HOKKAIDO UNIVERSITY

Title	Summary International Reports, July 1985-June 1986
Citation	Memoirs of the Faculty of Engineering, Hokkaido University, 17(1), 21-96
Issue Date	1986-12
Doc URL	https://hdl.handle.net/2115/38020
Type	other
File Information	17(1)_21-96.pdf

Hokkaido University Collection of Scholarly and Academic Papers : HUSCAP

Second International Conference on the Use of Fly Ash, Silica Fume, Slag and Natural Pozzolans in Concrete
April, 1986, Madrid, Spain

Surface Layer Strength of Concrete as a Measure of Scale Resistance

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The properties of the surface layer of concrete may be closely related to the causes of frost damage and may play an important role in the durability of concrete. In order to study the mechanical properties of the surface layer, which are affected by the type of cements, curing and atmospheric condition etc., some tests were carried out using model specimens with penny shaped cracks (penny shaped crack test) or truncated steel core (pull out test).

The ratio of the surface layer strength to split tensile strength was found to be approximately proportional to the thickness of the layer. It was boumd that the surface layer strength is influenced by the curing conditions and is related to the degree of scaling and frost damage.

Proceedings of 1985 Australasian Conference on Coastal and Ocean Engineering, Christchurch, New Zealand, December 2-6, 1985

Random wave deformation and bispectral change

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Bispectral change accompanied with wave deformation in a shoaling region is considered. Observed bispectra are compared with theoretical one in both the real and the imaginary parts. The theoretical bispectra estimated from local power spectra show faily good agreement with the observed one, in a deeper region. But the patterns of imaginary parts of obserbed bispectra in this experiment show slight complexity due to statistical errors. In shallower region, the differences between observed and theoritical bispectra become significant.

Proceedings of the Fouth Symposium on Coastal and Ocean Management, Baltimore, U. S. A., July 30-August 2, 1985

Nonlinear deformation and bispectral changes of random gravity waves on a sloping bed

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A WKB-perturbation method is applied to the deformation of random gravity waves in water of slowly varying depth. In the present analysis, a spectral representation of WKB-type is assumed in a statistically stationary wave field. Power spectra (including directional spectra) and bispectra of the surface displacement are obtained based on the assumption of quasi-Gaussian processes. From this analysis, it is found that the imaginary part of bispectra is associated with the nonlinear deformation of waves. The wave set-down and stationary flow induced by random wave motion are investigated by using the same perturbation method.

International Conference on Ice Technology Boston, June 10-12, 1986

Experimental Study on Permeability Coefficient of Sea Ice

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Recently, caisson type structures are in use for offshore structures, such as artificial islands and oil drilling rigs, in extremely cold regions. As the liquid filling the caisson freezes, the internal pressure rises. It has previously been verified that this pressure rise, due to an increase of volume caused by ice growth, depends strongly upon the permeability coefficient of sea ice (Saeki et al. 1984). Presented in this paper are results of experiments on the permeability coefficient of sea ice reguimed to estimate the internal pressure. The following conclusions were obtained from this investigation:

1) Saline water percolation in sea ice due to internal pressure in caissons can be described almost entirely by Darcy's law.

2) The permeability coefficient increases with both temperature and salinity of sea ice.

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

5th International Symposium on Offshore Mechanics and Arctic Engineering (ASME)
Tokyo, April 13-18, 1986

ICE FORCES DUE TO CHANGES IN WATER LEVEL AND ADFREEZE BOND STRENGTH BETWEEN SEA ICE AND VARIOUS MATERIALS

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In cold regions, change in water level can induce vertical forces on offshore structures (such as caisson and tower type) when sea ice cover on structure adfreeze bonding is present.

This paper summarizes a theoretical analyses of vertical ice forces as well as the results of experiment from which parameters required for estimating sea ice adfreeze bond strength. Were led forth.

5th International Symposium on Offshore Mechanics and Arctic Engineering (ASME)
Tokyo, April 13-18, 1986

TOTAL ICE FORCES ON THE CLUSTERS OF CYLINDRICAL PILES

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When multi-pile tower structures, such as oil drilling rigs, are constructed in offshore cold regions, sea ice forces must be considered in their design. Presented in this paper is a method to estimate the total horizontal ice force acting on clusters of vertical cylindrical piles. The authors have conducted two type of experiments needed to evaluate this total ice force. The following areas have been clarified:

1) calculation method for the ice force transmitted to a pile by an approximate quarter ice sheet with a pile diameter to ice thickness aspect ratio of 5 : 1,

2) the contact interaction between a steel pile and cantilever ice sheet

3) calculation method to determine the ice force which a cantilever ice sheet transmits to a pile,
4) calculation of the total ice force acting on a multi-pile structure using results of the previously mentioned experiments and the past experimental results of Saeki et al.

Proceedings of lst Japan-China Bi-National Governmental Conference on River and Dam Technology, Beijing, Wuhan and Nanjing, China, October 17-29, 1985

Computer-Based Prognosis of Bed Agradation and Degradation by Dam Construction in Alluvial Rivers

Tsutomu KISHI and Mikio KUROKI
Hokkaido University, Sapporo, Japan

The authors describe three kinds of simulation models to conduct computer-based prognosis of river bed agradation and degradation caused by dam construction in alluvial rivers. The dam treated in the present models should be relatively low in height, because the effect of density current in the reservoir is not considered in the models.

Three types of simulation models which differ from each other in treatment of sediment motion, are dealt with. Namely, a) bed load+unsteady suspended load, b) bed load+steady suspended load, and c) bed load.

For the three simulation models i) stability condition of a finite difference equations system, ii) scheme of finite difference equations, and iii) applicability of models are decribed respectively.

WCTR WORLD CONFERENCE ON TRANSPORT RESEARCH
11-15, May 1986
VANCOUVER CANADA

The effects of the Seikan Tunnel on Intercity Passenger Transport in Japan

Keiiti SATOH

The Seikan Tunnel which links Honshu (or the Mainland) with Hokkaido, the northernmost island in Japan, is the world's longest underground tunnel. The measured length of the tunnel is 53.85 Kilometers. The pilot tunnel was finished in January, 1983, and the main tunnel was scheduled to be completed in the spring of 1985.

The major passenger transportation systems between Honshu and Hokkaido are airlines and railroads, the latter requiring the tunned that passes under the channel. Until 1973, more people traveling between Hokkaido and Honshu, utilized trains rather than airtransport. However, the

situation was reversed in 1974, and more and more passengers were and are still using the airways rether than trains.

The reasons are traveling by train reguires much longer and furthermore railroad passengers fares increased phenmenclly in 1975. The completion of the Seikan Tunnel would make the travel time much shorter, compared with the time required by ferry boats. Furthermore, there would be less possibility for the journey to be blocked by typhoons and snowstorms which often occur at the Tsugaru Channel. It can be expected, therefore, that many of the airline passengers may switch to railroads again.

This paper is concerned with the results of a quantitative analysis on this change-over of the passengers through an experimental planning model, which is a mode choice model that we devised.

The data obtained by conducting a public opinion survey using an othogonal array table, was regressed using an aggregate logit model. The results of these analyses are summarized as follows:

1) With the completion of the Seikan Tunnel, the railroad will be able to increase the number of passengers. Especially, the introduction of the Sinkansen would accelerate the transition even more rapidly.
2) The railroad will be highly valued as an all-weather transportation system.
3) However, as the distance between the origin and destination becomes greater, the utilization of railroads will gradually decrease.

ASTM Symposium on Advanced Triaxial Testing of Soil and Rock, Louisville, U. S. A., June 19-20, 1986.

The Influence of Shape of Filter Strips on the Consolidated Undrained Triaxial Extension Test Results

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In consolidated undrained triaxial tests on cohesive soils, filter strips are generally used as side drains in order to accelerate the process of consolidation. Some experimental results regarding the influence of the shape of side drain on the triaxial test results have been reported in which ordinary type and spiral type of filter strips are used for compression and extension test, respectively. In these studies, however, the influence of the shape of filter strips on the stress-strain-strength behavior of clay in consolidated undrained extension test have hardly been reported.

A series of consolidated undrained triaxial extension tests was performed to investigate the influence of the shape of the filter strips on the required time of consolidation and undrained shear behavior of clay. Remolded saturated specimens of clay with five different shapes of filter strips were consolidated isotropically in the triaxial apparatus and then sheared under undrained extension by decreasing axial stress, while lateral stress was maintained constant. Based on the test results, filter strips with spiral slit were judged to be suitable for practical use of consolidated undrained extension test.

National Symposium of Water Supply, Thailand. Chiengmai University, Thailand, July 3-4, 1985

Drinkable Tap Water

—Overall experiences in developed countries—

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The international drinking water supply and sanitation decade, 1981-1990, announced by the United Nations is a mile stone in the development of world water supply systems. The problems in developing countries and useful experiences in developed countries are discussed systematically on the historical evolutional scale of the water technology with its environment. In the discussion, three phases of the water quality management scheme from the conventional to the future are proposed and characterized. The scope of the metabolic systems of water and contents of transportation and water conversion technology in the systems are characterized. Building installations with water and wastewater management are also discussed with the three phase of the metabolic system.

The Hokkaido University International Symposium on Control of Refractory Organics in Water, Sept. 6, 1985

Prediction of THM and TOX Formation by a Kinetic Model

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Studies to develop an overall quantitative picture of the kinetics of THM and TOX formation were conducted. The process of THM and TOX production was described by the use of a consecutive first-order reaction model. To evaluate the chlorination process in a practical case, the standardized technique for the THM and TOX formation potential measurement was obtained experimentally in a very short time. The validity of this short time ultimate THM and TOX prediction method was proved with respect to various types of water samples and different rates of chlorine to the precursor. The reaction coefficient was expressed as the function of reaction temperature. The THM and TOX formation curve obtained by the kinetic model describes the complex consecutive THM and TOX formation pattern with accuracy.

5th Asia Pacific Regional Water Supply Conference, Seoul, Sept. 16-19, 1985

New Water Quality Indices of Organics for the Evaluation of Treatment Process and Self-purification

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Hokkaido University, Sapporo 060, Japan

The choice of processes and systems for the removal of organic contaminants from water and wastewater and the prediction of the biodegradability of organic compounds dumped into natural waters are discussed. Simple and informative water quality indices with respect to treatability evaluation are presented using Sephadex G-15 gel-chromatography with the indices of ultraviolet absorption at 260nm wave length(E260) and total organic carbon concentration(TOC), By the method, the pseudobinary nature with the major amount of organic compounds in natural water is shown. By the pseudobinary nature which is characterized by TOC/E260 ratio and apparent molecular size distribution on a gel-chromatogram, it became possible to calculate the extent of removal of natural organics by chemical coagulation, aerobic biological process and activated carbon absorption.

International Heat Pipe Symposium, Feb. 13-14, 1986 at Osaka, Japan

ANALYSIS OF DRYOUT CHARACTERISTICS OF HEAT PIPES

Masashi KURAMAE, Nobuhiro NAKAYAMA and Masahide MATSUMOTO
Faculty of Engineering, Hokkaido University

Dry-out characteristics of heat pipes with capillary wicks were analyzed by a simple model on the basis of the effect of axial heat conduction. It was found that the profiles of axial temperature distribution in the wall for the heat transfer rate over a critical point were dependent upon the value of a dimensionless parameter Y* representing the degree of axial heat conduction corpared to radial heat conduction. Namely, for heat pipes larger then Y*, the temperature at the end point of heating section rises suddenly by a slight dry-out. But for heat pipes of smaller than Y*, the temperature at that point will not rise so highly if the dry-out progresses. From this viewpoint, the sighnificance of a critical heat flux by capillary-pumping-limit was investigated.

International Heat Pipe Symposium,
Feb. 13-14, 1986 at Osaka, Japan

ANALYSIS OF TRANSIENT CHARACTERISTICS OF HEAT PIPES

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Faculty of Engineering, Hokkaido University

This paper deals with the problem of transient heat transfer characteristics of heat pipes with a capillary wick under the condition that the thermal loading vaues with time.

A mathematical model was developed to predict the performances by considering the heat and mass transport phenomena taking place in a heat pipe. The governing differential equation of simultaneous heat and mass transfer was solved numerically based on the finite-difference method with suitable initial and boundary conditions.

Such heat transfer characteristics as the transient behaviour of axial surface temperature profiles and output heat transport were measured for a typical heat pipe under several conditions of time varying heat input.

Transient heat transfer mechanism of heat pipes were discussed by running a comparison between the experimental results and calculated ones.

International Symposium on the Role of Rock Mechanics in Excavations for Mining and Civil works, Zacatecas, Mexico, September 2-4, 1985

Temperature Control of Ventilation in a Large Cave for Storage of Nuclear Waste Canister for a Long Term

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Sapporo, Japan
Sigeki NISHIMURA
Nishimatsu Construction, Tokyo, Japan

Some factors of ventilation control for stable storage of nuclear waste canister (N. W. C.) for long terms are discussed. The Main results of the study are as follows.

1) Measurement of air temperature is effective to determine the condition of N. W. C..

2) When surface temperature of N. W. C. increases under stable conditions, supply of energy by fan for cooling decreases.

3) Regulaters are available for both aspects of economy and safety in the case of emergency.

4) Maximum temperature in the N. W. C. of 0.32 m×1.5 m is less than the melting with point of nuclear waste mixture in the case when heat production of N. W. C. with homogenenous packing is less than 3500W.

5) In the case of abnormal terperature increase, elapsing time until the melting point can be estimated in comparison with the temperature increase pattern drawn by the finite difference method.

The 2nd U. S. Mine Ventilation Symposium, Reno, Nevada, September 23-25, 1985

Algorithm for Fast Simulation of Mine Ventilation using Dual Micro Computers

Yuusaku TOMINAGA, Hiroaki MATSUKURA and Kiyoshi HIGUCHI
Faculty of Engineering, Hokkaido University, Sapporo, Japan

In order to plan a mine ventilation network by micro computer and to control airflow rate in a network in real time with a mini computer, a novel algorithm for mine ventilation simulation was developed. The principal results of the study are ;

1) the correction value of airflow rate for a basic mesh can be estimated as a root of an equation for a parabola derived from Kirchoff's seccond law,

2) convergent time of ventilation simulation is dependent on the order of applying basic meshes for correction airflow rate,

3) a dual micro computer system is available to accelerate the simulation of the ventilation network.

