary.

In the previous InP conference, we described a novel UHV process for passivation of the $In_{0.53}$ $Ga_{0.47}$ As surface by using an ultrathin MBE Si layer, which realized a completely unpinned InGaAs surface. Applicability of such a passivation process to realistic device fabrication is, unfortunately, saverely limited, since air-exposure of the InGaAs surface is not allowed thoroughout the whole device processing sequence including etching, photolithography, handling etc.

The purpose of the present paper is to propose and characterize a modified surface passivation technology using an ultrathin MBE Si layer which is compatible with the standard device processing sequence. The modified passivation scheme is the following:

(1) InGaAs is grown on the InP substrate by standard MBE or MOCVD process.
(2) Necessary device processing sequence is made on the InGaAs surface in the standard clean room environment.
(3) A special surface chemical treatment using HF is applied for adjustment of surface stoichiometry towards an As-rich condition.
(4) An ultrathin MBE Si layer is grown in an MBE/CVD chamber.
(5) A thick outer passivation layer is deposited by a photo-CVD process using SiH_4, N_2O and an ArF excimer laser.

The new process was characterized by XPS, capacitance-voltage and Photoluminescence measurements. It was found that, by optimizing the thickness of the Si layer for two-dimensional growth and minimal subcutaneous oxidation, completely unpinned interface with N_{ssmin} of $10^{11}\,cm^{-2}eV^{-1}$ was obtained which is comparable to the value obtained with the previous UHV process. The mechanism was explained in terms of complete reduction of arsenic oxide

by Si which realizes an oxide free interface, it started from a surface made arsenic rich by the HF treatment. On the other hand, a simple thermal cleaning in the MBE chamber under As overpressure resulted in a pinned interface, although it reduced surface oxide components a great deal. This is most probably due to oxygen incorporation into InGaAs during high temperature cleaning, similarly to the well-known case of the "regrown" interfaces which we discussed previously. Application of the present process to MISFET fabrication is also discussed.

20th Int. Conf. Physics of Semiconductors, Thessaloniki, Greece, August 6-10, 1990

"Surface" Effects in Superlattices: Formation of TAMM States

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Surface effects induced by a terminating layer of $Al_xGa_{1-x}As$ on $GaAs/Al_yGa_{1-y}As$ superlattices are observed by interband optical transitions. Results clearly show the presence of localized Tamm states and their interaction with other extended superlattice states.

The 6th Int. Conf. Molecular Beam Epitaxy, Sandiego, Carifornia, USA, August 27-31, 1990

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p-Type Diluted Magnetic III-V Semiconductors

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Diluted magnetic III-V semiconductors $In_{1-x}Mn_xAs$ with p-type conduction have been suc-

cessfully grown by molecular beam epitaxy under the specific growth conditions of substrate temperatures above 275℃ with Mn compositions $0.001 \lesssim x \lesssim 0.03$. No MnAs second phase was detected in these films in which the Mn ions serve the dual purpose of providing conduction holes and local spins. Hole concentrations fall in the range of 5×10^{17} to 10^{20}cm^{-3} depending on the Mn composition, and they can be varied with donor impurities as Sn. Magnetotransport at low tempeatures exhibits striking hysteretic characteristics, suggesting the occurrence of ferromagnetic order induced by the presence of holes.

The 35th Annual Conference on Magnetism and Magnetic Materials. San Diego, California, USA, October 29-November 1, 1990

New III-V Diluted Magnetic Semiconductors (Invited)

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A new class of diluted magnetic semiconductor (DMS) based on a III-V semiconductor is reviewed. The new DMS, (In, Mn) As, was made possible by low temperature molecular beam epitaxial growth. Magnetic measurements and x-ray diffration showed homogeneous incorporation of Mn in the films under certain growth conditions, and inclusion of a MnAs-like phase if the conditions are not optimized. The films can be made either p-or n-type by choosing the growth conditions and/or doping. Homogeneous n-type (In, Mn) As layers were paramagnetic and showed negative magnetoresistance. On the other hand, remanent magnetization was observed in p-type samples at low temperature and an anomalous Hall effect associated with it. The presence of such effects was most readily explained in terms of formation of bound magnetic polarons. A first result of anomalous Hall effect in a heterojunction is also presented.

1991 March Meeting of American Physical Society, Chinchinachi, Ohio, March 18-22, 1991

Tamm States in Superlattices.

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A superlattice terminated by a potential barrier in a semiconductor can be thought of as a solid having an internal "surface", where localized "surface" states discussed by Tamm in 1932[1] (Tamm states) may be present. The presence of the Tamm states in their pure form is not possible in real surfaces, since many effects are concurrently in operation. Superlattice structures, however, can provide ideal potential profiles, i. e., "model surfaces" in semiconductors, and the formation and properties of the Tamm states can be closely studied using them. The formation of Tamm states in $Al_{0.2}$ $Ga_{0.8}$ As (40Å)/GaAs (40Å) superlattices with a terminating layer of AlAs on one side is demonstrated in their photoluminescence excitation spectra by a strong excitonic interband transition above the heavy-hole and light-hole excitonic transitions. Critical confirmation is provided by the photocurrent spectra under various electric fields, where a strong anti-crossing between the electron Tamm state and one of the electron stark-ladder states associated with the bulk of the superlattice is present. The transition energies, including their electric field dependence, are reproduced very well by the envelope-function calculation. In addition to the usual Tamm states, which are energetically higher than the bulk superlattice states, the presence of localized surface states *below* the miniband is also confirmed by photocurrent measurements in samples where the terminating barriers are lower than the barriers in the superlattice.

1. I. Tamm, Physik. Zeits. Sowjetunion, 1, 733 (1932).

*Collaborators: E. E. Mendez, A. Alexandrou, J. A. Brum, J. M. Hong, F. Agulló-Rueda, L. L. Chang, and L. Esaki. Work done at IBM T. J. Watson Research Center.

The 5th International Photovoltaic Science and Engineering Conference, Kyoto, Japan, November 26-30, 1990

Computer Analysis of Surface Recombination Velocity for High Efficiency Single Crystalline Solar Cells

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The recombination process at SiO_2/Si interface is rigorously simulated. The result shows that the effective surface recombination velocity S_{eff} is not a "constant" of the surface, but depends strongly on the light intensity and doping. S_{eff} can be reduced by introducing fixed charge, or by forming highly doped surface layers. S_{eff} to be used in the solar cell simulation is generally different from that obtained by the standard measurements. For proper measurement of S_{eff} by time-domain and frequency-domain techniques, a detailed simulation is shown to be necessary.

The 3rd International Conference on Formation of Semiconductor Interfaces, Italy, May 5, 1991

Relationship among Surface State Distribution, Recombination Velocity and Photoluminescence Intensity on Semiconductor Surfaces

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Recombination processes through surface states with arbitrary distributions are analyzed on computer, and the behavior of the band edge photoluminescence (PL) intensity, IPL, is studied.

In contrast to previous PL analyses based on an assumption of a constant surface recombination velocity S_e, The present result shows that S_e is not a constant, but strongly depends on the intensity of the excitation light, ϕ. The behavior of IPL vs. ϕ is investigated in detail for different shapes and densities of surface states. The effect of fixed surface charge is also analyzed. It is shown that N_{ss} distributions on free surfaces can be determined by a detailed

measurement of the ratio, I_{PL}/ϕ, vs. ϕ. The result is applied to actual measurements on chemically etched and sulfur treated GaAs surfaces.

The 22nd (1990 International) Conference on Solid State Devices and Materials, Sendai, Japan, August 22-24, 1990

A Computer Simulation of the Recombination Process at Semiconductor Surfaces

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A rigorous computer simulation of the surface recombination process is made. It is shown that the surface recombination velocity, S, is not a characteristic constant of the surface as is usually assumed, but is a complicated function of charge neutrality level of surface states, sign and amount of fixed charge, substrate doping level and profile, and light intensity and spectrum. It is also shown that S can be reduced by introducing a suitable amount of a fixed charge or by forming a highly doped surface layer. Effect of device doping profile on S is also discussed.

International Conference organized by the IPSJ to Commemorate the 30th Anniversary, Tokyo, October 2-5, 1990

Termination of Direct Sum of Simply-Terminating Term Rewriting Systems

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A term rewriting system, which is a computer program written as a set of rewrite rules, is said to be simply-terminating if, intuitively, its termination is proved with the simplification ordering method of Dershowitz. The direct sum $R_0 \oplus R_1$ of term rewriting systems R_0 and R_1 is their disjoint union.

In this paper, we prove that $R_0 \oplus R_1$ is simply-terminating if and only if each of R_0 and R_1 is so. The result is novel and practically useful for the semi-mechanical termination proof of 'modular' computer programs written as the set of term rewriting systems.

Pacific Rim International Conference on Artificial Intelligence '90, Nagoya, November 14-16, 1990

Using ATMS to Efficiently Verify The Termination of Term Rewriting Systems

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We apply de Kleer's ATMS architecture to a verifier of termination of term rewriting systems, computer programs written as a set of rewrite rules. Compared with the traditional verifiers based on the ordinary backtracking, our verifier greatly improves the overall efficiency by virtue of the ATMS's ability to avoid futile backtracking, rediscovering inferences and rediscovering contradictions. The novelty of the work lies in the practical use of the ATMS for the verification, and in the design choices we have made for communication protocols between the verifier and the ATMS. Although we restricted ourselves in this paper to a single termination method based on the lexicographic path ordering, our architecture is naturally extended to other precedence-based termination methods and, more importantly, the Knuth-Bendix completion procedures for generating decision procedures for equational systems.

The 19th International Symposium on Acoustical Imaging April 3-5, 1991
Ruhr-Universität Bochum, Germany

Improvement of Resolution in Acoustical-Holographic Imaging by Neural Netwark Processing

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In this paper we propose a neural network processing to improve resolution of the reconstructed images from holograms of long-wavelength, such as acoustical and microwave holograms. Since the wavelengthes are long in such waves, improvement of resolution is necessary, because the apertures of hologram planes are narrow compared with the optical holography, resulting in the low-quality reconstructed image.

In this paper we adopt a Hopfield model for neural network processing. A computer simu-

lation of image reconstruction from holograms was conducted in a one-dimensional case to certify the validity of the proposed method. This method is extended to two-dimensions and applied to the image reconstruction in a microwave holography in X-band region, where a rotatory one-dimensional linear array with 16 antenna elements are used and images were reconstructed from the collected data.

The 3rd Optoelectronics Conference (OEC'90), Makuhari Messe, Japan, July 11-13, 1990

Ultimate Performance of Guided-Wave KTP Frequency Doubler as a Miniaturized Blue or UV Coherent Light Source

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A miniaturized frequency doubler utilizing an ion-exchanged KTP optical waveguide is proposed. The dependence of the performance as a blue or UV light source on representative waveguide parameters is examined and discussed.

The 3rd Optoelectronics Conference (OEC'90), Makuhari Messe, Japan, July 11-13, 1990

Principle of All-Optical Gating Operation Using Collinear Interaction in Dichromatic Nonlinear Waveguides

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A novel all-optical integrated-optics signal-processing scheme without using directional coupling between waveguides is proposed using dichromatic fields copropagating in an intensity-dependent planar waveguide made of a semiconductor-doped glass.

The 3rd Asia-Pacific Microwave Conference, Tokyo, Japan, Sept. 18-21, 1990

Finite-Element Analysis of Dielectric Loaded Periodic Waveguides with Axisymmetry

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The finite-element formulation based on the functional in terms of three components of magnetic field is derived for analyzing propagation characteristics of periodically dielectric-loaded axisymmetric waveguides. In order to eliminate spurious solutions, the penalty function method is introduced. Since a singular integrand is involved in the functional expressed in the cylindrical coordinate system, numerical integration formulas derived by Hammer et al. are employed to avoid this singularity. Validity and effectiveness of the approach are confirmed by numerical computations.

The 3rd Asia-Pacific Microwave Conference, Tokyo, Japan, Sept. 18-21, 1990

Three-Dimensional Finite-Element Solution of Scattering from Dielectric Obstacles in a Rectangular Waveguide

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A numerical approach is described for the analysis of scattering from dielectric obstacles in a rectangular waveguide. The approach is a combination of the finite-element method and the analytical solution. To confirm the validity and usefulness of the present approach, numerical examples are shown for a rectangular dielectric scattering obstacle in a waveguide.

The 12th International Conference on Boundary Elements in Engineering, Sapporo, Japan, Sept. 24-27, 1990

Numerical Analysis of H-Plane Waveguide Junctions by the Combination of Finite and Boundary Elements

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A numerical method is formulated for the analysis of H-plane waveguide junctions with arbitrary cross sections. The junctions are loaded with arbitrarily shaped dielectric or ferrite. The method is a combination of the finite and boundary element methods (CFBEM) where the finite-element (FEM) and the boundary-element method (BEM) are applied to the inhomogeneous and homogeneous regions, respectively. Discontinuity problems with a large homogeneous region or with variations of the location of an inhomogeneous region can be effectively treated by the CFBEM. To show the validity and usefulness of the method, a ferrite slab in a rectangular waveguide is investigated in detail.

The 3rd Japan-China Joint Meeting on Optical Fiber Science and Electromagnetic Theory, Fukuoka, Japan, Oct. 12-14, 1990

Analysis of Discontinuities in an Asymmetric Dielectric Slab Waveguide by Combination of Finite and Boundary Elements

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For discontinuities in a dielectric waveguide, we have proposed an approach based on a combination of the finite-element and boundary-element methods (CFBEM), and have confirmed that the CFBEM is very useful for arbitrarily shaped discontinuities. However, the approach is limited to discontinuities in a symmetric slab waveguide. In this paper, we extend the CFBEM to the analysis of discontinuities in an asymmetric slab waveguide. Here, all the eigenmodes in the waveguide are taken into account. To show the validity and usefulness of

this approach, computed results are given for three kinds of step discontinuities with TE and TM mode incidences.

The 3rd Japan-China Joint Meeting on Optical Fiber Science and Electromagnetic Theory, Fukuoka, Japan, Oct. 12-14, 1990

Cerenkov Doubling of Infrared Coherent Radiation Utilizing Organic Crystal Core Bounded by Glass Capillary

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We present a mode field analysis of the second-harmonic electromagnetic wave that radiates from a nonlinear core bounded by a dielectric cladding. With this analysis the ultimate performance of organic crystal-cored single-mode fiber waveguides as a guided-wave frequency doubler is evaluated through the solution of nonlinear parametric equations.

The 3rd Japan-China Joint Meeting on Optical Fiber Science and Electromagnetic Theory, Fukuoka, Japan, Oct. 12-14, 1990

Mutual Guiding Assistance between Eigenmodes of Nonlinearly Coupled TE-TM Waves

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We present a useful numerical approach based on a self-consistent finite-element method for solving stationary properties of third-order nonlinear guided-wave phenomena in a planar optical waveguide down which nonlinearly coupled TE-TM modes propagate. Mutual guiding assistance between TE and TM components could provide an interesting all-optical scheme which could not be realized with any state-of-the-art scheme employing only a single polarization component.

The 4th Japanese-Sino Sapporo International Conference on Computer Applications, Sapporo, Japan, Oct. 27-30, 1990

Analyses of Soliton Propagation in an Optical Fiber Using Numerical Techniques: Finite-Element Method and Propagating-Beam Method

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Soliton propagation in an optical fiber can be simulated by solving the nonlinear Schrödinger equation (NLSE) which can be analytically solved. However, to make the simulations more realistic, it is needed to include a variety of perturbations such as higher-order dispersion, induced Raman scattering, and loss, and to solve the perturbed NLSE. This equation is no longer solvable in an analytical fashion and we have to use numerical analysis techniques. We have analyzed the behavior of various nonlinear pulse propagations in optical fibers using the finite-element method. On the other hand, the propagating-beam method has been used in most investigations reported so far. In this paper we analyze soliton problems with both techniques.

The 4th Japanese-Sino Sapporo International Conferece on Computer Applications, Sapporo, Japan, Oct. 27-30, 1990

Optimal Design of Miniaturized Blue Light Sources Utilizing Guided-Wave Cerenkov Phase Matching

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The structural dependence of the efficiency of the second-harmonic generation (SHG) using Cerenkov-radiation scheme is examined in order to predict optimal structures. We have evidenced more efficient SHG in a domain-inverted waveguide.

IASTED International Conference on Adaptive Control and Signal Processing New York, U. S. A. October 10-12, 1990

A Study of a Speech Coding Method Using a Compact ARMA Lattice Filter

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In this report, a new speech coding method using a compact ARMA lattice filter is proposed. This report mainly discusses some differences between the proposed method and a conventional coding method using PARCOR. In comparisons, spectrum parameters and residual error signals are quantized at the same bit rate. First, we compared their performances of parameter coding without sophisticated coding schemes for residual signals. Next, we applied a CELP coding method to a compact ARMA lattice coding system. The results of experiments show that the proposed method is superior to the conventional method in the segmental S/N ratio and in audible experiments of synthesized speech, especially, when the lattice parameters are quantized at low bit-rate.

IASTED International Symposium on Machine Learning and Neural Networks New York, U. S. A.
October 10-11, 1990

Self-Organized Adaptive Cluster Based on Gaussian Distribution

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This report proposes an adaptive clustering method which efficiently realizes the dominant characterisitics of a self-organized neural network. The method is applied to parallel nodes which are embedded in a compact network, and the method implements Gaussian distribution in a node. A node memories a typical recognition pattern and the error distribution of the recognition pattern. A recognition pattern and its distribution are automatically updated by using an adaptive approach. Since a node represents the pattern distribution associated with a cluster of input patterns, the total number of nodes becomes small. Thus, efficient recognition

can be realized only using a compact network. Additionally, the proposed network automatically determines the total number of nodes for given input patterns. Since only a compact network should be designed,a suitable architecture and its control flow become simple.