FOURTH CONFERENCE ON ACOUSTIC EMISSION MICROSEISMIC ACTIVITY IN GEOLOGIC STRUCTURES AND MATERIALS, The Pennsylvania State Univerity, October 22-24, 1985.

MICROSEISMIC ACTIVITY INDUCED BY LONGWALL COAL MINING

K. SATO, Y. FUJII, Y. ISHIJIMA and S. KINOSHITA

A mine-wide microseismic monitoring facility has been developed utilizing a digital telemetry system and a minicomputer system to clarify the strata mechanics of longwall mining at a great depth. The system detected about 20,000 microseismic events, whose local magnitudes were greater than −2.5, during mining of the two longwall panels of Horonai colliery, Hokkaido, Japan. The magnitude frequency relation of seismic events followed the Gutenberg-Richter's formula, with the b-value of 1.01 for both panels. The highly seismic zone was located at the tail entry T-junction on the face line where it is subjected to both the front and side abutment pressure. Hanging walls up to 50 m above the coal seam also suffered from intense seismic activity, but the footwall was aseismic during mining. The release rate of seismic energy was intensified as the coal face reached the area affected by the old workings.

The 5th International Iron and Steel Congress, washington, D. C. USA, April 6-9, 1986

A STUDY OF REDUCTION OF IRON OXIDES WITH H_2-CO-CO_2 HIXTURES BY MEANS OF GAS ANALYSIS

Kuniyoshi ISHII, Tomohiro AKIYAMA, Naoki KASAI
Yoshiaki KASHIWAYA and Shin-ichi KONDO
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The reduction of iron ore with Ar-CO-CO_2-H_2-H_2O multi-component gas was followed by gas analyses. The samples were treated as a fixed bed and the data were analyzed by using the reaction kinetic models and the parameter fitting method. The water-gas shift reaction(WSR) was not so rapid as the reduction by H_2 and by CO. Therefore, the reduction with Ar-H_2-CO_2 tended to proceed beyond the limitation of gas equilibrium because of the extremely fast reduction with H_2. On the other hand, it was hardly expected in Ar-CO-H_2O that reduction was accelerated by WSR. When these results were applied to the reduction of sinter under the condition simulated to blast furnace, it was suggested that water gas reaction was more important for conversion of H_2O to H_2 than Boudouard reaction.

IUTAM Symposium on Fluid Mechanics in the Spirit of G. I. Taylor 24-28 March 1986, University of Cambridge, Cambridge, U. K.

A Vortex Ring Interacting with a Vortex Filament and its Deformation near a Two-dimensional Saddle

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This paper describes a numerical study of the interaction between a vortex ring and a vortex filament and the deformation of a vortex ring near a two-dimensional saddle by a three-dimensional discrete-vortex method. These problems are respectively concerned with the effect of the free stream turbulence on plane mixing layers and the production of turbulent energy near saddles associated with large-scale coherent structures in free turbulent shear flows. The results have revealed several typical patterns of the interaction between the vortex ring and the vortex filament, i. e. exchange mode, coalescence mode and weak-interaction mode, depending on their circulation and initial configuration. The deformation of the vortex ring near the two-dimensional saddle produces counter-rotating vortices elongated in the direction of out-going separatrices; the amplification of the circumferential velocity and the vorticity of the vortex rings are also demonstrated.

8th National Heat and Mass Transfer Conference in India

SOME HEAT TRANSFER PROBLEMS OF BOILER AND FURNACE

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Typical problems of computer simulation in the field of thermal engineering are introduced. They are the simulations in a furnace, combution phenomenon of solid fuel and latent heat recovery from flue gas. The above simulations are practical problems and should be checked by the experiments obtained by industrial sized units. Furthermore each problem will have a complex or combined phenomenon and require an effort which has to be supported by analytical and experimental studies. So, several methods are exploited to solve the problems, Monte Carlo method for radiation, SIMPLER method for convection. And these results of the furnace analysis are compared with experimental data and show good agreement.

International Symposium on Combustion in IC Engines, Tianjin, China, September, 10-14, 1985

Combustion Characteristics at Acceleration in Diesel Engines Operated with Alcohol-Diesel Fuel Blends

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Combustion characteristics and exhaust smoke were analyzed during acceleration in diesel engines operated with alcohol-diesel fuel blends. The engines were accelerated by increasing the fuel amount abruptly, and the indicator diagrams, fuel injection rates, smoke density, and the wall temperatures of the combustion chamber were measured over 90 consecutive cycles.

The results show that the alcohol-diesel fuel blends give faster acceleration and much lower smoke emission than conventional diesel fuel operation. The results also show that the combustion behavior under acceleration can be estimated from the steady state values.

INTERNATIONAL SYMPOSIUM ON
HEAT TRANSFER 15-18 October,
1985, Beijing, CHINA

HEAT AND MASS TRANSFER AND COMBUSTION VELOCITY PROFILE OVER A FLAT PLATE WITH DISTRIBUTED FUEL GAS BLOWUP

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The present study is to investigate the temperature distribution of fuel surface with radiation heating and the stability of a roll-up flame observed in coal combustion. The roll-up fiame is analyzed by use of a flame holding model which has the solid-fuel plate with inflammable gas blowing from upstream surface and flammable gas from downstream. These results were confirmed by using a combustion wind tunnel. The objective of this study is to estimate the temperature distribution of the fuel surface before ignition, the complex heat transfer and the combustion after the ignition.

INTERNATIONAL SYMPOSIUM ON
HEAT TRANSFER 15-18 October,
1985, Beijing, CHINA

LATENT HEAT RECOVERY FROM GAS FLOW WITH WATER VAPOR

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Reduction of exhaust gas loss in boiler is effective for an increase in boiler efficiency. Low temperature corrosion has limited its wide application. Recent progress in the field of anti -corrosive materials and in the combusion technique of wet fuels like Coal Water Slurry or Oil Water Mixture makes it possible to recover even latent heat from boiler flue gas. Boiler flue gas contains 10-20 wt% of water vapor. Many investigators have studied condensation heat transfer in humid air (water vapor content of 0-2 wt%) or steam with slight air (Water vapor content of 70-100 wt%). But the other region between these two extreme conditions has not been studied. The objective of this study is to investigate the applicability of the heat and mass transfer equations which are obtained for humid air, water vapor with slight air and the medium water vapor content conditions. By using these results, analyses were also made on the performance of a latent heat recovery heat exchanger and on the effects of its installation on a thermal efficiency of thermoelectric power station.

1985/U. S.-JAPAN HEAT TRANSFER
JOINT SEMINAR SEPTEMBER 17-20,
San Diego, U. S. A.

RADIATIVE HEAT TRANSFER IN PACKED SPHERES BY MONTE CARLO METHOD

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The ray-tracing technique combined with a Monte Carlo method are employed to determine the optical characteristics of a unit cell and radiant heat transfer in a packed bed of spheres. Two limiting cases, dependent and independent scattering models, are treated. The effects of spatial variation in the volume fraction of spheres on the radiation characteristics are determined. Theoretical prediction is compared with the existing experimental results. It is concluded that the independent-scattering model agrees well with test data. The Monte carlo method yields the optical characteristics of a cell unit and the radiant heat transfer performance in a packed bed with two-dimensional variations in the volume fraction of spheres. The technique may be extended to treat three-dimensional radiant heat transfer problens in a packed bed with variable local emissivity and volume fraction.

Fourth International Conference on Numerical Methods in Thermal Problems, July, 15-18, 1985, Swansea, U. K.

TURBULENT FORCED CONVECTION FROM RADIATION-HEATED SOLID-FUEL PLATES

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** The University of Michigan
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A numerical study is performed on steady two-dimensional turbulent forced convection from a coal plate whose surface is heated by radiation and releases volatile substances. A Monte Carlo method is employed in the radiative heat transfer analysis, while convective heat transfer is solved by a finite-difference technique. The governing transport equations are discretized and then solved by the SIMPLER algorithm. Results are obtained for the distributions of gas flow velocity and temperature, together with the fuel surface temperature profile.

International Symposium on Diagonostics and Modeling of Combustion in Reciprocating Engines, Tokyo, Japan, September 4-6, 1985

Schlieren Visualization of Exhaust Gas Motion and Mixing in the Exhaust System of a Single Cylinder Methanol Fueled S. I. Engine

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Hokkaido University

Gas motion and mixing in the exhaust tube of a single cylinder methanol engine was observed with the aid of Schlieren Visualization Method. A high speed movie camera was employed to perform the experiments. The Shlieren movie shows that the mixing in the exhaust stream is relatively strong in the flow at blowdown just after the exhaust valve opening and decays with advance of crank angle. The mixing at the cycle to cycle boundary is insignificant and gas moves like a plug flow. The gas velocity diagram given by the Schlicren movie shows the presence of three large velocity peaks corresponding to the blowdown, upward piston motion, and acoustic vibration. Finally, using the velocity diagram the differences between concentrations determined by the two methods, continuous and time-resolved gas samplings, are indicated to be around 10 percent.

23rd ASME/AICHE National Heat Transfer Conference Denver, Colorado, USA, August 4-7, 1985

Application of a Second Order Derivative Spectrophotometer to the Measurement of CH_2O, NO, NO_2 and NH_3 in Exhaust Gases from a Methanol Fueled S. I. Engine

Kenichi ITO, Toshiaki YANO and Osamu FUJITA
Department of Mechanical Engineering
Hokkaido University

For the measurement of CH_2O with second order derivative spectrophotometry, choice of spectrum band, establishment of sampling and calibration method were carried out. Interference of coexistent components with the spectrum band was investigated. From the results, the potential of this method was evaluated on CH_2O measurement.

For the measurement of NO and NO_2, the difference between the present method and the conventional determination with CLA (chemiluminescence analyzer) were compared in the presence of CH_3ONO. Furthermore, this measurement technique is applied to a practical methanol fueled S. I. engine and the availability is emphasized.

International Congress and Exposition
Detroit, Michigan February 24-28, 1986

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

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Takemi CHIKAHISA and Noboru MIYAMOTO
Hokkaido Univ.
Koichiro ITOW
Komatsu Ltd.

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

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

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

World Congress on Heating Ventilating and Air Conditioning, August 25-30, 1985 Copenhagen, Denmark

WASTED HEAT RECOVERY AND TEMPERATURE UPGRADING BY ABSORPTION HEAT PUMP AND OTHER SYSTEM

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Among energy conservation technologies absorption heat pumps have been gradually introduced in practice into industries, district heating system and also developed even for small -capacity heating of the buildings. The present paper overviews such actual situations as the introduction of absorption heat pumps nowadays showing the data of capacity, temperature level upgraded and installation costs for already-installed examples, which implies the large

potencialities in the field of heat energy utilization. Moreover some future applicabilities of heat pump technology are discussed here, such as a combined system of mechanical vapor recompression with an ejector heat pump for higher temperature generation over 150℃ and the possibility of integration of absorption heat pump into district heating with latent heat recovery from flue gas as heat source.

International Conference on Experimental Mechanics, Beijing, CHINA, October 7–10, 1985

Stress-Strain-Optic Laws of Cellulose Acetate under Uniaxial Tension

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The usability of cellulose acetate as a photoplastic model material was examined under uniaxial tension. The stress-strain-optic laws were uniquely represented in the nondimensional forms regardless of both temperature and strain-rate, and did not depend on residual strain as well as residual fringe order. Plastic fringe order could be expressed by plastic strain only.

Kontinuumsmechanik Fester Körper, Mathematisches Froschungsinstitut Oberwolfach, B. R. D., 5.1. bis 11.1. 1986

Constitutive Equation of Cyclic Plasticity Considering Plastic Deformation Induced Anisotropy

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The motion of the center of the loading surface and plastic deformation induced anisotropy are incorporated in the loading function of the constitutive equation for cyclic plasticity. The associated plastic flow law is derived from the so called normality of the plastic strain increments to the loading suface. The Zigler type of assumption is used as the evolution equation of the center of the loading surface. All the stress-strain curves in cyclic loading are also assumed to be well represented by the modified Ramberg-Osgood law which should be applied from the current center of the loading surface. The computer simulation based on this model is verified by virtue of several kinds of experiments on type 304 austenite stainless steel. As a result, this model is recognized, by the simulation in question to be adequate to describe the essential features of cyclic plasticity.

International Conference on Computational Mechanics, Tokyo, JAPAN, May 25-29, 1986

Constitutive Modeling of Cyclic Plasticity Considering Induced Anisotropy

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In this paper the authors proposed a constitutive model for cyclic plasticity incorporating the motion of the center of the loading surface and the plastic deformation-induced-anisotropy. The Ramberg-Osgood law was applied to each cycle with respect to the current center of the loading surface. Computer simulation based on this model was verified by means of several kinds of experiments on type 304 austenitic stainless steel. As a result, this model was recognized to be adequate to describe the essential features of cyclic plasticity.

International Conference on Experimental Mechanics, Beijing, CHINA, October 7-10, 1985

Quenching Stress of High Frequency Induction Hardening Steel

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The quenching stresses of a commercial carbon steel bar hardened by high frequency induction hardening are measured using X-ray. The stress distributions are compared with the results of numerical calculation. It was ascertained that both results are in good agreement with each other.

The 1985 ASME Technical Conference, Winter Annual Meeting, November 17 -22, 1985 Florida, USA

A Dual-Axis Micro-Finishing Tool for Free-Form Metal Surfaces of a Mold Cavity

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The purpose of this study is to develop a high utility tool for automatically finishing free-form metal surfaces of a mold cavity on a NC milling machine.

The Mechanism and properties of a dual-axis micro-finishing tool in which a small disk wheel with a partial spherical body can revolve on both wheel and spindle axes at the same time is presented in this paper.

The two finishing tools which are similar to each other in mechanism but different in properties are developed. One is used for obtaining a smooth surface of less than 3μmRz, the other is for obtaining a mirror surface of less than 0.5μm Rmax.

International Forum on Die and Mold of JDMA, September 2-5, 1985, Tokyo.,

Finishing of Free-Form Surface on a Cavity of a Die and Mold

Katsumasa SAITO *

The finishing and polishing operation of a free-form suface employed in the Japanese mold industry are reviewed as an example. These surfaces are machined mainly by a numerical controlled machine or a copying milling machine, and are finished by hand-work of a skilled machinist. In order to improve the productivity of the die-mold and machine products with a free -form surface, molders and machine tool makers in Japan are now making an attempt to develop automatic machining tools and finishing equipment, and proposals and ideas are being made.