ISMM International Conference on Parallel and Distributed Computing, and Systems New York, U. S. A. October 10-12, 1990

Automatic Design System of Parallel/Pipelined VLSI Architecture for Adaptive Signal Processing

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This report proposes an automatic design system of parallel/pipelined data path architectures for real time adaptive signal processing. In the system, a new design language is introduced. The language is defined to easily describe time notations commonly used in an adaptive algorithm. Additionally, a written program consists of some modules and the modules are assembled in a hierarchy structure. Since an adaptive algorithm includes the backward time flows of delayed data, matrix calculation and complex hierarchy, it is difficult to execute a data flow graph derived directly from an algorithm in parallel/pipelined form. Thus, from given algorithm description, this system first derives a data flow graph and then realizes the maximum parallelism and a high efficient pipelined mechanism using some rules. As an example, it is shown in this report that a high efficient parallel/pipelined architecture can be automatically designed from a typical adaptive algorithm.

IEEE International Symposium on Circuits and Systems
The Westin Stamford and Westin Plaza, Singapore
June 11-14, 1991

Parallel and Adaptive Clustering Method Suitable for a VLSI System

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This paper proposes a two-functional network in which adaptive methods are implemented for sophisticated recognition and clustering. In the first subnetwork, selforganized clustering is realized. The clustering is based on Mahalanobis distance. The result of the first subnetwork becomes a vector of similarity values between a given imput pattern and all patterns of cluster nodes. The second subnetwork determines the optimum label from the similarity vector. The second network consists of nodes associated with specific labels. All connections between the label nodes of the second functional network and the cluster nodes of the first functional network are determined by supervised learning. Every calculation is executed in parallel and pipelined forms. In addition, the proposed network is shown to provide good performance by some experiments. In particular, this report shows that hand-writing letters can be accurately recognized by using this network.

International Symposium in Organo Fluorine Chemistry, Institute of Shangahai Organic Chemistry, Shanghai, China October 12-13, 1990

Preparation of Fluoroarenes in One-Pot Diazotization and Fluoro-Dediazoniation of Aminoarenes using HF or HF-Base. —The Functions of Bases in the HF Solution—

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In a one-pot diazotization of anilines followed by fluorodediazoniation in situ using HF or HF with bases (HF-Base) as a solvent, the diazotization stage has been found to play the most important part to yield fluoroarenes effectively. Diazotization of anilines was greatly

influenced by the composition of the HF solution, and greatly enhanced by employing appropriate amounts of bases, such as pyridine.

On the other hand, fluoro-dediazoniation of diazonium salts, once formed, took place very readily in HF or HF-Base to produce fluoroarenes in high yield, although such bases served to slow down the rate of decomposition of diazonium salts to some extent.

The 2nd Sino-Japanese Seminar on Fluorine Chemistry, Ganzu Hotel, Ganzu, China October 7-10, 1990

Preparation of Fluoroaromatics. Diazotization-Fluorodediazoniation of Aminoaromatics.

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Progress and recent development of fluoro-dediazoniation of aromatic diazonium salts derived from diazotization of the corresponding aminoaromatics, which remains the most generaly means of introducing a fluorine substituent into aromatic ring, but is not free from difficulties, are reviewed.

The 7th International Meeting on Boron Chemistry, Torun, Poland, July 30-August 3, 1990

Organic Synthesis via Catalytic Hydroboration

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Although the catalytic hydrometallation such as hydrosilylation was widely examined, only a few reports were published on the catalytic hydroboration, because the reaction with most of hydroborating reagents proceeds readily without any catalysts. We have found that the hydroboration of 1, 3-butadiene, isoprene, myrcene, 2, 3-dimethyl-1, 3-butadiene, and 1, 3-cyclohexadiene with catecholborane (1, 3, 2-benzodioxaborole) in the presence of Pd $(PPh_3)_4$ or $Rh_4(CO)_{12}$ catalyst occurs smoothly to provide 2-[(Z)-2-alkyl-2-butenyl]-1, 3, 2-benzodioxaboroles in very high regio- and stereoselectivity.

Several rhodium(I) complexes containing chiral phosphine, (+)DIOP, (+)BINAP, (S, S) CHIRAPHOS, and (S) (R) BPPFA, have been found to be effective as catalyst for the asymmetric hydroboration of prochiral alkenes with catecholborane to give optically active 2-alkyl-1, 3, 2-benzodioxaboroles. Among the ligands examined, DIOP has been recognized to be most effective to give high asymmetric induction.

The 7th International Meeting on Boron Chemistry, Torun, Poland, July 30-August 3, 1990

Synthetic Studies via the Cross-Coupling Reaction of Organoboron Derivatives with Organic Halides (Invited Lecture)

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Previously, we reported the palladium-catalyzed cross-coupling reaction of 1-alkenylboron compounds with various vinylic or aryl halides in the presence of base to provide corresponding coupling products in good yields, stereo- and regioselectively. The recent progress of such reactions is discussed. Most recently, it has been found that B-alkylorganoboranes react readily with vinylic halides or haloarenes in the presence of special palladium catalyst and base. Furthermore, even the most difficult cross-coupling of B-alkyl-9-BBN with alkyl iodides has been demonstrated to proceed smoothly to give coupling alkane derivatives in moderate yields under special conditions. Finally, it will be discussed that B-alkyl-9-BBN derivatives react with iodoalkanes under carbon monoxide atmosphere in the presence of potassium phosphate and a catalytic amount of $Pd(PPh_3)_4$, yielding unsymmetric ketones in excellent yields. The reaction is extremely accelerated by irradiation of light.

The33rd IUPAC International Symposium on Macromolecules, Montreal, Canada, July 8-13, 1990

Structural History on ^{13}C NMR Spectra of Na-Cellulose

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Na-Celluloses were prepared from cellulose (Cell) I (Valonia, bacterial Cell, ramie) and Cell II (Fortisan, rayon) with 15% aq. soln. at 100℃. The former and the latter showed com-

plete X-ray patterns of Na-Cell I_I and I_{II}, respectively. And their solid state CP/MAS ^{13}C NMR spectra were measured. It is known that NMR spectra of Valonia and bacterial Cell group and plant Cell group are different from each other. The NMR spectra of Na-Cell I_I prepared from the both Cell I groups were similar each other, but different in detail. Those of Na-Cell I_I from the Valonia group kept their characteristics in the origin, sharp and singlet like signals of C_1 and C_4. Furthermore, the characteristics were remained after regeneration into Cell I from the Na-Cell I_I. The spectra of Na-Cell I_{II} were quite different with those of Na-Cell I_I. A signal of C_1 was splited into triplet having almost same intensity at 103.5, 105.0, and 107.5 ppm. Also, signals of C_4 and C_6 were splited into two or three. And a main peak in undissolved signals of C_2, C_3, and C_6 shifted to 78.0 ppm from 75.5 ppm in Na-Cell I_I. It was confirmed that Na-Cell I_I changed into Na-Cell I_{II} with a time, by X-ray method. And the NMR spectra of Na-Cell I_I changed into those of Na-Cell I_{II} at the same time. Na-Cell I_I regenerated complete Cell I by decomposition with hot water, but it regenerated a mixture of Cell I and II with the time and the change into Na-Cell I_{II}. The NMR spectra of Na-Cell I_I from the Valonia group changed into those of Na-Cell I_I' from the plant Cell group and then into those of Na-Cell I_{II} with a time.

The 33rd IUPAC International Symposium on Macromolecules, Montreal, Canada, July 8-13, 1990

Applications of Bacterial Cellulose Composite

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The physical properties of bacterial cellulose composite, such as stiffness, opacity and hydrophilicity, can be controlled during synthesis. The cellulose composite with carboxymethyl cellulose (CMC) has an extremely strong Young's modulus more that 100GPa compared with 50GPa of the original cellulose. In this paper, small amounts of water-soluble polymers of ether derivatives of cellulose and chitin, hydroxylethyl cellulose (HEC), hydroxylpropyl cellulose (HPC), CMC, methyl cellulose (MC) and carboxymethyl chitin (CM-chitin), were added to Hestrin-Schramm medium. They were incorporated into bacterial interpenetrating polymer. From the x-ray analysis, the diffraction of $(1\bar{1}0)$, water-soluble polymers influence the preferential orientation of bacterial cellulose. The opacity of the cellulose membrane would be much improved by incorporation of water-soluble polymers. Especially, the composite membranes with CMC, CM-chitin, HEC and MC showed high index of opacity more than twice compared to that of the original. The cellulose composite also has a high performance of solute rejection as an ultrafiltration (UF) membrane. The composite with HEC is a good UF membrane which showed sharp rejection curve(100% rejection for solute more than 50,000 M_w) and relatively fast flux. The porosity of the cellulose would be altered by interpenetrating the water-soluble polymers.

The 33rd IUPAC International Symposium on Macromolecules, Montreal, Canada, July 8-13, 1990

A New Method for Acylation of Cellulose with the Salt of Carboxylic Acids

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Acylation of cellulose using a salt of carboxylic acid was investigated. We have reported that cellulose can be acetylated by the use of acetic acid, without acetic anhydride or acetyl chloride, in the system of pyridine (Py) containing p-toluenesulfonyl chloride (TsCl). When the same system was used, cellulose was acylated by the use of a salt of carboxylic acid even in the case of higher carboxylic acids.

After pretreatment with water and replacement with Py, cellulose sample (pulp) was acylated in the system of Py containing a desired amount of Na-salt of carboxylic acid and TsCl for a given period at 50℃. The product was obtained by pouring the reactant into an excess amount of water. When the equimolar ratio of TsCl and the salt was used, the reaction proceeded most rapidly. For acetylation dimethyl formamide was more effective than Py.

The 33rd IUPAC International Symposium on Macromolecules, Montreal, Canada, July 8-13, 1990

Improvement of Cellulose Productivity of *Acetobacter* sp.

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For improvement of cellulose productivity of *Acetobacter* sp. using recombinant DNA techniques, isolation and characterization of the genes involved in cellulose biosynthesis are essential.

We developed a host-vector system for cloning of cellulose synthesis genes. 1)Shuttle vector pUF106(4.8kb) was constructed by ligation of pFF6(2.1kb), which is a plasmid of *Acetobacter aceti* subsp. *xylinum* IFO-3288, to *Escherichia coli* plasmid pUC18(2.7kb). It had unique restriction sites suitable for insertion of a foreign DNA fragment and conferred ampicillin resistance to a host. This vector transformed cellulose-producing *Acetobacter xylinum* ATCC-10245 as well as *E. coli* JM109. 2)After some modifications in a standard transformation method, this system earned a transformation efficiency of more than 10^4 transformants per

μg vector DNA, which is practical level for cloning experiment. Actually we were able to clone β-isopropylmalate dehydrogenase gene (leucine synthesis gene) of *Acetobacter xylinum* ATCC-10245 using shotgun cloning method.

Thus the host-vector system will facilitate gene cloning work on cellulose-producing bacteria.

The International Symposium on Chitin Derivatives in Life Sciences Sapporo, Japan October 5-7, 1990

Separation and Evapomeation Characteristics of Chitin Paper

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Chitin from Loligo pen, β-chitin, has displayed some ability easy to form paper without binder. The chitin paper has good physical properties. The hand-made chitin paper from Loligo pen shows a high bursting factor of 7.4 and breaking length of 6.7 Km, compared with those of α-chitin from crab shell, 1.0 and 3.0 Km. The Loligo pen paper is obviously softer than that from crab shell as to stiffness calculated from Young modulus. Furthermore the higher permeability of moisture is shown for Loligo pen than that of crab shell together with water regain. The different property is due to the crystal structures of α-and β-chitins. A continuous paper-making machine was designed in bench scale and constructed in our Faculty Machine Shop. A 15 g of Loligo pen chitin was suspended in 1,200 ml of water and ground to fine piece with homogenizer at room temperature as stock solution. Freeness of the homogenate is almost zero. Thus the machine requires a suction process. Resulted chitin suspension was diluted to 121 by water (final chitin consistency: 1.25g/l) and subjected to the paper preparation. Paper width and length are 80mm and 30m, respectivity. Paper-making speed was 0.5m/min. On the other hand, bacterial cellulose laminated the chitin gel of Loligo pen has a high performance of solute rejection as an ultrafiltration membrane. The laminated bacterial cellulose showed more than 85% rejection for PEG 500,000 and 2,000,000 as compared with a control of bacterial cellulose to 30%. The flux rate at constant pressure of 4Kg/cm^2, N_2 gas, was ranging in relatively fast from 15 to 7Kg/m^2 hr. This is useful rate order for a industrial development of membrane separation. It seems that the separation of solvent and solutes is carried out in the layer of the chitin, while the layer of bacterial cellulose serves to

increase the flux rate. The composite membrane is also very advantageous for a separation of aqueous alcoholic solution by evapomeation method as faced the chitin laver to vapor-phase. This result is responsible for the high hydrophilicity of Loligo pen chitin. It is suggested that water molecules are selectively dissolved into the chitin layer and also predominantly diffused through the composite.

Symposium on Cellulose and Lignocellulsics Chemistry Guangzhou, China May 13-15, 1991

A Study on Irreversible Change among Allomorphs of Na-Cellulose by ^{13}CNMR Spectra

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Allomorphs of the cellulose I family change into cellulose II in fiberous state by mercerization. We have found that a critical step for the irreversible change was not on the formation step of Na-Cellulose (Na-Cell) with a large swelling. Na-Cell (I_I) prepared from allomorphs of the cellulose I family was different with Na-Cell (I_{II}) from the cellulose II family in intensity ratios of meridional X-ray diffractions, and decomposed into cellulose I and II with hot water, respectively. Na-Cell I_I and I_{II} were transformed into Na-Cell III_I and VI_I, and III_{II} and VI_{II} by drying, respectively. Na-Cell III_I and VI_I could back into cellulose I, however, after irreversible change into Na-Cell III_{II} and VI_{II} with time at room temperature, they could not back into cellulose I. Namely, the irreversible change took place in dry state without any morphological changes.

In this study fine solid state ^{13}CNMR spectra of allomorphs of Na-Cell were obtained, using a Bruker MSL-400. In Na-Cell I_I, C_1 and C_4 signals in the spectrum were like singlet and their chemical shifts were at 107.8 and 85.9 ppm, respectively. On the other hand, in Na-Cell I_{II}, all signals of C_1, C_4, and C_6 were triplet. Chemical shift of C_1 signal were 103.0, 105.2, and 107.3 ppm and those of C_6 were 58.7, 61.0, and 61.8 ppm and shifted to higher magnetic field side from those of 62.1 and 63.8 ppm in cellulose. NMR spectrum of Na-Cell I_I changed into that of Na-Cell I_{II} with time. A content of celluose II in cellulose regenerated from the Na-Cell I increased with the change of spectra.

Symposium on Cellulose and Lignocellulosic Chemistry Guangzhou, China May 13-15, 1991

An Alkali-Oxygen Pulping of Rice Straw (3) —A Closed System of the Pulping—

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The cut straw was treated in 1% NaOH solution of 10 times weight of the straw, 10% NaOH based on the straw, at 90℃ for 10minutes, then squeezed to 3 times as much as the original straw, and then diluted into 15% as straw consistency with water containing NaOH of 5.67% based on the original straw. The straw was oxidized with oxygen of 5kg/cm^2 at 90℃ for 1hr. In the 1st recycling pulping, the solution for alkali treatment was prepared with all black liquor of the previous alkali treatment, about a half black liquor of the previous oxidation pulping, and water containing NaOH to comport with the setting conditions, liquor ratio of 10 times and NaOH of 10%. Amount of the water was about 20% of the solution and that of added NaOH for a supplement was 8.8% based on the straw. Another half of the black liquor of the oxidation was used to dilute the squeezed straw into 15% as straw consistency. And additional NaOH aq. solution was added to it to comport with the fixed conditions. And the straw was oxidized under the same conditions. By the same way, the pulping was recycled until the 4th. The results were showed in Table 2. A total yield increased with increasing of the recycling, from 49.8% to 57.3%. Brightness was 44.7 to 48.1 and breaking length was 6.3 to 7.2 km. Brightness and paper strengths were almost the same through the recycling. An accumulated organic compounds in the black liquor of alkali treatment (9.33% at 4th cycle) did not block pulping and brought an increasing of yield. Amount of SiO_2 in the black liquor saturated in about 11g/l.

The 93rd Annual Meeting of The American Ceramic Society, Convention Center, Cincinnati, U. S. A., April 28-May 2, 1991

Preparation and Electrical Properties of In_2O_3 (ITO) Thin Films by Sol-Gel Method

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Transparent and conductive tin-doped In_2O_3 (ITO) thin films were prepared at 550°-900℃ on fused silica substrates by a sol-gel method. Sol solution was prepared by hydrolysis of In and Sn sulfates with NH_4OH solution. Sol films applied on the substrates were subsequently transformed to transparent gel films by drying at 110℃ for 30 minutes. ITO films were obtained through amorphous state by releasing OH groups from gel films during firing. ITO films were polycrystal with grain sizes of 20-40 nm. The electrical resistivities of ITO films doped 14 mol%Sn were $2-4\times10^{-3}\Omega$ cm. The resistivities were decreased in nitrogen and ethanol atmospheres at 300℃ due to the desorption of adsorbed oxygen and the adsorption of ethanol donating electrons.

The 10th Congress CHISA '90, Praha, Czechoslovakia, August 26-31, 1990

Measurement of Particle-Velocity Profile in A Conical Moving Bed by Means of A Video-Scope

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Here the particle velocity within a conical hopper was measured directly by means of a Bore Scope connected with a video system. Thus, inserting the Scope tube horizontally through guiding holes of the hopper wall and a vertical guide plate, the Scope top can be set on the vertical plane at constant radii and angles from the central axis. The velocities were measured in the radial and peripheral directions by pursuing coloured tracers in each frame of a recorded video film.

As a result, the distribution of the radial velocity within the conical moving bed was described by a mathematical model as a function of an angle from the axis and the radius from the apex.

The 2nd World Congress Particle Technology, Kyoto, Japan, September 19-22, 1990

Segregation Mechanism of Binary Solids in Filling Axi-Symmetric Hoppers

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Powder Science and Technology Research A/S,
Porsgrunn, Norway.

The mechanism of particle segregation in filling axisymmetric vessels is generally analyzed irrespective of particle properties such as size, density and shape. The segregation process during forming a conical heap in storage hoppers is described for binary mixtures.

As a result, the distribution of a mixing fraction of the segregating component inside the vessel was explained on the basis of particles' net volume. The zone, where the segregating component is contained around a feed point, was found to expand by an increment of the initial mixing fraction, the volumetric feed rate or the flow length.