As a result, various new equipments and tools to machine and finish free-form surfaces have become available to the Japanese die and mold industry.

The 8th IASTED International Symposium on Robotics and Artificial Intelligence ; June 10-12, 1986, Toulouse.

Automatic measurement of 3-D object shapes by means of image processing

T. MIYOSHI, H. Z. LU and K. SAITO

A new image processing technique for automatic measurement of 3-D object shapes is proposed and verified by computer simulation as well as experiments. The surface profile of a 3-D diffuse object is obtained by measurement of the phase distribution across the image of a projected sinusoidal grating deformed by the surface. The deformed grating images are detected by a highly sensitive CCD camera and processed by a microcomputer.

The Advantage of this method is to automatically generate a reference surface which is proximal to the surface profile to be measured. This is done so that comparatively large objects with a relatively compact optical system can be utilized in comparison to conventional methods.

Areas of application include robot vision, industrial quality control and computer graphics.

JAPAN-U. S. A. Symposium on Flexible Automation July 14-18, 1986, Osaka, JAPAN

AN EXPERT SYSTEM FOR AUTOMATIC PROCESS PLANNING OF BORING OPERATION BY PROLOG

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This paper shows the development of an Expert System for automatic process planning of boring operation by machining center. The system accepts the data of stepped holes with arbitrary geometry and accuracy, and searches for an optimum machining process for the hole. Based on several investigations, the empirical knowledge of boring in the system is represented by a three level hierarchical structure ; rules, meta rules and actual tool data-base. And the system has the control mechanism for deciding the machining process by backward-chaining and estimation of machining time. The system is implemented by Prolog which is appropriate for

knowledge representation and inferring mechanism, and can infer the optimum machining process more efficiently in comparison with a search only by rules. In this paper, the constitution of the system, hierarchical representation of empirical knowledge on boring, the mechanism for inferring the optimum process and example of the systems' execution, are described.

International Conference on Intelligent Manufacturing Systems June 16-19, 1986, Budapest, Hungary

An Integrated approach to CAD/CAPP/CAM based on Cell Constructed geometric Model (CCM)

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Computer integration of CAD, CAPP and CAM is a very serious problem for industry, and a number of research works on it have been done.

In order to realize the integration of CAD/CAPP/CAM, a geometric model which is named Cell-Constructed-geometric-Model(CCM), and a neutral meta-interface which is called MKS (Machining Kernel Software) are introduced for CAD/CAPP/CAM interface.

This paper presents the concept of integration for CAD/CAPP/CAM, and the developed CAD/CAPP/CAM system which is based on the Cell-Constructed-geometric-Model(CCM) and Machining Kernel Software(MKS).

35th CIRP General Assembly August 25 -31, 1985, Palermo, Italy

MKS: Machining Kernel Software for CAM-System

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A Machining Kernel Softwerae (MKS) which provides a set of basic functions for the CAM system was developed. The main aim of introducing MKS for the CAM system is to allow application programmers to easily form a direct link between CAD and the machining system while interactively processing the machining information.

In order to form the direct link between CAD and CAM, a rational parametric representation of a geometric model which is supported by IGES and CCM (Cell-Constructed-geometric-Model) which is proposed by the authors are employed for the interface.

MKS is featured by a hierarchical module processing structure, which consists of Data Handling Module, Interactive Machining Information Processing Module and Machine Handling Module, based on CCM.

In this paper, the concept of MKS, the relationship between CAD system and MKS/CAM, the basic functions of MKS and some examples of the data processing are described.

INTERNATIONAL MACHINE TOOL RESEARCH FORUM August 20 and 21, 1985 Chicago, U. S. A.

Geometric Modeling and Geometric Simulation

Norio OKINO

Geometric modeling and geometric simulation are main suppports which CAD/CAM systems in the near future are based on. It is said that research on the solid modeling come to a stage where it can take a rest. However, it is still active for the time the solid model CAD will be on the way to be used widely in industry. Some approaches in Japanese Universities and Industries are introduced here. The author made a little progress for TIPS geometric modeler. It made assembly modeling including parametric definition by an interactive process.

Development of applications for the solid model is the most important key point and the geometric simulation is one of the typical application. The geometric simulation means simulations of characteristics which depend on geometry of objects. For example, TIPS/GSP(TIPS Geometric Simulator Project) consists of 4 kinds of simulators; assembly simulator, engineering simulator, NC simulator and robot simulator. This paper reviews some approaches about such geometric simulations in Japan.

35th CIRP General Assembly August 25 -31, 1985 Palermo, Italy

O/O (Object and Operation) Dualism for CAD/CAM Software Architecture

Norio OKINO

Not a computer oriented but an application oriented software architecture is strongly required by engineers who are involved in information processing in the design and manufacturing field. This paper describes a conceptual approach for developing CAD/CAM oriented software architecture based on dualism of Object and Operation on the hypothesis that information processing in design and manufacturing consists of interaction between Object and Operation.

After abstracting Object and Operation, the O/O dualistic software structure, including conceptions of O/O frame, Object cell and Operation cell is introduced with graphic description rules. This is applied to the following problems as examples.

(1) Modelling problems; Solid model and models for drawing, drawing, design, NC and assembly are defined by the O/O dualistic structure.

(2) Progromming problems; After describing a methodology of programming by the O/O dualistic structure with graphic programming, examples of design process, process planning, NC command generation and robot operation planning are mentioned.

(3) CAD/CAM system design; This section presents a system design for CAD/CAM at which the discussion by the O/O dualism arrives. And also, it is shown that the proposed system has the possibility to grow into an intelligent system.

Presented at Int. Symp. Behavior of Lattice Imperfections in Materials (Osaka 1985).

History, Present Status and Future of Electron Radiation Damage of Materials by High Voltage Electron Microscopy

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Research history on radiation damage and structure of materials with high voltage electron microscopes related to the present work is briefly reviewed. Explanations of the status of 10 research subjects, the majority of which are dealt with metals and alloys, are given with comments on future prospects. These are: primary damage processes, dynamical point defect processes during continued radiation damage, clustering process of point defects, motion properties of point defects, electron radiation induced diffusion of point defects, interstitial–dislocation interaction, point defect–solute interaction, electron radiation damge and the nature of point defects in semiconductors, electron irradiation of amorphous materials, and effective use for the development of nuclear materials.

Presented at 2nd Int. Conf. Fusion Reactor Materials (ICFRM-II) (Chicago 1986).

FACTORS CONTROLLING THE NATURE AND AMOUNT OF RESIDUAL DEFECTS IN NEUTRON IRRADIATED MATERIALS*

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Requirements for the research progress towards a unified understanding of the defect structure evolution by high energy neutron irradiation are described. Experimental data to be considered are categorized from the observations made on defect structures in various materials irradiated with fusion neutron source RTNS-II. Comparison of defect structures developed in thin foils with those in bulk specimens was found to be extremely efficient in increasing our understanding of defect processes. The variation of microstructure which comes from the difference in the point defect configuration in freshly made cascade damage is discussed. The consideration of the stability of point defect clusters includes absolute instability in some materials, stacking fault tetrahedron nucleation, and cooperation among sub-cascades. Roles of interstitial atoms are evaluated, such as the annihilation within a unit cascade, free interstitial migration to eliminate vacancy clusters, and the formation of interstitial clustered defects. Dynamical effect of collisions on point defect processes is discussed. Formation of voids is explained in relation with helium production.

Presented at Int. Symp. Behavior of Lattiece Imperfections in Materials (Osaka 1985).

ELECTRON RADIATION DAMAGE STUDY OF GERMANIUM AND III–V COMPOUND SEMICONDUCTORS BY HIGH VOLTAGE ELECTRON MICROSCOPY

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Germanium and III–V crystals, GaP, GaAs, GaSb, InP, InAs and InSb, were irradiated and their defect structure evolution were observed under a high voltage electron microscope HU-3000 at the voltage of 2 MV under tempertures T between 100 K and 750 K. In the case of small interstitial type faulted dislocation loops with diameters d up to 150 nm appear on (113) type planes below 200 K after a fairly long incubation period. While vacancy type faulted dislocation loops on (113) planes can also be seen induced at high temperatures around 500 K in specimens coated with carbon film. From the shrinkage behaviour of these two types of dislocation loops above 750 K, self-diffusion carriers are identified as vacancy type in germanium. In III–V compounds, tiny perfect interstitial type loops, less than 40nm, appear at room temperature. From the observed temperature dependence of the amount of number and the growth speed of interstitial type of dislocation loops in these materials, the apparent migration energies of interstitial loops in GaP, InP and GaSb were estimated to be about 0.9, 0.9 and 0.6 eV, respectively, and that of vacancies in InP are estimsted to be about 3.5 eV. The spacial distribution of clusters is inhomogeneous, the major part being localized near the upper foil surface, in the cases of GaAs and InAs. This must be one of the most important questions that remain unsolved.

Presented at 2nd Int. Conf. Fusion Reactor Materials (ICFRM-II) (Chicago 1986).

Mechanical Property Change and Its Correlation with Defect Structure Evolution in D-T Neutron Irradiated Au and Ni

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The mechanical property change that resulted from the defect structures formed by irradiation with D-T fusion neutron was investigated for Au and Ni.

The increment of the yield stress on irradiation was proportional to 1/3 and 1/2 power of the neutron fluence in Au and Ni, respectively. The number density of defect clusters in Au and Ni was confirmed to be proportional to the neutron fluence.

The deformation process in Au was observed to proceed by two stages. The first stage was development of dislocation channels. The second stage, for larger deformation, was affected by the neutron fluence. Dislocation channels which were closely spaced were formed at high fluence. At low fluence the channels could not be recognized, and small cell structures developed.

Presented at 2nd Int. Conf. Fusion Reactor Materials (ICFRM-II) (Chicago 1986).

Parametric Analysis of the Disc Bend Test

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The disc-bend test has been one of many techniques investigated for the purpose of extracting mechanical properties from small volume specimens. While a number of different fixture geometries are in use in the disc-bend test, no systematic study of the influence of fixture geometry has previously been undertaken.

Discs 3mm in diameter with 0.25, 0.15 and 0.1mm thickness were tested in a disc-bend fixture. A total of ten fixtures were used in which the spherical penetrator(steel ball) diameter was varied from 1.0 to 1.6mm, the recess hole diameter varied from 1.3 to 1.9mm. Four materials were used; cold-rolled and fully recrystallized copper and Japan prime candidate alloy(JPCA).

In general, as the ball dimeter to hole size ratio decreased, a part of load-displacement curve where the load increased slowly became larger due to a greater amount of bending occurring prior to membrane stretching. The displacement to failure varied with the position of the fracture point, which occurred in the middle of the specimen for intermdiate ball size, but occurred at the periphery for large and small ball sizes. The results of these tests are considered in terms of optimizing the disc-bend test for determining various flow properties.

Presented at 2nd Int. Conf. Fusion Reactor Materials (ICFRM-II) (Chicago 1986).

THERMAL STABILITY OF CASCADE DEFECTS IN FCC PURE METALS

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Annealing experiments on irradiated FCC pure metals were made above room temperature (25℃) to examine the thermal stability and the nature of point defect clusters formed at the displacement damage cascade sites in pre-thinned specimens. Vacancy-type loops and stacking fault tetrahedra were produced in Au irradiated with 14-MeV neutrons at temperatures higher than the stage-III temperature, and it was found that the annealing behavior of these defects was similar to that of quenched-in defects in Au. Although a limited number of annealing experiments and quantitative TEM analyses make it difficult to show a clear-cut interpretation, we propose the following annealing mechanism in Au, Cu, Ag, and Ni irradiated with neutrons at or under the stage-III temperature. Interstitial-type defects and probably small vacancy-type defects disappear while part of submicroscopic vacancy-type defects grow and become visible at the stage -III temperature. Above this temperature, small vacancy-type defects disappear releasing vacancies and interstitial-type defects disappear absorbing these vacancies, and finally stable vacancy-type defects are annealed out at higher temperatures. Some submicroscopic vacancy -type defects grew even at temperatures higher than the stage-III temperature.

Presented at 2nd Int. Conf. Fusion Reactor Materials (ICFRM-II) (Chicago 1986).

CASCADE-OVERLAP EFFECT ON DEFECT STRUCTURE EVOLUTION REVEALED BY REPEATED D-T NEUTRON IRRADIATION+

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Two systematic neutron irradiation studies were carried out in gold and copper to investigate the effect of cascade overlap on the damage structure evolution. One is the irradiaton with a wide range of dose, from 10^{19} n/m^2 to 10^{22} n/m^2, and the development of defect structure was studied as a function of irradiation dose. The other is a repeated irradiation and observation, in which an

identical part of the specimen was observed after several irradiations, and more direct information on the formation and evolution of defect structures from cascade damages were obtained. Point defect clusters forming closely spaced groups, which are formed from subcascade damages, were confirmed to reveal themselves by the survival of larger number of defect clusters in the cascade with increasing irradiation dose by the aid of effective annihilation of interstitials to defect clusters formed by previous irradiation.

Presented at 2nd Int. Conf. Fusion Reactor Materials (ICFRM-II) (Chicago 1986).

DEVELOPMENT OF DEFECTS FROM DISPLACEMENT DAMAGE CASCADES IN LOW TEMPERATURE D-T NEUTRON IRRADIATED METALS

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Pre-thinned pure metal foils were irradiated with D-T neutrons below 20K, cryotransferred to an electron microscope, and the displacement damage cascades were observed at 130 K. Subsequently the specimens were annealed isochronally to observe cascade relaxation. Pure gold was the most extensively examined in the present experiment. At a very low fluence (6×10^{15} n/cm^2), the defects observed at low temperature were interstitial loops while vacancy clusters were not observed. These may be frozen in an unrelaxed spongy structure. The interstitial loops disappeared partially with the increasing annealing temperature. At the low fluence (3×10^{16} n/cm^2), the interstitial loops grew significantly at 220 K to 250 K and shrunk at the 300 K to 430 K. Small dotted clusters (vacancy SFT) appeared at 300 K near grown interstitial loops and some grew up to 520 K. At medium fluence (6×10^{17} n/cm^2), many defects observed at 130 K showed a typical triangular contrast of stacking fault tetrahedra. Ninety-five percent of the defects observed at 130 K were found to be of vacancy type by the 2-1/2 D TEM method. These were annealed to a significant extent at room temperature. Visible vacancy clusters seem only to be formed by overlap of cascades during low temperature irradiation. Small interstitial clusters which remain specimens move to vacancy clusters during the room temperature annealing. At medium fluence, clusters of both vacancy and interstitial types were formed in nickel, while almost all defects were of an interstitial type in copper.