The 4th World Congress Chemical Engineering, Karlsruhe, Germany, June 16-21, 1991

Prediction of Segregation During Filling of Silos

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Particles of different properties often segregate during filling silos and it is enhanced during the following operation of emptying. It largely depends on the shape of the vessel, that is, a mass-flow hopper or a funnel-flow one.

Based on Shinohara's mathematical model, the heap segregation process is described and the segregation patterns to be expected are computed according to his program. Therefore, measuring the segregation patterns with a segregation tester devised, the segregation parameters are determined, and then the segregation patterns are predicted in a large scale vessel in given geometries, at given filling rates etc.

The 1st Tokyo Conference on Advanced Catalytic Science and Technology, Tokyo, July 1-5, 1990

Mechanism of Methanol Synthesis from CO_2 and H_2 over Cu/ZnO at Atmospheric Pressure

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The mechanism of the title reaction was studied over coprecipitated Cu/ZnO (Cu/Zn=3/7) catalyst. By diffuse reflectance FT-IR spectroscopy and temperature programmed desorption of adsorbed species, it was shown that two types of surface formates (unidentate and bidentate formates) and zinc methoxide were formed in the course of the reaction. The amount of these species as well as the gaseous composition of products was determined under the various transient conditions. Zinc methoxide was formed by hydrogenation of unidentate formate and hydrolyzed to methanol.

The 13th IUPAC Symposium on Photochemistry University of Warwick, Coventry, England. July 22-28, 1990

Conformation Specific Photorearrangements of β, γ-Unsaturated Cyclic Ketones

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The populations of boat and chair conformations of the ground state of several β, γ-unsaturated ketones such as A-homocholest-4a-en-3-one, B-homocholest-5-en-7a-one, and A-homo-5α-cholest-1-en-4-one as well as all possible A-homocholestenones were calculated by the empirical force field method. The stereochemistry of the products of 1, 3-acyl shift in the

photorearrangements of these 7-membered β, γ-unsaturated cyclic ketones was found to depend clearly upon the conformation of the ground state of the starting β, γ-unsaturated steroidal ketones and the ratio of stereoisomers of the products was found to depend on the ground state population of the conformers of the starting unaturated ketones. These conformational dependence of the sterochemistry of photochemical 1, 3-acyl shifts of β, γ-unsaturated cyclic ketones is discussed in conjunction with the mechanism.

The 16th Sandbjerg Meeting on Organic Electrochemistry, Sandbjerg, Denmark, June 14-17, 1991

Regiocontrolled Electrochemical Allylation of Carbonyl Compounds with Allylic Halides by the Use of a Reactive-Metal Anode. Synthesis of Some Terpenes and Ipsdienol

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Regiocontrolled electrochemical prenylation of aldehydes to give the corresponding homoallyl alcohols and a similar prenylation of carboxylic acid derivatives to give the corresponding β, γ-unsaturated ketones by making use of a reactive-metal anode are reported. Regioselectivity of the prenylation was found to be controlled by the use of an appropriate prenyl halide, prenyl bromide or chloride, and by using an appropriate anode material, a cadmium-modified platinum anode or a nickel anode.

The regiocontrolled prenylations of aldehydes or acid derivatives were successfully applied to a synthesis of terpenes such as artemisia alcohol, artemisia ketone, and egoma ketone.

A new and convenient method for the isoprenylation of aldehydes using 2-bromomethyl-1, 4-dibromo-2-butene by making use of a zinc anode or a reactive zinc metal and its application to a synthesis of pheromone, ipsdienol, are also reported.

The 16th Sandbjerg Meeting on Organic Electrochemistry, Sandbjerg, Denmark, June 14-17, 1991

Stereoselective Synthesis of Substituted Pyrrolidines by Anodic Oxidation of Unsaturated Amines. A New Synthesis of (−) -Anisomycin

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Stereoselective cyclization of neutral aminyl radicals generated by anodic oxidation of lithium alkenylamides to give *cis*-4-and *cis*-5-substituted 1-methyl-2-benzylpyrrolidines in high yields is reported. Furthermore, a new synthesis of (−)-*N*-methylanisomycin by means of the aminyl radical cyclization is also reported.

The starting δ-alkenylamine for a synthesis of (−)-anisomycin was prepared in ten steps from (*L*)-diethyl tartarate with a total yield of 58%. That amine was converted into lithium amide by treatment with BuLi at −78℃. Anodic oxidation of the resulting lithium amide in a 30 : 1 mixture of THF and HMPA containing 0.25M lithium perchlorate at −10℃ gave the pyrrolidine having three chiral centers in a 52% yield. An NOE and a decoupling study of the produced pyrrolidine suggests that it has a configuration of *2R, 3S, 4S* which corresponds to the stereochemistry of (−)-anisomycin. Four step transformations of the pyrrolidine gave *N*-methylanisomycin.

The Taniguchi Conference on Precision Polymer Synthesis, Kyoto, Japan, May 13-17 1991

Stereoregular Polymerization of Aromatic Poly Acetylene with [Rh(Norbornadiene)Cl]$_2$-Triethylamine

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It has been demonstrated that the [Rh(norbornadiene)Cl]$_2$-Triethylamine (TEA) was a quite useful catalyst for the living polymerization of m-chlorophenylacetylene (m-CPA) with cis-transoidal structure as the major conformation in chloroform and also the formation of polymer whth extremely high molecular weight, so called ultra high molecular weight (UHMW); Mw, ca 4.43×10^6. And a possible mechanism on this polymerization was presented together with the characterization of the resulting polyacetylene using conventional spectros-

copic methods.

ESR (Electron Spin Resonance) and SQUID (Superconductive Quantum Interference Device) methods were used in order to obtain information on the spin state of the resulting conjugated polymer, such as poly (p-methoxy phenylacetylene) which was considered as a base polymer of so called *polymer magnet*.

The 15th Biennial Conference of International Association on Water Pollution Research and Control, Kyoto, July 29-Aug 3, 1990.

Biological Phosphate Removal by Sea Water Activated Sludge

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The effect of salinity on excess uptake of phosphate in an aerobic-anaerobic activated sludge process was examined by the fill and draw procedure. In a sea water activated sludge process, the anaerobic period shorter than 8 h was favorable to achieve an excess uptake of phosphate. The anaerobic period longer than 8 h was unfavorable because of formation of hydrogen sulfide due to sulfate reduction. The amount of released phosphate in one cycle for sea water sludge was smaller than that for fresh water sludge when the removal of P in the cycle was the same. The correlation between low molecular polyphosphate and biological phosphate that is defined by total P minus chemically bound orthophosphate (CB-OP) in suspended solids showed a good agreement between the sea water and fresh water sludges. CB-OP increased at the beginning of the first aerobic period and then decreased gradually in a successive aerobic period showing the reuptake of once chemically bound P.

The 15th Congress of the International Commission for Optics, Garmisch-Partenkirchen, FRG, August 5-10, 1990

Free Surface Reconstruction Based on Projections

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A new method is proposed to reconstruct a 3-D free surface using its multiple projections. It is not based on the conventional triangulation but on a model matching principle and does not require any reference point on the object. Surface of the object is approximately reconstructed by repeatedly improving its polyhedral model adding a new vertex for every run so as to decrease the value of a certain cost function, which is defined on the mismatch of contours between projections of both the object and the model.

The 15th Congress of the International Commission for Optics, Garmisch-Partenkirchen, FRG, August 5-10, 1990

Optically Induced Light Frequency Modulation of Laser Diode

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Experimental results on the light frequency modulation of a laser diode performed by illuminating amplitude modulated light on its active domain are described. Optical frequency modulation up to 100 kHz of a laser diode without incidental modulation has been achieved by adjusting injection light power. Furthermore, frequency modulation up to 170 MHz was confirmed for the present state if an increase of intensity modulation was tolerated. The upper bound of the signal frequency may be raised by increasing power of injected light. Discussions on the phenomenon are also described.

The 15th International Congress and General Assembly, International Union of Crystallography, Bordeaux, France, July 19-28, 1990

Measurements of X-Ray Pendellösung Beats From Heat-Treated Silicon Single Crystals

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Effects of randomly distributed small defects on the Pendellösung interference phenomenon are studied. The intensity beats of white radiation diffracted from Czochralski silicon wafers were successively measured by SSD with respect to the wavelengths in a range from 0.15 to 0.8 Å. The defects were introduced by heating the wafers 0.5mm thick in argon gas for 24-100 hrs at 850-1000℃.

As the heat treatment proceeded, the following changes became predominant in the Pendellösung beats: (1) The diffracted intensity increases over the whole range of wavelengths. (2) The rate of increase in intensity is high in the long wavelength side. (3) The spacing of the beats increases. (4) The amplitude of beats decreases. Although the degree of changes was dependent on the heat treatment as well as on the order of reflection, these phenomena were observed for all the specimens examined.

An attempt was made to interpret the present results by Kato's statistical dynamical theory of crystal diffraction (Acta Cryst. 1980, A36, 770-778). The theory has been expressed in terms of the static Debye-Waller factor E, the correlation lengths of lattice phase factor τ and of X-ray beam Γ. The observed results can be fairly well explained by the theory, provided that Γ is independent of the extinction distance. For example, the data for 220 reflection from a specimen treated for 100 hrs at 900℃ is explained by the theory with parameters E, τ and Γ of 0.993, 0.3μm and 0.6μm, respectively.

LT 19-19th International Conference on Low Temperature Physics, Brighton, U. K., 16-22 August 1990.

Superconductivity and Oxygen Deficiency in $CaLaBaCu_3O_x$

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Measurements of magnetic and resistive T_c's and lattice parameters of $CaLaBaCu_3O_x$ (CLBCO) indicate that CLBCO is a tetragonal bulk superconductor in the range of $x=6.7$ to 7. As oxygen content decreases, T_c decreases significantly, though there exist a plateau at 80K near $x=7$. No superconducting transition is observed below $x=6.7$. Large suppression of superconductivity observed in the region of relatively high oxygen content suggests the absence of the oxygen vacancy ordering in CLBCO.

The 3rd International Symposium on Supoercoinductivity (ISS'90), Sendai, Japan, November 6-9, 1990

The Properties of Normal Carriers in $Bi_2Sr_2CaCu_2Oy$

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Resistivity and Hall coefficient in the a-b plane of single-crystals $Bi_2Sr_2CaCu_2O_y$ measured as a function of temperature have been analyzed by a simple two-band model involving holes and electrons. It is found that the calculated values of the resistivity and Hall coefficient reproduce well the data, and the carrier concentration, mobility and mean-free-path obtained from the model are reasonable values in physics. It also is found that the model reproduces the data of resistivity and Hall coefficient of $YBa_2Cu_3O_y$ measured by Penney et al. and $Tl_2Ba_2CuO_y$ by Kubo et al. These results indicate that the two-band model is very useful for investigation of transport properties in high-T_c oxides.

The 19th International Conference on Low Temperature Physics, Brighton, Sussex, UK, 16-22 August 1990

Low-Temperature Tetragonal Phase and Electronic Coefficient of Specific Heat in $(La_{1-x}Ba_x)_2CuO_4$

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Low-temperature specific heat was measured on $(La_{1-x}Ba_x)_2CuO_4$ system by using the well-characterized samples. The sample with $x=0.065$ used in the present study exhibits the transition to the low-temperature tetragonal phase around 60 K and is in the normal state over almost whole volume at least down to 2 K. It is found that the electronic coefficient as a function of x is fairly reduced around $x=0.065$. This result strongly suggests that the transition to the low-temperature tetragonal phase reduces significantly the density of states at the Fermi level.

The 2nd ISSP International symposium on Physics and Chemistry of Oxide Superconductors, Tokyo, Japan, 16-18 January 1991

Coefficient of Electronic Specific Heat in $(La_{1-x}M_x)_2CuO_4$ (M=Ba, Sr)

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The coefficient of electronic specific heat in superconducting $(La_{0.955}Ba_{0.045})_2CuO_4$ is determined from measurements of low-temperature specific heat in the Zn-doped system $(La_{0.955}\ Ba_{0.045})_2Cu_{1-y}Zn_yO_4$. The relation between the coefficient of electronic specific heat and the suppression of superconductivity with Zn doping for Cu is briefly discussed.

Materials Research Society Symposium on Scientific Basis for Nuclear Waste Management XIV Boston, U. S. A November 26-29, 1990

Migration of Cesium, Strontium and Cobalt in Water-Saturated Concretes.

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Diffusivities of Cs, Sr and Co were measured in several kinds of water-saturated concretes. The measured penetration profile of every tracer was composed of two parts. Those were a steep slope near the surface and a gradual slope in the deeper part. This profile was successfully explained by considering two diffusion paths in concrete. One diffusion path was possibly fissure with a width of a few microns and another was network of submicron pores. The volume of submicron pores was approximately 90% of the total free space volume in every concrete. The orders of magnitude of the apparent diffusivities for all tracers ware 10^{-12}-10^{-11} m^2/s through the fissure and 10^{-16}-$10^{-15} m^2/s$ through the network of pores. The difference between the diffusivities of the two paths is thought to be caused by small geometrical factor of the network of submicron pores.

The 3rd International Symposium on Advanced Nuclear Energy Research Global Environment and Nuclear Energy Mito, Ibaraki Japan March 13-15, 1991

Migration Behavior of Uranium (VI) in Laboratory Scale Granite

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When radionuclides released from an underground repository are transported with the moving groundwater along fissures in the rock, the radionuclides will be retarded by not only

adsorption on the surface of rock but also diffusion into the micropores of rock matrix. To study migration behavior of uranium (VI) through granite, column migration experiments were carried out in pH range 3.0 to 10.5.

The break-through curves were analyzed by a method which takes into account adsorption on surface of rock and diffusion into rock matrix but no dispersion. Diffusivities of uranium (VI) and iodine into rock matrix were in the order of $10^{-13}m^2/s$ and $10^{-12}m^2/s$ respectively and not affected significantly by pH. Equilibrium coefficient of adsorption for uranium (VI) varied with pH. In the case of wafer specimen, the breakthrough of uranium (VI) was not completed in this experimental period. It might be caused by channeling of flow path and not uniform distribution of adsorptive minerals.

The 11th Triennial World Congress of the International Federation of Automatic Control Tallin, Estonia, USSR, August 13-17, 1990

Robot Path Control with Variable Speed by Preview Control and Adaptive Control

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New trajectory planning method taking control ability of designed robot manipulator control system into consideration is proposed. It is made systematically without trial and error method on the basis of the frequency response of the designed control system. The following control methods are applied to path control along with the proposed trajectory planning method. * Preview control utilizing future desired signal * Zero error tracking control * Adaptive control. Future information is shown to be useful in the first method. Nonlinear compensation error is compensated by zeroing method at the steady state in the second method. Adaptive control method is very suitable to apply the variable speed trajectory planning method because each servo system in decoupled by applying adaptive control method. Parallel drive robot manipulator is taken to be our example to show effectiveness of the proposed method combining with three control methods.

The 12th International Conference on Boundary Elements in Engineering, Sapporo Japan, Sept. 24-27, 1990

A Treatment for the Multiplicity of Flux on Edge in 3D BEM Analysis using Higher Order Conforming Elements

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A method of treating the multiplicity of flux variables is proposed when potential problems are analyzed by boundary element method using conforming elements. Two kinds of subsidiary equation which support the multiplicity are derived. It is proved that a higher order subsidiary equation corresponding to the order of the employed boundary elements gives a much more accurate solution in the example problem governed by the Laplace equation.

The 12th International Conference on Boundary Elements is Engineering, Sapporo Japan, Sept. 24-27, 1990

Development of the Automatic Mesh Generator for the 3D Boundary Element Method

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This paper describes a new automatic mesh generator for the Boundary Element Method (BEM) using the Constructive Solid Geometry (CSG). We define four primitives (a rectangular parallelepiped, an ellipsoid, a circular cone and a cylinder) and construct the objective shape by logical operation of each primitive. The proposed method has the charactor using the previously patched primitives with mesh.

The 11th Triennial World Congress of the International Federation of Automatic Control Tallin, Estonia, USSR, August 13-17, 1990

PWM Inverter Control by System Control Theory

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Systematical design method of pulse patterns of PWM (Pulse Width Modurated) inverter is proposed in this paper on the basis of system control theory. Merits of the design by means of system control theory are as follow: (1) Pulse patterns are designed in consideration of the load conditions and then, optimal pulse patterns are designed for the whole system. (2) PWM inverter with low sensitivity for the system variations such as variations of the source voltage and load changes etc. is theoretically designed. (3) Output feedback control or partial state feedback control or observer application is effective when measurements of variables such as currents and/or derivatives of voltages are difficult.

The 11th Triennial World Congress of the International Federation of Automatic Control Tallin, Estonia, USSR, August 13-17, 1990

Quick Response and High Efficiency Control of the Induction Motor Based on Optimal Control Theory

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An idealized induction motor is described as a three-input and three-output controlled object. A novel approach for constructing a field oriented control theory is proposed and developed for efficiency optimization. A control system, in which speed control, vector control and high efficiency optimization are attained simultaneously, is constructed on the basis of multi-input and multi-output optimal regulator theory. Simulation result of the efficiency

optimized speed control system are carried out and the availability of the proposed method is confirmed.

The 12th International Conference on Boundary Elements in Engineering Sapporo, Japan, Sept. 24-27, 1990

On the Efficiency of an Analytical Volume Integral Formula for a 3D Poisson Equation Using the Boundary Element Method

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In this paper, under the condition that non-homogeneous term of the governing equation of the problem is expressed by a n-th order polynomial with respect to the coordinates, we introduced the analytical volume integral formulas for 3D Poisson equation. The objective region is subdivided into small tetrahedral cells, and the volume integral of the non-homogeneous term is transformed to the surface integral on the cell. Numerical experiments of sample problems show that the proposed integral method enables us to calculate a 3D Poisson problem with more accuracy and at a higher speed as compared to the numerical integral.

March Meeting of American Physical Society, March 1991, Cincinnati, U. S. A.