International Conference on Computational Mechanics, Tokyo, Japan, May 25 -29, 1986

Numerical Study on Mixed Boundary Element Solutions for a Transient Convection-Diffusion Equation

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It is very difficult to solve the convection-diffusion equation, when the convective term dominates. Various numerical techniques in domain-type approaches such as the finite difference and the finite element method have been developed to eliminate nonphysically spurious solutions. Particularly in three-dimensional problems, domain-type methods require much more complicated and laborious input-data processing for analyzers. On the other hand, the boundary element method (BEM) which is one of the boundary-type methods effectively reduces the dimensionality of the problem under consideration by one. Hence, as only the surface of the domain should be discretized, input data processing can be done cheaply.

In this paper, a mixed boundary element equation is formulated using mixed boundary elements for solving a transient convection-diffusion equation. Numerical transient solutions for simple two-dimensional models are presented in order to examine the validity and usefulness of the present method. It is shown that these results are stable even at large Courant and diffusion numbers. In addition, the characteristics of mixed elements can also be demonstrated : the reduction of the number of unknowns, explicite consideration of discontinuity of normal fluxes at edges and so on. As a result, the authors found out that no disadvantage exists on the mixed boundary element method in transient convection-diffusion analysis.

7th International Conference on Boundary Element Methods in Engineering, Como, Italy, September 24-27, 1985

A Boundary Element Analysis of TEM Waveguides for Plasma Heating

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TEM waveguides for ion cyclotron radio frequencies plasma heating are analyzed using the mixed boundary element method (BEM) in such a way that we have reasonable geometrical parameters to design TEM waveguides. In this analysis, only the boundary of TEM waveguides is discretized, so that the mixed BEM is superior in input data to domain-type methods, It is also found that the mixed BEM is useful to study the dependence of TEM waveguides on several geometrical parameters. As a result, the important parameter to design TEM Waveguides is the separation between inner conductors. In a three-dimensional analysis, we can confirm the number of elements required to obtain numerical solutions with a high accuracy.

International Conference on Computational Mechanics, Tokyo, May 25-29, 1986

An Analysis of MHD Equilibria of Cylindrical Plasmas Using the Boundary Element Method

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In the present work, the boundary element method is applied to analyze MHD equilibria of cylindrical plasmas surrounded by a metal wall, and the initial equilibria are studied to make use of the iterative scheme in the nonlinear analysis. For this reason, we reduce the governing equation to the scalar Helmholtz equation subjected to Dirichlet's boundary condition, so that the equilibria problems are formulated by using both the conventional and the regular boundary element methods. Comparing boundary elemnt solutions with the exact solutions, we confirm the usefulness of the boundary element method.

Proceedings of the First Shenyang -Sapporo International Symposium on Applied Techniques of Computers

Development of a Robot Language for Microcomputer Systems Using the Technique of Speech Recognition

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A robot language is developed to control an arm robot, where control commands are fed to a microcomputer using human speech. A speech recognition system is constructed using an 8-bit microcomputer and LSIs is used for speech recognition, namely an analogue interface with A/D converter and amplifier is utilized and an LSI for compressing digitalized voice and an LSI for DP (Dynamic Programing) matching is used.

In the process of operating the system, first the voice of an operator is registered in advance for the recognition of a reference voice. External memories are used to store the reference voice pattern and 16 K-bytes memories are used for 128 different patterns.

A real-time interpreter is developed to control an arm robot by spoken Japanese words. With the robot language developed here, we can make the robot take several besic actions. For example, " mae " is to make the hand of the robot move forward and " migi mawari " is to make the arm rotate toward right and oher combined commands to simulate Japanese speech can be used to control the robot.

Proceedings of the First Shenyang -Sapporo International Symposium on Applied Techniques of Computers

Artificial Tactile Sensor for Robotics

T. KAWSHIMA and Y. AOKI

An artificial tactile sensor is proposed which utilizes a combination of pressure-optical and opto-electrical transductions. The sensing system consitst of three layered flexidle pressure sensitive sheets and opto-electrical elements along its edges. Emitted light from one edge is attenuated in the sensitive sheet when an object is applied to the surface. From the measurements of the light intensity pattern at another edge, the projection of the pressure distribution is derived. In this paper, the transduction principle and the performance of the sensor system are described.

Proceedings of the First Shenyang
-Sapporo International Symposium on
Applied Techniques of Computers

SPEECH RECOGNITION AND ITS APPLICATION USING THE DP METHOD

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In this paper, we introduce a DP (Dynamic programing) method for speech recognition. By means of this method, the procedure of recognition becomes comparatively simple so that a rapid response time can be obtained. In addition, because the characteristic vector picked out from input speech is dynamically matched with that of registered patterns, the affect on precion caused by the variety of the speech time for the same word can be reduced. Furthermore, because each pattern is contracted to a length less than 80 bytes the memory locations can be saved and it is also convenient to store the registered patterns into a disk for later use. As a last step we connect the speech recognition board to the host computer and for all practice purposes control a mini-robot by speech input and satisfactory results are obtained. The experiment for recogniging Chinese speech also was done and the distinguish rate is up to 90 %.

Proceedings of the First Shenyang
-Sapporo International Symposium on
Applied Techniques of Computers

A Method of Changing Flow-Chart to PAD Using Adjacent Matrix Techniques

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In this paper a method is presented for graphically and mechanically converting a well used FC (Flow-Chart) representation into a PAD (Program Analysis Diagram). A practical algorithm within the method is proposed that works on a adjancent matrix generated according to a directional graph of a FC diagram. By applying matrix technology to FC and PAD graphs, the method makes it possible to mechanically translate a FC into a PAD representation using computers. As a resutt, the proposed method and the algorithm may apper quite attractive to technicians of computers and other fields in automatic translations from FC to PAD, because of the advantaige of PAD representation in the processes of program analysis and program transplants as well as analyses of other problems.

In this paper, a rough outtim of the PAD concept is described in section I, and the proposed method including the algorithm are depiated in section II. Examples completd by computer with the method are given to illustrate the procedures of the algorithm in section III.

Proceedings of the First Shenyang -Sapporo International Symposium on Applied Techniques of Computers

A Method to Reconstruct 3-Dimensional Shapes and Location of 2-dimensional Shading Information

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A photometric stereo system, which utilizes several 2-dimensional pictures taken by a fixed camera, is one of the possibilities to reconstruct the shape of 3-dimensional objects. However, the problem of how to determine the location of objects has not been well solved. In this paper, we propose a new method to determine the absolute location of the objects using shadow information appearing in the pictures. An experimental system was constructed and the experimental results show that this method can be applied even when the scene the target consists of mutiple objects.

Reprinted from PROCEEDINGS OF IEEE-IECEJ-ASJ INTERNATIONAL CONFERENCE ON ACOUSTICS, SPEECH, AND SIGNAL PROCESSING, April 7-11, 1986

SIGNAL PROCESSING OF HOLOGRAPHIC UNDER-SNOW RADAR WITH A DISTLAYING SYSTEMS OF THREE-DIMENSIONAL INFORMATION

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A new technique to process images of under-snow radar with a displaying system of three -dimensional information is proposed and an experiment to display three-dimensional radar images is carried out with the constructed under-snow radar system. Since the principle of the proposed radar system is holographic imaging radar, a large IC memory system of 256 K byte, which corresponds to $128 \times 128 \times 128$ boxcels, is constructed to store hologram data and reconstructed images, where each memory cell of 128×128 pixcels has 7 bit data corresponding to 128 gray levels of depth information. An experiment to display radar images of the burried objects in snow is done using X-band microwave. Improvement of the resolution of images of under-snow radar is also discussed using the constructed dispaying system.

1985 Nov. 24-26 JOINT SYMPOSIUM
ON ACOUSTICS

A STEREOSCOPIC A-SCOPE DISPLAYING SYSTEM OF ACOUSTICAL IMAGES RECONSTRUCTED FROM ULTRASONIC HOLOGRAMS

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In this paper a memory system is developed to display stereoscopic A-scope images reconstructed from ultrasonic holograms. Using the conventional systems of ultrasonic holography, two-dimensional information of reconstructed images are recorded in IC memories in the proposed system. Since quasi-stereoscopic images can be displayed on CRT scope by changing the point of view in this system, it is convenient to analyze images of low-resolution. A trial system was constructed with video memories of $128\times128\times128$ ($=2$ M) bits, which are controlled by a 16 bit microcomputer. In this experimental system 128 images of 128×128 pixcels are displayed, where depth information of images is displayed with 128 gray levels, that is, the gray levels correspond to the distances of image planes from a fixed point. The experimental results show that the proposed method and constructed system are useful in ultrasonic holography.

PROCEEDINGS OF ISAP '85

AN UNDER SNOW RADAR USING MICROWAVE HOLOGRAPHY

Yuji SAKAMOTO and Yoshinao AOKI
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An under snow radar is required in many fields to detect objects covered by snow. Radar waves that can penetrale snow cover are requied and a high sesolution in a short range is also required. One solution is to use microwave holography.

In this paper, we report an experiment of the under snow radar using microwave holography. The results of experiment shows that the radar has a capability of detecting metalic objects covered by snow.

The Proceedings of 1986 IEEE-Academia SINICA Workshop on Acoustics, Speech and Signal Processing, April, 1986 Beijing, China

IMAGE RECONSTRUCTION OF ULTRASONIC CORPUTED TOMOGAPHY WITH PROJECTED DATA BY PULSE-ECHO TECHNIQUE

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We propose a new tomographic method for reconstructing images from the projections which are obtained by using a A-mode pulse-echo technique. In the proposed method, the pulse echoes of objects placed along the propagation direction of ultrasonic waves are recorded as projections of the objects using the A-mode reflected pulse-echo technique. Here the projections are considered as integration of reflectivity along the circular arc path which center is a transducer. To reconstruct 2-dimensional images, these projections are collected by using a transducer to scan the surronding of the objects. Taking into account the circular arc integration path, the image reconstruction from these projections is conducted by the modified filtered backprojection method proposed here. Moreover pulse-echo compression is done by the wide band chirp signal compression technique which needs less calculation than coventional compression technique.

Tenth Biennial Cornell conference on Advanced Concepts in High Speed Semiconductor Devices and Circuits, Cornell University, Ithaca, NY, U. S. A., July 29-31, 1985.

$(GaAs)_1/(InAs)_1$ Superlattice Semiconductor

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A superlattice semiconductor is a semiconducting monolayer in a several monolayer superlattice whose electronic structure cannot be treated as a combination of two semiconductors described by the effective mass theory.

This paper describes the growth of alternating monolayer of GaAs and InAs ($(GaAs)_1/(InAs)_1$) superlattice by molecular beam epitaxy, which belongs to a new class of semiconductor, superlattice semiconductor.

$(GaAs)_1/(InAs)_1$ superlattice semiconductor was grown on InP substrates with and without AllnAs buffer layer and on GaAs substrates with a GaAs buffer layer. RHEED oscillation was observed and used to calibrate the growth rate.

The grown layer was characterized by X-ray diffraction, optical absorption, and Hall measurements. Satellite peaks observed in X-ray diffraction pattern were comparable with those obtained from GaAs/AlAs structures in terms of intensity and half width.

Second Biennial OMVPE Workshop, Cornell University, Ithaca, NY, U. S. A., August 1-2, 1985.

Electrical Properties of Re-Growth Interface in MOVPE GaAs

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The electrical properties of re-growth interface in GaAs grown by metalorganic vapor phase epitaxy (MOVPE) are characterized for the fabrication of advanced high speed devices.

No dopants were used in this work. Processing during growth interruption was exposure to air or soaking in organic solvent to simulate the photolithography process. Variation of V/III ratio at the suspension and the resumption of growth was carefully eliminated by reducing the arsine flow when TMG flow was stopped.

Most of the samples exposed to air for 3 hours prior to resuming the growth showed carrier accumulation of about 5×10^{11} cm^{-2} at the growth interrupted interface, although carrier depletion was also observed occasionally. This is explained by the states generated by the disorder at the interface.

In samples soaked in acetone prior to resuming the growth, a carrier depletion of about 3×10^{11} cm^{-2} was observed at the re-growth interface. Auger Electron Spectroscopy measurement revealed that the coverage of carbon on the GaAs surface soaked in acetone was 50% more than as-etched surfaces, which suggests that the carrier depletion was caused by carbon contamination.

17th Conference on Solid State Devices and Materials, Tokyo, Japan, August 25-27, 1985

ABSENCE OF SIDE-GATING IN InP MISFET INTEGRATED CIRCUITS

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It is shown that InP MISFETs are virtually free from the side-gating effect under normal dark operating conditions. In order to understand the difference in the side-gating behavior between InP MISFETs and GaAs MESFETs, a detailed study on the surface I-V Characteristics was carried out. It is concluded that the difference is due to the low surface state density in InP.

The second International Conference (Yamada Conference) on Modulated Semiconductor Structures, Kyoto Park Hotel, Kyoto, September 9-13, 1985.

Reflection Electron Diffraction Intensity Oscillation during Molecular Beam Epitaxial Growth of $(GaAs)_n/(InAs)_n$ Superlattice Semiconductor

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Reflection Electron Diffraction (RED) intentity oscillation is a powerfull tool for diagnosing the growth mechanism in situ and gives real time information on the growth process. Here we report RED intensity oscillation at the initial stage of InAs growth on a GaAs substrate where 7% lattice mismatch is present and RED oscillation during growth of $(GaAs)_n/(InAs)_n$ (n=1, 2) superlattice semiconductor on a InP substrate.

RED (12 KV) intensity oscillation in [011] azimuth is observed by an optical fiber connected to a photo-multiplier. For InAs growth on a GaAs substrate, a well defined oscillation is observed up to the second monolayer growth, showing that even with 7% lattice mismatch, InAs grows two dimensionally on GaAs at the initial stage. The period of RED intensity oscillation during growth of $(GaAs)_1/(InAs)_1$ is equal to the time required for the monolayer growth of GaAs and InAs calculated from the qrowth rate. Thus, the RED intensity oscillation can be used to control the growth of alternating one monolayer of GaAs and InAs. The fact that a clear oscillation was observed during growth, in turn, is evidence of a two dimensional growth which is maintained in MBE for a material system whth 7% lattice mismatch.

Successful growth of $(GaAs)_n/(InAs)_n$ (n=1, 2) on InP substrate was confirmed by X-ray diffraction, where no peaks were present other than the noes from the intended structure.

12th International Symposium on Gallium Arsenide and Related Compounds, Karuizawa, September 23-26, 1985

Traveling Wave Interactions in GaAs and AlGaAs/GaAs Layers

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Interaction between semiconductor carrier waves and slow electromagnetic waves is investigated theoretically and experimentally. The theoretical analysis shows that transverse carrier

confinement by application of suitable structures reduces carrier diffusion loss and greatly enhances the interaction. Experimental carrier confinement by a thin GaAs layer and by a selectively doped AlGaAs/GaAs heterostructure both indicate the presence of strong traveling wave interaction.

12 th International Symposium on Gallium Arsenide and Related Compounds, Karuizawa, September 23–26, 1985

Molecular Beam Epitaxial Growth of $(GaAs)_m/(InAs)_n$ Superlattice Semiconductors

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Molecular beam epitaxial growth of $(GaAs)_m/(InAs)_n$ superlattice semiconductors is reported. Elimination of the alloy scattering is expected in such semiconductors, which renders the material attractive as a new material for high speed devices.

$(GaAs)_m/(InAs)_n$ were grown on (100) InP substrates with GaInAs or AlInAs buffer layers and on (100) GaAs substrates with GaAs buffer layers. Growth temperature was $T_s = 450$ C. The growth rate was in a range of 0.2 μm/h to 0.5 μm/h.

Reflection High Energy Electron Diffraction (RHEED) pattern was used to monitor the growth process for $(GaAs)_m/(InAs)_n$ for the first time. RHEED pattern was streaky during the gowth of $(GaAs)_m/(InAs)_n$ (m, $n<3$) indicating a two dimensional growth. The critical thickness, above which three dimensional growth takes place, was estimated from the RHEED intensity oscillation to be approximately 4 monolayers (12 A) for InAs grown on GaAs substrates, which is thicker than that estimated from MOVPE growth.

The successful growth of $(GaAs)_1/(InAs)_1$ and $(GaAs)_2/(InAs)_2$ on InP substrates were confirmed by X-ray diffraction. Note that there are no peaks due to the periodic structures other than the intended ones, indicating that the thickness of each layer is maintained very closely to the designed thickness.

Electrochemical Society Symposium on Dielectric Films on Compound Semiconductors, Las Vegas, Nevada, October 13-18, 1985

"COMMON ANION RULE" IN COMPOUND SEMICONDUCTOR MIS SYSTEMS

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Density distribution and photoionization properties of interface states in GaAs, InP. GaP and InGaAs metal-insulator-semiconductor (MIS) interfaces are investigated on the basis of detailed C-V and photocapacitance transient spectroscopy (PCTS) measurement. U-shaped distributions without any characteristic peaks were observed. Energy location for minimum state density was found to be a characteristic point for each semiconductor. It was found that this location agrees within the error of ± 0.1 eV with the Fermi level pinning position at the metal-semiconductor interfaces, which is known to obey empirically the common anion rule. It is also found that the photon energy dependence of the photoioniztion cross-section is similar for Si, GaAs, InP and GaInAs. The unified defect cannot explain these experimental results. The surface disorder model by the authors are shown to be capable of explaining the experimental observation.

Electrochemical Society Symposium on Dielectric Films on Compound Semiconductors, Las Vegas, Nevada, October 13-18, 1985

EFFECTS OF SURFACE STATES ON DEVICE AND INTERCONNECT ISOLATION IN GaAs MESFET AND InP MISFET INTEGRATED CIRCUITS

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Surface electrical breakdown and side-gating that cause failure of the device and interconnecting isolation are investigated for GaAs MESFET and InP MISFET integrated circuit structures. Striking differences in behavior are observed between GaAs and InP with regards to the surface conduction, surface breakdown and side-gating. These differences are shown to be related to the surface state properties of the insulator-semiconductor interface. In GaAs, high density of surface states rather than the bulk trap state control the surface I-V characteristics and side-gating, causing serious premature avalanche breakdown and triggering side-gating at a low nominal field intensity of 1-3 kV/cm. On the other hand, InP MISFET integrated circuits are virtually free from these premature breadowns and side-gating effects under normal dark operating conditions because of a very low surface state density.

18th IEEE Photovoltaic Specialist Conference, Las Vegas, Nevada, October 21-26, 1985

PROPERTIES OF INSULATOR-SEMICONDUCTOR INTERFACES IN AMORPHOUS SILICON SOLAR CELL STRUCTURES

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It has been accepted that interface states do not play a major role in a-Si surfaces as compared with the bulk gap states. This paper shows for the first time that the electrical characteristics of interfaces are controlled predominantlly by the interface states and not by the bulk gap states.

Detailed MIS C-V and ICTS measurments were done on various passivated a-Si surfaces (SiO_2, Si_3N_4, Al_2O_3 single and double layers by CVD and electrolytic/plasma andization processes), using MIS structures. All the MIS C-V curves show three distinct features that obviously preclude simple straightforwrd interpretation based on the single crystal MOS theory. In order to analyze the measured C-V curves, Losee's admittance analysis of Schottky barriers with many traps, was extended to simulate the MIS C-V curves. It is shown that the measured curves can only be well simulated by including a particular type of high density interface state distribution in addition to gap states. ICTS results also strongly indicated that interface states control the MIS interface properties. Implications of the results to solar cell devices are also discussed.

13th Conference on Physics of Semiconductor Surfaces and Interfaces, pasadena, California, January 28-30, 1986

UNIFIED DISORDER INDUCED GAP STATE MODEL FOR INSULATOR-SEMICONDUCTOR AND METAL-SEMICONDUCTOR INTERFACES

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The energy location for the interface state density, N_{ss}, minimum of the insulator-semiconductor (I-S) interface and the Fermi-level pinning position at the metal-semiconductor (M-S) interface are shown to coincide and to lie at the same position of 5.0 eV from the vacuum level for major tetrahedral semiconductors. Neither the unified defect model or the metal induced gap state model can explain the novel striking correlation between the I-S and M-S interfaces.

The correlation as well as the observed peculiar photoionization behavior of the I-S interface are explained in unified manner by the surface disorder model where the disorder induced gap states (DIGS) pin or restrict the movement of the surface Fermi level. The above characteristic

energy, E_{HO}, is shown to be the Fermi energy of the DIGS spectrum which is given by the hybrid orbital energy of the sp^3 bond of the host.

The DIGS model explains remarkably well the behavior of the the M-S interface formed on the bare or oxide covered surface as well as the various features of N_{ss} distribution of the I-S interface. The correlation between the DIGS-free heterojunction (S-S) interface and M-S/I-S interface is explained by the fact that E_{HO} is a universal reference energy level of the host which is invariant under any off-diagonal interactions, as in evidenced by the alignment of transition metal deep levels, DX centers and EL2 with respect to E_{HO}. Band offset at the S-S interface is proposed to be determined by the alignment of E_{HO} Which inevitably involves formation of interface dipole when two E_{HO} levels lie at different positions from the vacuum level.

22nd Annual International Workshop on Compound Semiconductor Microwave Materials and Devices, San Francisco, California, February 10-13, 1986

Unified Modeling of Insulator-Semiconductor and Metal-Semiconductor Interfaces Based on Disorder Induced Gap States

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It is shown that the energy point E(min) for interface state density minimum at insulator -semiconductor(I-S) interface and the Fermi level pinning position E (pin) at metal(Au) -semiconductor (M-S) interface lie at the same point of -4.9 ± 0.1 eV from the vacuum level for major tetrahedral semiconductors. The correlation is explained by a newly proposed unified disorder induced gap state (DIGS) model for I-S and M-S interfaces. In this model, deposition of insulator or metal introduces a DIGS spectrum at the semiconductor surface. E(min) and E (pin) correspond to the Fermi energy of the DIGS spectrum which is determined by the hybrid orbital energy E_{HO} of the sp^3 bond. Schottky barrier heights as well as other features of I-S and M-S interafces can also be explained by this model in a unified manner.

Electrochemical Society Symposium on Compound Semiconductor Science and Technology, National Tsing-hwa University, Tsing-hwa, Taiwan, R. O. C., March 10-11, 1986

INSULATOR-SERICONDUCTOR AND METAL-SEMICONDUCTOR INTERFACES IN COMPOUND SEMICONDUCTOR LSI TECHNOLOGY

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This paper reviews the present status of understanding and control of insulator-semiconductor and metal-semiconductor interfaces as related to the rapidly growing compound semiconductor LSI technology. New remarkable correlations between these two interfaces is pointed out, and is explained by the authors'unified disorder-induced gap state (DIGS) model. Effects of surface states on device performance and packing density are discussed. Necessity of a scientifically optimized insulator-semiconductor technology is emphasized for further progress of compound semiconductor LSI/VLSI technology. A concept of the interface control layer(ICL) is discussed in this regard.

Electrochemical Society Tutorial on Compound Semiconductor Science and Technology, National Cheng Kung University, Tainan, Taiwan, R. O. C., March 10-11, 1986

Process and Analysis of AlGaAs/GaAs Heterostructures

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Processing and analysis of AlGAaAs/GaAs heterostructures are reviewed and key issues are discussed in detail. In particular, it is proposed that the alignment of the hybrid orbital energy, E_{HO}, is required at the heterojunction interface. The locations of E_{HO} are tabulated for AlAs, GaP, GaAs, InP and InAs. The matching of E_{HO} reproduces the valence band discontinuity observed experimentally remarkably well. An interpretation based on a simple thermodynamic consideration is given to explai the reason why matching of E_{HO} is required at the heterojunction interface, which involves inevitable formation of interface dipole as opposed to Tersoff's quantum dipole theory.

Workshop on Compound Semiconductor Integrated Circuits, Visby, Sweden, May 5-7, 1986

Unified DIGS Model for Metal-Semiconductor and Insulator-Semiconductor Interfaces

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The energy point E(min) for interface state density minimum at the insulator-semiconductor (I-S) interface and the Fermi level pinning position E(pin) at the metal (Au)-semiconductor(M-S) interface lie at the same point of -4.9 ± 0.1 eV from the vacuum level for major tetrahedral semiconductors. A unified disorder induced gap state (DIGS) model for I-S and M-S interfaces is proposed which explains this correlation as well as other features of I-S and M-S interfaces. Deposition of an insulator or metal introduces a DIGS spectrum at the semiconductor surface. E (min) and E(pin) correspond to the Fermi energy of the DIGS spectrum which is determined by the hybrid orbital energy E_{HO} of the sp^3 bond.

4th Conference on Semi-Insulating III-V Materials, Hakone, Japan, May 18-21, 1986

On the Alignment of Transition Metal Impurity Levels in III-V Compound Semiconductors

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The difficulty in previous deep level research is related to the lack of energy reference. Hasegawa-Ohno's hybrid orbital energy E_{HO} is shown to serve as a usiversal reference energy for transition metal(TM) deep levels. Viewed from E_{HO}, each TM energy lelel E(TM) in III-V and II-VI compound semiconductors satisfies a simple relation of $E(TM)=E_{HO}\pm(m+1/2)$ E with $m=0, 1, 2, \ldots$ and $E=0.24$eV. the vacuum level pinning of TM levels is not generally obeyed. The new level scheme reproduces the experimental heterojunction band line-up. A new picture for deep levels including lattice relaxation is suggested.

Workscop on Dielectric Systems for Compound Semiconductors-1986, Half Moon Inn, San Diego, CA, U. S. A., June 17-18, 1986.

Correlation between the insulator-semiconductor interface and Schottky barrier heights and the unified disorder induced gap state model

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It is found that a striking correlation exists between the pinning position E(pin) at metal-semiconductor (MS) interfaces and the location of the interface state density minimum E(min) at insulator-semiconductor (IS) interfaces in major semiconductors. Both E(min) and E(pin) lie at the same energy position which is the hybrid orbital energy, E_{HO}, of the host crystal. E_{HO} lies at -5.0 eV from the vacuum level for the major III-V semiconductors, and hence E(min) and E(pin) also lie at the same position from the vacuum level. The correlation can consistently be explained by the unified disorder induced gap state (DIGS) model of the MS and IS interface.

1986 Electronic Materials Conference, University of Massachusetts, Amherst, MA, U. S. A., June 25-27, 1986.

Correlation between the location of interface state minimum at insulator-semiconductor interface and Schottky barrier height

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A correlation between the energy location of the minimum density of the interface states in insulator-semiconductor systems and the location of the Fermi level pinning in metal-semiconductor systems is reported. The correlation extends over the major III-V semiconductors, which can be explained by the surface disorder model. The unified defect model is not capable of explaining the present correlation.

1985 International Symposium on Antennas and Propagation (ISAP 1985), August 20-22, 1985, Kyoto, Japan

ADAPTABILITY EXPERIMENTS OF SATELLITE BROADCASTING ANTENNA SYSTEMS IN SNOWY DISTRICTS

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In Japan, a direct broadcasting satellite was launched in January 1984. Several elctric manufacturers are produceing a home receiver sets for satellite broadcasting. At present, an offset parabolic antenna is mainly employed for the receiving antenna. In snowy districts, however, we often have difficulty in receiving owing to snow accumulation on the antenna. On the other hand, a planar antenna has the advantage that it is hardly affected by the snow accumulation. This paper describes the problems of a parabolic reflector antenna in snowy districts, together with the advantage of a planar antenna and adaptability experiments of satellite broadcasting antenna systems in snowy seasons. It is seen that the picture is degraded seriously owing to the snow deposits. Also, it was observed that the wet snow remains on the primary radiator of the offset parabolic antenna. This caused the degradation of the picture quality.