High Frequency Phonon Scattering in Undoped GaAs

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A slotted-sample geometry and phonon imaging are combined to measure the absolute scattering rates of 700 GHz phonons in GaAs. Comparison to Monte Carlo calculations show that the scattering rate for longitudinal phonons is attributable to elastic scattering from isotopes but that for transverse phonons is approximately four times higher than predicted. Irradiation of the GaAs with 1.60-μm wavelength light modifies both the frequency distribution of transmitted phonons —indicated by angular shifts in the phonon-focusing caustic— and the fraction of scattered phonons. Our study examines this unusual process —attributed to the

EL2 defect— with spatial, temporal and frequency resolution. The slotted-sample geometry allows separation of the ballistic and scattered components of the phonon flux.

The 12th International Symposium on Nonlinear Acoustics, August 27-31, 1990, Austin, Texas, U. S. A.

Propagation of Acoustic Shock Waves of Large Amplitude

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The propagation of a plane acoustic wave is studied without the restriction of low amplitude. The method of analysis is based on the exact solution in terms of characteristics up to the time of shock formation, and beyond the time on the numerical calculation by means of the upwind difference scheme. The initial sinusoidal shape is progressively distorted and this leads to the formation of a shock. Then it evolves into a kind of sawtooth wave as a whole. The strongly nonlinear wave however possesses the following distinctions in contrast to the well-known weakly nonlinear wave: (i) shock waves propagate with supersonic speed; (ii) the waveform does not have any symmetry between the region of rarefaction and that of compression; (iii) the acoustic streaming occurs after the shock formation.

The 1st International Symposium on Corrosion of Electronic Materials and Devices, The 178th Electrochemical Society Meeting, Seattle, Washington, U. S. A., October 14-19, 1990

Study on Corrosion of Copper Thin Film in Air Containing Pollutant Gas by a Quartz Crystal Microbalance

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A quartz crystal microbalance (QCM) technique was applied to investigate the corrosion kinetics of copper thin films at 303 K in air or nitrogen gas at different relative humidities

containing small amount (20ppm) of SO_2, H_2S or NO_2. The corrosion increased with increasing relative humidity and was promoted by oxygen in air. The corrosion kinetics and corrosion products were different depending on the species of pollutant gas. The relative humidity dependence of parabolic corrosion rate costant was explained in terms of the nonstoichiometry of corrosion products or their porous structures with easy diffusion paths.

The 7th Tihany Symposium on Radiation Chemistry, Balatonszeplak, Hungary, September 9-14, 1990

Reaction Mechanism for Radiation-Induced Degradation of Poly(methyl methacrylate) as Studied by ESR and ESE

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The study is aimed at elucidating the reaction mechanism for the radiation-induced degradation of poly(methyl methacrylate), a typical radiation-degradable polymer, based on the nature and behavior of free radicals in γ-irradiated PMMA observed by the ESR and ESE (electron spin echo) methods.

PMMA was irradiated at 77 K in vacuum and heated stepwisely to room temperature. Major radicals observed at 77 K are the side-chain radical $-COOCH_2$ ($G=2.0$), the main-chain radical $-CH-$ ($G=1.0$), and the anion radical ($G=1.2$). The observed behavior of radicals during warming indicates that the scission of the main chain proceeds from the side-chain radical. The presumed radical $-CCH_3-$ has not yet been observed successfully. However, its transient formation is strongly supported by the effect of UV irradiation of the side-chain radical.

The 3rd International Meeting on pulse Investigations in Physics, Chemistry and Biology, Pultusk, Poland, April 15-20, 1991.

Pulse Radiolysis Study on Electron Migration along Polymer Chain

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Electron migration along polymer chain is shown by the pulse radiolysis-optical aborption study of poly(4-vinyl-biphenyl-co-1-vinylpyrene) in 2-methyltetrahydrofuran solution. For small vinylpyrene fractions, excess electron is initially trapped on a biphenyl side-group to form biphenylyl anion radical, which then transforms into pyrenyl anion radical. This transformation is enhanced by the increase in the vinylpyrene fraction in the copolymer, whereas it is independent of the copolymer concentration in the solution. The results indicate that the electron migrates along the polymer chain by electron transfer reaction successively occuring between neighboring biphenyl side groups until the electron is stably trapped on a pyrene side group.

The 12th Annual International Conference of the IEEE Engineering in Medicine and Biological Society, Philadelphia, U. S. A., November 1-4, 1990

Three-Dimensional Measurement of Dental Cast Profiles and Its Applications to Orthodontics

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A system for measuring three-dimensional profiles of dental casts and three-dimensional tooth movement during orthodontic treatment has been developed. The profile measurement is based on the triangulation method which detects a laser spot on a cast using an image sensor.

The system is computer-controlled and designed to achieve the depth and lateral resolutions of 0.05 and 0.1 mm, respectively, within a depth range of 25 mm. We have applied our system to measuring three-dimensional movement of teeth, including rotations, during orthodontic treatment. The movements have been obtained by means of three-dimensional registration of tooth profiles using a computer between casts serially taken at different stages of the treatment. Measurements over periods of 70 to 190 days on patients have revealed that this technique is capable of quantifying the difference in movements due to orthodontic therapeutics.

IARP Workshop on Machine Vision Applications, November 28-30, 1990, Tokyo, Japan.

Applications of Image Reconstruction by Means of Chirp Z-Transform

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The chirp z-transform is referred to as a method of evaluating z-transforms which represent a sequence of discrete data. While DFT (Discrete Fourier Transform) evaluates z-transforms on the unit circle in the z-plane, the chirp z-transform evaluates them on a circular or a spiral contour inside or outside the unit circle. This paper discusses the peak value and the bandwidth of the improved spectrum by the chirp z-transform in relation to the ordinary DFT (Discrete Fourier Transform) method and proper selection of a contour for a given set of data. The validity of replacing DFT by the chirp z-transform in different image reconstruction schemes is also discussed. The improvement in image quality is demonstrated for experimental data obtained from the optical CT system and that obtained from MRI specifically for the purpose of chemical-shift imaging.

The 11th International Symposium on Biotelemetry, Yokohama, Japan, August 29-September 4, 1990

Medical Telemetry From Moving Vehicles Using A Communication Satellite

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The moving vehicles far from the land are not well prepared for medical emergencies such as cerebrovascular and coronary diseases. To provide appropriate instructions from a qualified person on the ground to the crew members in the vehicle, a new technique of biotelemetry using mobile satellite communication is proposed. Specific problems of this technique were identified and solved through theoretical and numerical analyses. Thus the feasibility of this technique was verified theoretically. Based on the results of these analyses, a data transmission system was developed. Using this system, the signals from a patient, e. g. color -video, audio, 3 channels ECG and blood pressure signals are transmitted from a moving vehicle to a ground station. From the ground station an audio signal is transmitted to the vehicle. Error control techniques, e. g. ARQ and FEC were applied to maintain high reliability in ECG and blood pressure transmission. Fundamental data transmission characteristics were measured with this system in the ground station. The threshold value of C/N_0 (carrier to noise ratio) was evaluated to guarantee the proper function of this system in conceivable practical conditions. Experiments were conducted successfully using a navigating ship and a flying jet plane.

The 11th International Symposium on Biotelemetry, Yokohama, Japan, August 29-September 4, 1990

Multiplexing Techniques for the Optical Telemetry Using Indirect Light Transmission

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Recently, an optical biotelemetry technique using indirect light transmission was proposed, and its usefulness has been proved. However, with this technique the spatial discrimination among the different transmitters has been difficult. We have developed two techniques suitable for the optical biotelemetry using indirect light transmission. The first technique is a " pulse burst multiplexing " technique. An original signal such as an ECG is modulated into pulse intervals (PIM). Each PIM pulse is composed of a train of much narrower pulses, or a pulse burst. Different channels are differentiated by the frequency of the pulse burst. The second technique is the " spread spectrum multiplexing " technique. The frequency spectrum of an original signal is expanded by multiplying pseudo-noise signal in time domain. In a receiver, the original signal is differentiated from other signals by taking the correlation with the same pseudo-noise signal as the transmitter. Using different types of pseudo-noise signals for each transmitter, many channels can be multiplexed in a common space. Fundamental characteristics of these techniques were studied in theoretical and numerical analyses. Based on the results of the analyses, experimental systems were developed. In the experiments of optical biotelemetry, multichannel ECG signals were transmitted with a satisfactory channel separation.

The 11th International Symposium on Biotelemetry, Yokohama, Japan, August 29-September 4, 1990

Non-Invasive Stress Monitoring by Optical Telemetry

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A telemetry technique was developed which enables us to evaluate physiological stress -responses non-invasively without restraining the subject. The change in diameters of periph-

eral blood vessels is measured as the change in transmitted intensity of infrared light across an ear auricle. The signal is transmitted to a remote place using the infrared light diffusely reflected from a ceiling, a floor and walls of a room. The transmitter is small and light enough to be equipped in an auricle of a rabbit's ear. The feasibility of this technique was verified by detecting the reactions of a rabbit against various types of physical stresses, such as pouring some water, blowing cool or hot air, odor of ether. The system could detect both the constriction and dilation of peripheral blood vessels caused by the physical stresses. It should be useful to detect the physiological and psychological effects of other stimulations. They include the strong electric field and the ion-current, the safety assessment of which have been controversial problems.