1985 International Symposium on Antennas and Propagation (ISAP 1985), August 20-22, 1985, Kyoto, Japan

A PROPOSAL OF A HIGH-SPEED SCANNING ADAPTIVE SUPERRESOLUTION ARRAY

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An adaptive superresolution array (SRA) is used for pinpointing signal sources. However, it has been reported that the SRA performance deteriorates seriously when the scanning is rapid. This paper analytically derives the behavior of a scanned Howells-Applebaum (H-A) adaptive superresolution array in a steaby-state after convergence. We assume that the steering signal in the H-A loop is scanned in time to observe signal source locations. First, we study the causes of degradation of the scanned SRA performance at a high scanning rate. Second, we derive the conditions for the low pass filter in an H-A loop that gives a superior SRA performance even at a high scanning rate. Finally, we propose a new filter configuration with which the preceding conditions are satisfied, and we may obtain the better SRA performance and lower loop noise.

1985 International Symposium on Antennas and Propagation (ISAP 1985), August 20-22, 1985, Kyoto, Japan

RECTENNA COMPOSED OF A CIRCULAR MICROSTRIP ANTENNA

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" Rectenna", the Earth Station Terminal in the Solar Power Satellite (SPS) system converts the microwave power (2. 45GHz) transmitted from SPS into DC. The structure of the rectenna is divided roughly in two parts, namely, the receiving antenna and rectifying circuit. We propose the use of a circular microstrip antenna (CMSA) as a competitor to the linear antenna for the rectenna in the SPS system, since the CMSA has no higher resonance harmonics of integer multiples of the dominant resonace frequency. This paper is concerned with absorption efficiency of the rectenna composed of the CMSA. The efficiency is estimated explicitly using an infinite array model. It is concluded that the absorption efficiency of the infinite rectenna array composed of the CMSA is 100%. The results indicate the possibility of realization of the very thin rectenna which uses the CMSA as the receiving antenna.

1985 Internatinal Symposium on Antennas and Propagation (ISAP 1985), August 20-22, 1985, Kyoto, Japan

REFERENCE SIGNAL GENERATION IN AN LMS ADAPTIVE ARRAY FOR MULTIPATH FADING REDUCTION

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An LMS adaptive array may reduce the multipath fading effectively for any correlation coefficient between multipath signals when a reference signal is generated properly. In this paper, we obtain the required synchronization accuracy in the reference signal generation and we propose a processor configuration which generates a reference signal. It is shown that the synchronization is the reference signal generation must be extremely accurate when the input multipath components are correlated with one another. The reference signal generation consists of two parts identical to the synchroization process in a spread spectrum receiver. One is acquisition and the other is tracking. The acquisition process makes the reference signal coincide with the received signal within a clock pulse duration. The tracking circuit operates in such a way that the reference signal coincides with the transmitted pilot signal as precisely as possible. The numerical results indicate that the proposed circuit generates a adequate reference signal.

JIMIS-4 Grain Boundary Structure and Related Phenomena 1985, 11, 25-29

ELECTRICAL CONDUCTION IN HEAVILY DOPED POLYCRYSTALLINE SILICON FILM

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Carrier densities and Hall mobilities were measured in As heavily doped polycrystalline silicon CVD films which were annealed at high temperatures to stabilize the grain size, followed by annealing at low temperatures for segregation of deped atoms. The grain boundary segregation and the dependence of electrical conduction on terperature and grain size were examined. The density and property of disturbed lattice sites in a grain boundary differed among films with various grain size. The analysis by McLean isotherm gave the segregation enthalpy of 0.4−0.7eV. Barriers against electrical conduction form in grain boundaries. The resistivity of grain boundary was estimated to be $5\times10^{6}-5\times10^{7}$ Ωcm at room temperature assuming that its width was 10 Å.

Fifth Engineering Foundation Conference on Fluidization, May 18-23, 1986, Elsinore, Denmark.

Gasification of a Sub-bituminous Coal in a Two-stage, Jet-pouted Bed Reactor

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The application of the spouted bed technique to a coal gasifier was studied in a laboratory scale apparatus. The experiments were carried out using a jet-spouted-bed reactor and a conventional spouted-bed reactor. Both of these reactors had two particulate beds, one above the other. The fractional conversions of carbon were 0.60 to 0.88 over a temperature range of 1,000 K to 1,300 K under atmospheric pressure. Gases produced had calorific values up to 11 Mj/m^3.

Japan-China Symposium on Coal and C_1 Chemistry, Taiyuan, China, Sept. 1985

Overview of Coal Research in Japan

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The present status of PDU studies on coal liquefaction, gasification and of basic reseraches on coal in japan was overviewed.

Japan-China Symposium on Coal and C_1 Chemistry Taiyuan, China, Sept. 1985

Reaction Mechanism of Coal Hydrogenation (IV), Effect of Catalyst Type

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Taiheiyo Japanese coal was hydrogenated in naphthalene and tetralin under 10 MPa hydrogen pressure using 3 types of catalysts with varying activity; stabilized nickel, iron dust obtained from steel making converter plus sulfur, and cobalt-molybdenum on alumina support. In naphthalene conversion (pyridine soluble) and hydrogen consumption were proportional with catalyst activity, namely Ni>Fe>Co-Mo>no catalyst. In tetralin conversion and hydrogen consumption were in the same order as in naphthalene, and the ratio of the amount of hydrofen transfered from tetralin also had a similar tendency. This result supports the fact that the catalyst accelerates the direct hydroqenation of coal by gaseous hydrogen.

The Third IUPAC Symposium on Organometallic Chemistry Directed toward Organic Synthesis, Kyoto, Japan July 11-15, 1985

Organoboron Compounds in New Synthetic Reactions. A Novel Synthetic Method for Stereodefined Conjugated Alkadiene Structures (Invited Lecture)

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A general and convenient method for the stereo-and regiospecific synthesis of conjugated alkadienes, alkenynes, arylated alkenes, and other olefinic compounds was presented. The reaction of (E)-or (Z)-1-alkenyl-disiamylboranes, or 2-(E)-1-alkenyl-1,3,2-benzodioxaboroles readily obtainable by hydroboration, with either (E)-or (Z)-1-alkenyl halides in the presence of a catalytic amount of tetrakis(triphenylphosphine)palladium and bases such as sodium alkoxides

gives the corresponding (E.E)-, (E.Z)-, (Z,E)-, and (Z,Z)-conjugated alkadienes stereo-and regiospecifically. The reaction proceeds through retention of the configuration of both the starting alkenylboranes and haloalkenes. The reaction of (E)-and (Z)-1-alkenyldisiamylboranes with haloalkynes similarly provides a stereo-and regiospecific synthesis of conjugated (E)-and (Z)-alkenynes. A mechanism of this cross-coupling, which involves the transmetallation between a 1-alkenylborane and an alkoxopalladium(II) complex generated through the metathetical displacement of a halogen atom from RPd(II)X with sodium alkoxide, is proposed. The versatility of this method was demonstrated by the stereospecific synthesis of various natural products bearing conjugated alkadiene or alkenyne structures.

The Third IUPAC Symposium on Organometallic Chemistry Directed toward Organic Synthesis, Kyoto, Japan. July 11-15, 1985

Palladium Catalyzed Cross-Coupling Reaction of (2-Ethoxyethenyl) boranes with Ortho Functionalized Aryl Halides. A Novel and Convenient Synthesis of Benzo-fused Heteroaromatic Compounds

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Ortho functionalized styryl ethers can be synthesized in high yields by the cross-coupling reaction between tris(2-ethoxyethenyl)borane or B-(1-ehoxy-1-alken-2-yl)-1,3,2-benzodioxaborole with ortho-functionalized aryl halides in the presence of 3 mol% of tetrakis (triphenyphosphine)palladium and sodium hyroxide. Ortho amino-, acetoamino-, and methoxymethoxy styryl ethers thus obtained were readily converted into benzo[b]pyrroles or its acetyl derivatives, and benzo[b]furanes in high yields by cyclodehydration.

The application of the present reaction to the synthesis of an isoquinoline alkaloid, sendaverine, was also discussed.

The XIIth International Conference on Organometallic Chemistry, Vienna, Austria, September 8-13, 1985

New Application of Organoboron Compounds in Organic Synthesis. Haloboration Reaction (Invited Lecture)

Akira SUZUKI
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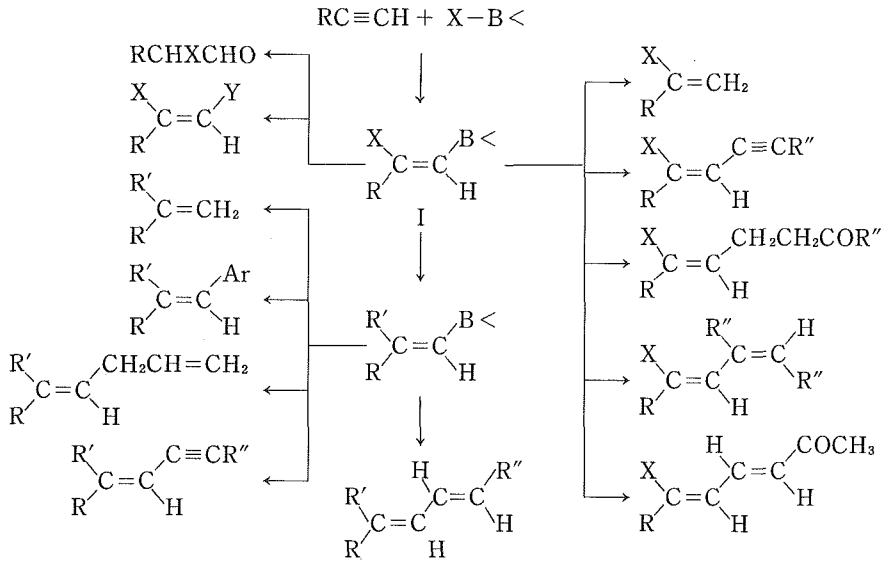
This paper describes the haloboration reaction of 1-alkynes and its application to organic synthesis. B-Bromo-or B-iodo-9-borabicyclo[3.3.1]nonane (B-X-9-BBN) and other halo-

boranes react with 1-alkynes through Markovnikov cis addition of the X-B moiety to C≡C bonds. The haloboration occurs chemoselectively at terminal C≡C, but not at internal C≡C, terminal and internal C=C bonds. The haloboration adducts (I) thus obtained are valuable intermediates to afford various organic compounds stereospecifically in good yields, some of which are shown below.



The XIIth International Conference on Organometallic Chemistry, Viena, Austria. September 8-13, 1985

Palladium-Catalyzed Cross-Coupling Reaction of 1-Alkenylboranes with Organic Halides in the Synthesis of Natural Products

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The reaction of (E)- or (Z)-1-alkenylboranes readily obtainable by hydroboration, with either (E)-or (Z)-1-alkenyl halides in the presence of a catalytic amount of palladium catalyst and base gives the corresponding (E,E)-, (E,Z)-, (Z,E)-, or (Z,Z)-conjugated alkadienes stereo and regiospecifically, while retaining the configuration of haloalkenes. The versatility of the present reaction was amply demonstrated by the stereospecific synthesis of natural products bearing conjugated and 1,4-alkadiene structures, e.g., bombykol and its three isomers, trans (C_{10})-allofarnesene, humulene, and trisporol B.

The 3rd Japan-Korea Seminar on Organic Synthesis and the 5th Symposium on Organic Chemistry of the Korean Chemical Society, Dae-Jeon, Korea, February 10-12, 1986

Some Aspects of Organic Synthesis Using Organoboron Compounds
(Invited Lecture)

Akira SUZUKI
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Hokkaido University, Sapporo 060, Japan

This paper describes the recent advances of haloboration reaction and the cross-coupling reaction of vinylic boranes with a variety of olefinic halides which have been discovered in our laboratory.

International Conference Science of Ceramics
13 Orleans, France, September 9-11, 1985.

A New Compound in the Ternary system, Li_2O-TiO_2-Nb_2O_5

Shiro SHIMADA, Chihiro KAWAI, Kohei KODAIRA
and Toru MATSUSHITA
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A new compound was found to be formed around the composition Li : Ti : Nb=19 : 10 : 12 in the system Li_2O-TiO_2-Nb_2O_5 by reaction at 1100℃ for 2-120 hrs in air between Li_2CO_3, TiO_2 and Nb_2O_5. This compound was also produced by the reaction of $LiNbO_3.0.5TiO_2$ with Li_2TiO_3. Single crystals of the compound were grown using a Li_2MoO_4 by the flux method. The crystals were shown to possess a hexagonal symmetry with lattice parameters of $a_o=8.89$ A and $c_o=55.10$ A by a Weissenberg film.

8th International Conference on Thermal Analysis. August 19-23, 1985, Bratislava, Czechoslovakia

Thermal Characterization of Iron Oxide and Aluminum Oxide Powders by Emanation Thermal Analysis

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Emanation thermal analysis (ETA) using a surface impregnation method by Ra-226 solution was applied for the thermal characterization of iron oxide and aluminum oxide powders with various preparation histories in the heating and grinding treatments. The stages of Rn-222 gas release during a linear temperature increase were broadly grouped into two parts according to the temperatures of 40-50% of melting temperature (K) of powders. The effects of the heating and grinding treatments on the characteristic ETA peaks were very complicated, but ETA technique was an interesting tool in the study on the thermal behaviors of near-surface of powders under the working state at high temperatures.

International Conference on Coal Science ,Sydney, Australia, Oct. 1985

Chemical Structure of Taiheiyo Coal; Analysis of Oil Obtained from Mild Hydrogenation of Coal

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Taiheiyo coal (77%C, daf, Japanese) was hydrogenated under mild conditions to preserve the original cluster structure of parent coal as far as possible. The n-hexane soluble (yield; 49.8wt% daf coal) was washed with acid and base, Then the neutral materials were separated into 7 fractions by vacuum distillation. The first six fractions were separated by liquid chromatography to hydrocarbon classes and each subfraction was analysed by GC and GC/MS.