The 11th International Symposium on Biotelemetry, Yokohama, Japan, August 29-September 4, 1990

Tutorial Session
Fundamentals for Biotelemetry-Engineering

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Biotelemetry is an interdisciplinary field of study. The various backgrounds of the participants of this symposium are widely diversified such as; ecology, engineering and medicine. This tutorial is designed to provide a common understanding of the principles of methodologies and technical terminology concerning the engineering aspects of biotelemetry. For the participants of non-engineering background, this session may be useful to better understand the presentations in the symposium. For those of an engineering background, it may serve to reinforce or refesh their knowledge.

The subjects covered are as follows.

Part I : Fundamental Principles of Telemetry
〃 1. Measurement, 2. Modulation, 3. Multiplexing,
〃 4. Signal processing, 5. Data compression,
〃 6. Error control in data transmission,

Part II : Techniques of Biotelemetry,
〃 7. Radio wave telemetry, 8. Optical telemetry,
〃 9. Ultrasonic telemetry.

The 11th International Symposium on Biotelemetry August 29-September 4 1990, Yokohama, Japan

Transcutaneous Optical Transmission for Implantable Artificial Hearts

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The next generation of artificial hearts will be actuated electrically, because electrical actuation permits the design of system free of tubes and wires passing through the skin. Transcutaneous energy transmission system has been developed to power artificial hearts. However, transcutaneous information transmission system has not been intensively studied to monitor and control the implantable artificial heart. In this study, the transcutaneous optical information transmission system has been developed for the implantable motor-driven artificial heart.

Information on both motor voltage and pump stroke is transmitted through the skin by frequency-modulated infrared pulses using a single pair of a light emission diode and phototransistor located in the center of cores of energy transformer.

The system was evaluated in vitro. Information on both motor voltage and pump stroke was successfully transmitted across the muscle without interference.

The developed system is useful for monitoring and controlling implantable artificial hearts.

The 2nd European East-West Symposium on Materials and Processes, Helsinki-Espoo, Finland, May 26-30, 1991

Joinings of Commercial Alloys to Magnesia

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The joining of nickel-metal to magnesia was previously examined at 1573 K under null pressure in air. In the case of not using a joining filler, a joint has a flat discontinuous interface between nickel-metal and the solid solution NiO-MgO. But, in the case of using a Ni -NiO composite filler which has a stepwise controlled compositional gradient, a joint had not

the flat interface. By this improvement of interfacial structure, residual thermal stress in the joint was released. Thus, the best adhesion was easily obtained.

This work is an application of the same principle to the joining of magnesia to either monel or permalloy. To evaluate the soundness of joints, three-point bending test was examined, and cross-sectional micro-structure and fracture surface were observed by electron probe micro-analysis, scanning electron micro-scopy and energy dispersive X-ray analysis.

The 4th Australian Coal Science Conference, Brisbane, Australia, December 3-5, 1990

Charge Transfer Complexes between Coal and Electron Acceptors Importance of Non Covalent Interaction in Coal Structure

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Non-covalent bond interactions play important roles in coal structure. They serves as virtual crosslinks which help to hold the network together. The paper concentrates particularly to hydrogen bandings and aromatic π-π interactions with respect to the charge transfer between coal and electron acceptors.

Iodine as an electron acceptor interacts with coal molecules producing charge transfer complex. A good correlation is obtained between the spin concentration, Ns, of coal-iodine complexes and rank. The value of Ns increase with the increase of rank up to 90% of carbon (daf). The change of spin concentration of iodine doped coal reflects the π-π interaction in condensed aromatic rings in coal structure.

On the other hand, TCNQ is a molecule with strong electron accepting ability as same as iodine. The value of Ns for TCNQ-doped coal increases with decrease of coal rank. Interpretation for the fact above is that TCNQ molecule goes to the sites associating with oxygen containing functional groups, which are able to form hydrogen bonding.

International Symposium on Carbon, New Processing and New Applications, Tsukuba, Japan, November 4-6, 1990

Structural Analysis of Mesophase Pitch by High Temperature ^{13}C-NMR

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The aim of this study is to develop an advanced technique which reveals a molecular structure of 100% mesophase pitch by using high temperature ^{13}C-NMR in the presence of pyrene as a solvent at high temperature.

It is clarified that pyrene plays a role as a solvent of mesophase pitch and keeps its viscosity much lower at the temperature where mesophase pitch itself is fusible.

^{1}H-NMR has been also carried out. High temperature ^{1}H-NMR is basically available for estimation of hydrogen distribution, but gives less structural information than high temperature ^{13}C-NMR.

It is concluded that high temperature ^{13}C-NMR with pyrene addition is a promising method to characterize a mesophase pitch which involves some insoluble fraction.

International Symposium on Carbon, New Processing and New Applications, Tsukuba, Japan, November 4-6, 1990

In-Situ Monitoring for Mesophase Formation Processes of Various Pitches by Means of High-Temperature ^{13}C-NMR

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Coal-tar-derived (pitch A), petroleum-derived (pitch B) and hydrogenated petroleum-derived (pitch C and D) pitches were selected as samples. Table 1 shows the characteristics

of the samples used in this experiment.

High-temperature ^{13}C-NMR spectra were obtained with hightemperature probe. The details of the relationship between structural characteristics of pitch and its behavior during mesophase formation process is discussed.

In-situ monitoring for the mesophase formation process in pitch has been successfully accomplished using the proposed methodology.

International Symposium on Carbon, New Processing and New Applications, Tsukuba, Japan, November 4-6, 1990

Surface Modification of Carbons in CF_4 Plasma

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The surface character of carbon materials dominates the performance of the final product. Cold plasma is useful method for surface treatment, because it can modify the surface without changing the bulk properties. This study concerns surface fluorination of carbon black and activated carbon using CF_4 plasma and characterization of the surface fluorine groups using electron spectroscopy (ESCA). Furnace black and activated carbon for gas chromatography are treated. CF_4 plasma generated by radio frequency (RF) of 13.56MHz. Fluorine is introduced over the surface of carbon black. Majority of the fluorine groups were type of (-CF-). Behavior of plasma fluorination depends upon the sort of carbons.

The 3rd China-Japan Symposium on Coal and C_1 Chemistry, Kunming, China, October 29-November 1, 1990

Low-Temperature Atmospheric Pyrolysis of Yallourn Coal in Presence of Selenium Oxide

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Composition and rate of gas evolved were measured during atmospheric pyrolysis of Yallourn coal mixed with SeO_2 powder. Gas evolution initiated at 320 K to 330 K almost indepen-

dently of the weight ratio of SeO_2 to coal. The gas evolution rate and the total gas volume increased with the ratio. For rhe ratio of 0.51 the evolved gas contained about 84 vol% of CO_2, 7 vol% of CO and 9 vol% of H_2O. Inspection of the solid residue revealed reduction of SeO_2 to Se, suggesting oxygen transfer from SeO_2 to coal. Decrease in absorbance intensity for the peak originated carboxyl group was observed in FT-IR spectra of the carbonaceous portion of the residue. Decarboxylation and oxidation of methyl group was confirmed in pyrolysis of some model compounds with SeO_2.

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Hydrogen Transfer and Non-Covalent Bonding as Probes of Coal Structure and Reactivity

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Coal remains an important fuel even in next century. Researches on coal structure and reactivity help: design of coal processing be made environment friendly, and recognition of similarities of dissimilarities in reactivity of coals from different parts of the globe. There is some approach to coal structure and reactivity in what we investigate. Spectroscopic methods such as NMR, IR and GC-MS, for example, are useful for access of these targets. In this lecture, author has reviewed "hydrogen transfer" during pyrolysis of coal and "electron transfer' between coal host molecules and guest molecule "as probes of coal structure and reactivity", which has been conducted in his laboratory.

International Symposium on the Development of Carbon Fibers and Their Applications, Taejon, Republic of Korea, April 23-25, 1991

Characterization of Carbon Precursor and Carbon Surface with High Temperature ESR

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High temperature ESR technique is useful for better understanding of interaction between the surface of carbon fiber and pitch matrix during the heat-treatment. It is reported that carbonization of petroleum pitch has been monitored by in-situ high temperature ESR.

From the temperature dependence of spin concentration, Ns, in pitch alone and pitch/carbon fiber systems, it is observed that the values of Ns by the addition of carbon fibers heat-treated are almost similar to those of anisotropic pitch alone. On the other hand, the value of Ns for the system of isotropic pitch/carbon fiber is decreased from that of pitch alone.

The change of Hpp for pitch with and without carbon fibers heat-treated at various conditions versus temperature is almost similar. Consequently the circumstance of electron spin in the samples at various temperature so far tested are similar between pitch alone and pitch/carbon fiber systems.

The 29th Symposium on Engineering Aspects of Magnetohydrodynamics (U. S. A.), New Orleans, June 18-20, 1991

Consideration of Electrical Power Output for a MHD Generator with Superconducting Magnet Coil

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This paper describes the results of numerical analysis of the optimal electrodynamic performance of a MHD generator. The optimal magnetic field configuration and optimal MHD channel cross section were determined simultaneously to obtain the maximum electrical power out-

put. Supposing a Faraday type equilibrium plasma MHD generator with 5 MW thermal input, it was shown that the optimal aspect ratio is about 3 to 4, and the optimized magnetic field over the cross section should be nonuniform with a strengthened field in the central region of the channel but weakened distribution near the electrode region.