Tenth International Congress of Heterocyclic Chemistry, Waterloo, Canada, August 11–16, 1985

Replacement of a Carbonyl Group of Cyclic Ketones by a Hetero Atom: A New Method for the Synthesis of Cyclic Ethers, Cyclic Amines, and Cyclic Sulphides

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Department of Chemical Process Engineering,
Hokkaido University, Sapporo 060, Japan

We Set out to describe a new versatile method for transforming five- to seven-membered cylcic ketones as starting materials into cylcic ethers, cyclic amines, and cyclic sulphides with the same ring size *via* 4 to 5 steps: Baeyer-Villiger oxidation of a steroidal ketone to a lactone followed by its reduction with DIBAL or by treatment with methyllithium gives the corresponding lactol. The irradiation of the hypoiodite generated *is situ* by means of the reaction of the lactol by an excess of mercury (II) oxide and iodine in benzene gives an iodo formate arising from a regiospecific β-scission of the C–C bond. These formates can readily be transformed into cyclic ethers, cyclic amines, and cyclic sulphides *via* 1 or 2 steps in good overall yields.

XIIth International Conference on Photochemistry, Tokyo, August 4-9, 1985

A New Photochemical Rearrangement of a α,β-Unsaturated Ketone Oxime

Hiroshi SUGINOME, Makoto KAJI, Toshiharu OHTSUKA,
Shinji YAMADA and Akio FURUSAKI *
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Hokkaido University, Sapporo 060, Japan
* Department of Chemistry, Faculty of Science,
Hokkdido University, Sapporo 060, Japan

The photo-rearrangement of excited oximes to lactams has been well documented. As part of our program to explore the potential of the photoreaction for organic synthesis, we have investigated the photoreaction of several steroidal α,β-unsaturated oximes. We found that the irradiation of 5α-cholest-1-en-3-one oxime in methanol afforded a product for which an isoxazoline structure was then established by an X-ray crystallographic analysis.

The mechanism of this novel stereospecific photo-rearrangement is discussed.

" New Trends in the Photocochemistry of Polymers " 26-29 August, 1985 Stockholm, Sweden

Effect of Mechano-radicals to Photodegradation

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All polymer materials undergo mechanical processing, such as extruding or pressing, before their use. Samples used for photochemical experiments also experience a mechanical process if in a pellet shape. It has been established that main chains are scissioned by such a mechanical force and the mechano-radicals initiate chemical reactions at higher temperature in a processing machine in presence of air. Ketons and other oxidized compounds formed by the mechano chemical reactions may play an important role as a chromophore which was not contained in the material before the processing. Formations of mechano-radicals in extruders were proved by the spin trapping action of a hindered amine light stabilizer (HALS). An acceleration of photo-degradation was observed after the processing.

1 st SPSJ, International Polymer Conference, Kyoto Japan, Aug. 20-24, 1984.

Ferroelectric Transition in Vinylidene Fluoride-Trifluoroetylene Copolymer Studied by the Nuclear Magnetic Resonance Method

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Hokkaido University, Sapporo 060, Japan

NMR abnorption lines for a uniaxially drawn film of vinylidene fluoride-trifluoroethylene copolymer were measured as a function of the alignment angle γ between the drawn axis and the magnetic field over a temperature range from 23 to 130℃.

Above the Curie temperature, the second moment decreased markedly owing to the chain motion accompanying conformational changes from the all trans sequence to the combination of TG^+, TG^-, T_3G^+ and T_3G^- groups. The remarkable γ dependence of the line shape as well as the line width observed in the paraelectric phase may be interpreted by a one-dimensional diffusion motion of conformational defects.

3rd International Conference on Chitin/
Chitosan, Senigallia (Ancona) Italy,
Apr. 1-4, 1985.

Molecular Motion and Dielectric Relaxation in Chitin and Acylchitins

Maeko KAKIZAKI, Takehiko SHOJI, Akihiro TSUTSUMI
and Teruo HIDESHIMA
Department of Applied Physics, Faculty of Engineering,
Hokkaido University, Sapporo 060, Japan

Broad-line NMR and dielectric measurements were made on chitin, acetylchitin, butyrylchitin, caproylchitin and caprylchitin. Temperature dependence of NMR second moment shows motional narrowing at ca. −20℃ for all the samples and below+100℃ for the samples with longer side chain than acetylchitin. Temperature dependence of loss permittivity at 1kHz shows only one peak for chitin and acetylchitin whereas it shows two peaks for other samples. The NMR and dielectric processes are designated as β and γ in the order of the descending temperature. The correspondence between the NMR and dielectric processes are clearly shown on a relaxation map. These processes seem to be very similar to the β and γ processes in poly (n-alkyl methacrylate)s. The difference in the frequency-temperature position of the β relaxation between the two series of polymers may be due to the difference in the molecular structure of the main and side chains.

The 6th International Conference on Science
and Technology of Synthetic Metals Kyoto,
Japan, June 2-6, 1986

ESR STUDY OF CONFORMATIONAL DEFECTS IN POLYPHNYLACETYLENE

Masayoshi TABATA, Toru MATSUURA, Satoshi OKAWA,
Junkichi SOHMA and Kazuaki YOKOTA
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Engineering, Hokkaido University, Sapporo 060, Japan

Electron spin resonance (ESR) study of conjugated polymer; polyphenylacetylene (PPA) was performed to determine the mechanism for increase of the spin concentration of PPA induced by heat treatment and doping. The radical concentrations of PPAs prepared with Ziegler and WCl_6 catalysts were found to be induced by the heat treatment from room temperature to 220℃. The ESR spectra of both the polymers observed at 220℃ showed hyperfine structures with more than twenty six lines. This fine structure was explained in terms of conjugated radical called soliton stabilized on this aromatic conjugated polymer chain.

International Symposium on Opto-Electronic Imaging, New Delhi, India, December 2-5, 1985

Opto-Electronic Techniques for Image Reconstruction from Projections

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The principle of image reconstruction from projections has been widely applied to the measurement of a three-dimensional objects in astronomical observation, interferometric phase mapping, X-ray tomography, non-destructive testing, and electron microscopy etc. The image is usually reconstructed from projection data by means of a digital computer as typically seen in X-ray computerized tomography. Besides digital methods for image reconstruction, optical analogue methods have also been proposed. These methods possess some promising properties such as high resolutin power, cost reduction etc. In the present paper, opto-electronic hybrid techniques for image reconstruction from projections are reviewed and discussed. Emphasis is placed on the opto-electronic image reconstruction techniques for X-ray axial tomography, which were developed in our laboratory. The technique can be effectively used for other practical applications of image reconstruction from projections.

OSA Topical Meeting on Holography, Honolulu, Hawaii, U. S. A., March 31 -April 2, 1986

Optimized Holographic Scanner with Diode Lasers

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Sapporo 060, Japan

Diode lasers are compact and potentially reliable for wide uses of digital audio disks. It is desirable to apply a holographic grating scanner on dichromated gelatin (DCG) at a wavelength that is different from the readout wavelength of diode laser because DCG suitable for a volume -phase holographic optical element (HOE) is insensitive to exposures at red light. The major problems associated with applying this HOE are that the aberration due to a recording-readout wavelength shift actually exists and that the scan spots diffracted from scanner at different aperture inputs are adversely influenced by the aberration.

This paper provides a general design of a transmission-type holographic scanning method with a diode laser to reduce the aberration by using two-step optimization techniques; the first step of modified Maréchal method of aberration balancing is used as the initial assumption of the

second step and the second step is used as the damped least-squares method. The desired holographic scanner is constructed with a diffracted optimum aspheric wavefront from a computer -generated hologram. Typical experimental results are shown.

OSA Topical Meeting on Signal Recovery & Synthesis II, Honolulu, Hawaii, U. S. A., April 2-4, 1986

Iterative Restoration of Images with Missing High-Frequency Components Using Adaptive Regularization

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Sapporo 060, Japan

The problem of restoring the details of bandlimited images of spatial finite extent or recovering the missing high-frequency components has recently been discussed extensively. Since the present problem is ill-conditioned, certain types of regularization techniques are required. Moreover, some types of *a priori* information or constraints are used to overcome the ambiguity and instability of the solution. We investigated the restoration of low-pass filtered images in the presence of noise by an iterative regularized pseudoinveres (RPI) method. In this method we used the adaptive regularization tcehnique in addition to *a priori* information regarding the non -negativity and finite extent of the object. We presented some results of computer simulations which demonstrate the optimum type of adaptive regularization and the effectiveness of the iterative RPI method for noisy data.

The 13th Congress of the International Commission for Optics, Sapporo, Japan, August 20-24, 1984

Image Reconstruction from X-Ray Projections Using Optical and TV Systems

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Shigeatsu Yamaguchi
Department of Radiation Technology, College of Medical Technology,
Hokkaido University,
Sapporo 060, Japan

An image processor that reconstructs an object from its X-ray projections has been developed. By rotating an object over 180°, the projection data are recorded with an image intensifier-video

system and stored on a video recorder. The projection data over 180° are then displayed sequentially on CRT and photographed on a moving film through a slit. The back projection process is performed by a cylindrical lens. A ρ-filtering is accomplished by means of the OTF synthesis method, in which two statistical low-pass filters are used in the pupil plane of the cylindrical lens. The back projected images produced by incoherent optical filtering are taken by TV camera and stored in a digital frame memory. The ρ-filtered back projection is obtained by subtracting one image from the other. The image addition of these ρ-filtered back projections over 180° reconstructs an image of the object. Some experimental results for the reconstruction of some phantoms are presented.

The 13th Congress of the International Commission for Optics, Sapporo, Japan, August 20-24, 1984

Volume Holographic Optical Elements Designed by the Least-Squares Method

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This paper describes design techniques of a reflection holographic lens to reduce the aberration at large field angles and of two types fo reflection holographic scanners with curvature-corrected linearized scan at wide scan angles by using the least-squares method. The phase function required to the aberration-reduction imagery is defiend as the sum of a spherical wavefront and a nonspherical wavefront. Input rays forming a polar array through flat HOEs are raytraced to the image or flat-field scanning planes depending on the field or scan angles. The merit function consists of a weighted mean-square spot radius at the desired image plane with respect to the field or scan angles. The merit function, that describes the state of correction of HOEs, is used to render the gyration radius of the spot diagram corresponding to each ray input to be held at a minimum during the least-squares optimization. The designing theory is supported by the experimental results.

The 13th Congress of the International Commission for Optics, Sapporo, Japan, August 20-24, 1984

Image Restoration by an Iterative Approximate Wiener Filtering Method

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Sapporo 060, Japan

We investigated a new digital restoration procedure, the iterative approximate Wiener filtering (AWF) algorithm, to restore noisy degraded images. Although the conventional Wiener filtering method has long been used as an image restoration technique, it has two drawbacks: (1) Inadequate (too smooth) restoration for low-SNR degraded images and (2) unavailableness of the additional constraints. Since the noise-to-signal power spectral density ratio involved in the Wiener filter is frequently not known, this ratio is sometimes approximated by a suitable constant. We call this the approximate Wiener filter. The proposed method is the iterative version of the AWF which was constructed based on the principle of damped least squares. We employed the additional constraints of nonnegativity of the object and median filtering to reduce the effect of noise. As a result, the drawbacks of Wiener filtering were removed and the proposed algorithm becomes significantly noise tolerant. The iterative AWF method also has an advantage of dealing with the wide range of degradations, including space-invariant and space-variant degradations, because our technique can be implemented in both spatial and Fourier transform domains.

The 13th Congress of the International Commission for Optics, Sapporo, August 20-24, 1984

Measurement of the Focal Length of a Lens Using the Moiré Technique

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Kazumi MURATA
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In measuring the focal length of a lens, the nodal slide and Bessel method etc are generally used. Moreover it is difficult to test a lens with a long focal length. In this paper we propose a simple method for measuring the focal length of a lens by using the moiré technique and Talbot

effect. A Talbot interferometer is constructed with two gratings, in which the moiré fringe is generated by superimposing the Talbot image of the first grating on the second. The test lenses are placed in front of two gratings. The principle of the method and some experiments are described.

The 13th Congress of the International Commission for Optics, Sapporo, Japan, August 20-24, 1984

Wide-Viewing Rainbow Hologram

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A new method for making a wide-viewing rainbow hologram is described. A cylindrical rainbow hologram is made by using a large cylindrical master hologram and some unique mirror elements. The viewing zone of a rainbow hologram is limited by the size of a master hologram and the slit. We propose a cylindrical rainbow hologram to widen the horizontal viewing zone.

The 13th Congress of the International Commission for Optics, Sapporo, Japan, August 20-24, 1984

Measurement of the Phase Distribution with a Sinusoidally Modulated Holographic Filter

Shun-ichi KAMEMARU and Kazumi MURATA
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Hokkaido University,
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This paper describes the measurement of phase distribution by using a holographic differentiation filter with a hybrid optical/digital system. The filter, on which the moiré pattern is recorded, is shifted in the spectrum plane by a quarter of a period of the moiré fringe to produce the irradiance distributions of an image which is approximately linear to the phase derivative of the object.

5th International Conference on Lasers and their Applications, Dresden, GDR, October 28-November 1, 1985

Laser Beam Wavefront Converters Using Hologram Filters

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In various laser applications such as optical testing, optical data processing, laser projection or optical radar, it is necessary to use a collimated laser beam. In this paper we describe two types of wavefront converters consisting of computer-generated hologram (CGH) filters to obtain a desired collimated wavefront. First, a set of two CGH filters for an afocal system is developed to convert the collimated Gaussian intensity profile into a uniform one. Second, a CGH is made to correct the aberrated wavefront reflected by an off-axis concave spherical mirror.

China..Japan Bilateral Symposium on the Synthesis and Materials Science of Polymers, Beijing, China, Oct. 21-24, 1984.

Relaxation Spectroscopy of the Side-Chain Relaxation in Poly(γ-n-alkyl-L-glutamate)s

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The relaxation spectra for the β-relaxation due to the motion of the side-chain in PnALG having the groups of methyl, ethyl, n-propyl and n-butyl were determined by dielectric and NMR measurements. The loss permittvity from 10^{-4} to 10^{-1} Hz was determined from the absorption current, while that from 10^{-1} to 10 Hz and that from 30 to 100kHz were measured with a bridge -type apparatuses. The narrowing regions of second moment vs. temperature plot are found to fall on the straight lines drawn through the loci of loss permittivity peaks. The dielectric relaxation spectra are quite similar to each other. The correlation spectra are quite similar in shape to each other and to that of the dielectric relaxation spectrum. The shape of the spectra for PnALG is the same as that of the dielectric relaxation spectra for the β-relaxation in poly(n-alkyl methacrylate)s which is also independent of the side-chain length.

Japan-U. S. Polymer Symposium Kyoto Japan, Oct. 29-Nov. 1, 1985.

ESR Study of Spin-Labeled Poly (L-leucine) in Benzene Solutions

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ESR study of poly(L-lencine)-benzene solution ranging in concentration from 0.1to 6.0wt% by spin-labeling technique was carried out in a temperature range from 25 to 90℃. The order parameter estimated from the ESR spectra of these samples shows highly anisotropic motion of radicals in that temperature range and changes remarkablly around 50 and 70℃. These temperatures correspond to temperatures of gel-sol transition, suggesting the existence of two kinds of gel states in these samples. The process of the gelation is analysed by the treatments proposed by Ziff et al.

I st SPSJ, International Polymer Conference, Kyoto Japan, Aug. 20-24, 1984.

Nuclear Magnetic Relaxation of Polypeptides in Solutions

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Bruno Perly and Claude Chachaty
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Centre d'Etudes Nuclaires de Saclay, 91191
Gif sur Yvette Cedex, France

In order to study the dynamic properties of polypeptides in solutions, H-1 and C-13 magnetic relaxations were measured for poly (L-histidine) (PLH) and poly (N-ε-hydroxyethyl L -glutamine) (PHEG) in aqueous solutions. The spin-lattice relaxation time was measured using spectrometers operating at the frequencies 15, 20, 23, 25, 63 and 100MHz for C-13 and 60, 100 and 400MHz for H-1. The temperature was varied from 5 to 95℃.

The spin-lattice relaxation time depended markedly not only on the temperature, but also on the frequency. These results were analysed using the theory of the nuclear magnetic dipole-dipole relaxation for a molecule undergoing multiple internal motions superimposed on the overall motion. It was found that a rapid segmental motion occuring in the backbone chain and the model of the internal motion around the side chain bonds were random jumps between 2 or 3 sites.

I st SPSJ, International Polymer Conference, Kyoto Japan, Aug. 20-24, 1984.

Mechanical Relaxations of Poly (vinylidene fluoride) and its Related Polymers

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From torsional stress relaxation measurements on two kinds of poly (vinylidene fluoride) (PVDF) and a copolymer of vinylidene fluoride (VDF) and tetrafluoroethylene (TFE) between −80℃ and+90℃, three relaxations are found and named α_2, α_1 and β in the order of the descending temperature. The activation energy and relaxation spectrum are determined by the method of reduced variables. It is concluded that the β relaxation is caused by the micro-Brownian motion of the amorphous chain, considering the temperature dependence of the relaxation time. The relaxation characteristics of the α_1 and α_2 relaxations in PVDF, VDF-TFE copolymer and polyethylene are shown to be very similar and also to be independent of the difference in chemical structure. The α_1 and α_2 relaxation in these polymers are thus thought to be caused by the same molecular mechanisms.

5th International Conference on Phonon Scattering in Condensed Matter, June 2-6, 1986, Urbana, Illinois, U. S. A.

Interaction between Phonons and ^{3}He-quasiparticles in the ^{3}He-^{4}He Mixture Confined in Porous Media

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The problem of liquid or solid He in restricted geometry has recently been a subject of extensive studies both theoretically and experimentally. It is expected that the dilute ^{3}He-^{4}He mixture confined in porous media should behave quite differently from the bulk mixture. The interaction between low-frequency phonons in porous media and ^{3}He-quasiparticles in the ^{3}He-^{4}He mixture was investigeted in this paper. The porous media considered here consist of pores of different shapes and channels connecting them. This system is related to the problem of heat transfer between porous media and ^{3}He-^{4}He mixture. It will be shown that ^{3}He-quasiparticles are regarded as the ones localized in the pores in a certain frequency and temperature region.

5th International Conference on Phonon Scattering in Condensed Matter, June 2 -6, 1986, Urbana, Illinois, U. S. A.

Damping of Phonons by Metal Particles Embedded in an Insulating Matrix

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The energy spectrum of electrons confined to a small region in space becomes discrete due to the quantum-size effect. The problem associated with the observation of such features has been receiving considerable attention using submicron metal particles, particularly from light scattering, magnetic susceptibility, and specific heat. In this paper we pointed out that such characteristics can be observed through the damping of phonons by metal particles embedded in the insulating matrix. It will be shown that a remarkable property of energy spectrum of metal particles; i. e., the quantum-size effect, can be observable through the frequency and the temperature dependence of the attenuation and the velocity dispersion of phonons.

The Third Workshop of the Japan-US Cooperative Science Program, Honolulu, March 27-29, 1986.

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

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Faculty of Engineering Hokkaido University

Electrical and fluid dynamical characteristics of an MHD generator with Shaped B-Field Configuration (SFC-type) were analized by solving parabolized Navier-Stokes equation coupled with the generalized Ohm's law and the Maxwell equations. The magnetic field in a conventional type MHD generator (UFC-type) had only one component Bz. By contrast the field in SFC-type was two-dimensional since the Bz-component was reduced within the cold electrode boundary layers in order to decrease electrical losses caused by the Hall's effect.

In the duct cross-section finite element method (FEM) was used, and an implicit scheme known as Crank-Nicolson method was used along the main flow direction.

Results were compared with those of a conventional MHD generator, and the following conclusions were derived. (1) The potential drop and the internal resistance of the SFC-type generator are considerably less than those of UFC-type owing to both the reduction of the Bz -component and the improvement of local conductivity tensor due to the By-component. (2) The secondary flow vortices over the generator cross section are weaker in the SFC-type. (3) The eletrical current and heat flux concentration on electrode surfaces, especially on anode surface can be reduced in the SFC-type MHD generator.

The Third Workshop of the Japan-US Cooperative Science Program, Honolulu, March 27-29, 1986.

Some Experimental Results of SFC-Type MHD Generator

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The report describes some experimental results recently obtained in a shock-drive MHD generator with a two-dimensionally shaped B-field configuration (SFC-type). The data include power output characteristics with the applied magnetic field, voltage distributions across the plasma, electrode voltage drops, photographic pictures of dynamic behaviours of arc-spots on anode and cathode, and the post test observations of arc-spot traces left on electrodes. The same experimental items were also examined in a conventional type MHD generator with a uniform B -field design.

The important conclusions obtained by comparisons and discussions are as follows:

1) The power output from the SFC-type generator is much higher than that of the UFC-type. The differences in the potential distributions and the potential drops due to the B-field design are the main cause of the performance improvement in the SFC-type.

2) Under the arcing mode, the electrical current distributions are considerably nonuniform on electrodes. The nonuniformity are much more enhanced on the cathode than on the anode.

3) The cathode arc-spots in the SFC-case are finer and smaller than in the UFC-case.

4) The existence of the J_z-component of the electrical current density was confirmed in the SFC-case. This is clearly effective to reduce the Hall eddy current losses and to reduce the local heat flux concentration by introducing the Lorentz force $J_z \times B_y$.

24th SYMPOSIUM ENGINEERING ASPECTS OF MAGNETOHYDRODYNAMICS, JUNE 24-27, 1986, BUTTE, MONTANA

The Effect of An Externally Applied Magnetic Field on Plasma Turbulent Flow

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and Y. OZAWA
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1. Experimental measurements of the plasma flow velocity were made by means of a cross -correlation funnction analysis.

The following results were obtained:

★ The velocity decreased gradually, the terperature profile of the boundary layer varied

appreciably as the magnitude of the externally applied magnetic field increased.

2. Boundary layer temperature profile using a newly devised light polarization line-reversal method without externally magnetic field.
   The following results were obtained:
   ★ The temperature increase by Joule heating made the boundary layer profile steeper.
3. The space-dependent plasma temperature in the boundary layer of an MHD generator with an extermally applied magnetic field was measured by means of a newly devised method using a lightpolarization line-reversal technique.
   The following results were obtained:
   ★ The measurements were performed at four hundred positions across the boundary layer during a period of 0.4 ms.
   ★ The spatial distribution of terperature thus obtained indicated the 1/7-th or 1/8-th power of the temperature.
4. The maximum entropy method (MEM) was applied to time series data from combustion MHD plasma, with an externally applied magnetic field as a high resolution estimator.
   The following renults were obtained:
   ★ A deviation of k-dependent power spectral densities from Kolmogoroff's $K^{-5/3}$-law was found in the inertial subrange (k: wave number).
   ★ The k^{-3}-dependent power spectral density was observed at the higher part of the range due to the effect of the strong magnetic field on the plasma turbulent flow.

U. S./Japan Seminar on MHD Power Generation Sponsored by JSPS/NSF March 27-29, 1986, Hawaii, U. S. A

Boundary Layer Profile of Plasma Temperature in Combustion MHD Channel

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In the boundary layer of MHD generators, various phenomena, such as electrode voltage drops along the direction of Faraday's electromotive force, breakdown of Hall voltage, etc., occur. These phenomena significantly affect the performance of MHD generators. Measurements of the temperature in a time scale of hundreds of microseconds to milliseconds are required for investigating phenomena in the boundary layer such as arcing. The conventional line-reversal methods are insufficient for the purpose mentioned above. Therefore, the authors attempted to use a device which would make it possible to implement a high speed measurement of terperature at several hundred positions in the boundary layer during a short period of hundreds of microseconds, using the light-polaization line-reversal method which has been developed by the authors' group.

INTERNATIONAL SYMPOSIUM ON HEAT TRANSFER, Beijing, China, Oct. 15-18, 1985

An Experimental Study of Potassium Condensation

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The present study is to examine the behaviour of a metal condensation including intensive conditions far from equilibrium. In the case of condensation of metal vapour, owing to high thermal conductivity of the condensate, an excess temperature drop at the vapour-liquid interface clearly occurs within a few mean free paths in width as a result of net transfer of matter, while for nonmetal vapours the interphase is almost at saturation temperature, except at very low pressures. The relationship between condensation mass flux and the difference of vapour and liquid surface temperatures, and the dependence of this relationship on vapour temperature are carefully examined. The condensation coefficient is found to be very close to unity. The general tendency of the present results on intensive condensation is in agreement with the most recent theoretical study.

26th Corrosion Science Symposium Manchester, U. K. September 23-26, 1985

1985 U. R. Evans Award Adress; Fundamental Concepts of Corrosion

Norio SATO
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The Corrosion theory has so far placed its emphasis on the oxidation-reduction nature of the corrosion processes. It is however the acid-base nature of corrosion reactions that makes corrosion diversified depending on the environment. The inhomogenous nature of corrosion processes is also of importance, which results from the defective and non-uniform structure of metal surfaces, the molecular fluctuation, and the mass transport perturbation. The theory of stability gives a marginal wave length of perturbation beyond which the perturbation grows into the formation of a localized dissipative structure of pemturbed components. Selective mass transport through corrosion precipitate on metals also leads to the creation of loclized corrosion.

The Fourth Japan-USSR corrosion Seminar, Tokyo, Japan October 22-25, 1985

Fundamental Aspects of the Active and Passive States of Metal Surfaces

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Metallic corrosion proceeds with the oxidation reduction producing metal ions followed by a Lewis acid-base reaction. It is the acid-base reaction that makes the corrosion diversified depending on the environment. The electrical double layer and the passive film undergo statistical molecular perturbation inducing a spatial inhomogenity of atomic dimension on the metal surface. The dynamic perturbation in mass transport near a corroding metal surface also creates a microscopic morphological inhmomogenity leading to a local passivity breakdown. The statistically attainable maximum size of local passivity breakdown plays a predominate role in the stability of the subsequent growth of local corrosion.

Corrosion Symposium at 191st American Chemical Society National Meeting New York city, New York, U. S. A. April 13-18, 1986

A Theoretical Approach to Corrosion Resistivity of Alloys

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A model is proposed in which the corrosion resistivity of alloys is closely related to the selective dissolution and surface enrichment of alloying elements. Most of the previous studies dealing with alloy corrosion resitivity have focussed their attention on the corrosion resistance of the passive films formed on alloys. It is however apparent that the selective dissolution of some alloy components takes place before the formation of passive films and that the capacity of pasivation depends on the surface enrichment of corrosion-resistive alloying elements. It is assumed that passivation commences when the surface enrichment of corrosion-resistive alloying elements exceeds a critical level. This paper deals with the kinetics of surface enrichment of alloying elements. The surface composition of an alloy can be derived as a function of the selective dissolution rate at the alloy surface and the interdiffusion rate in the alloy substrate. Application of the proposed model is made to the understanding of the corrosion-resistivity of iron-base alloys.

The 169th Meeting of the Electrochemical Society, Boston, Massachusetts, U. S. A., May 4-9, 1986

Effect of Aging of Hydroxide on the Formation of Composite Oxide Films on Aluminum

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Aluminum specimens covered with hydroxide were kept in a desiccator for different periods of aging, and then anodized in a borate solution to form composite oxide films. A 'relaxation' (loss of high voltage-sustaining ability) of the composite oxides was examined by keeping the specimens on an open circuit and reanodizing after the relaxation process. It was found that aging causes a retardation of transformation of amorphous oxide into crystalline oxide during anodizing. The composite oxides formed with aging have a large number of imperfections which can easily be relaxed and repaired.

The 169th Meeting of the Electrochemical Society, Boston, Massachusetts, U. S. A., May 4-9, 1986

Hot-Water Hydration of Porous Anodic Oxide Films on Aluminum and Acid-Dissolution of Hydrated Films. I. Analysis by Gravimetric Method

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Porous oxide films formed in an oxalic acid solution were hydrated in hot water at 99.5℃ and then dissolved in a chromic acid phosphric acid solution. The weight-time characteristics of the specimen was measured during successive experiments and the results were analyzed as a function of the initial film thickness and the time of hydration. The function of hydration resulting in increasing the protective ability of film is explained.

The 169th Meeting of the Electrochemical Society, Boston, Massachusetts, U. S. A., May 4-9, 1986

Hot-water Hydration of Porous Anodic Oxide Films on Aluminum and Acid-Dissolution of Hydrated Films. II. Analysis by Impedance Measurements

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Porous oxide films formed anodically on aluminum were hydrated with hot water at 99.5℃ and then dissolved in a chromic acid phosphoric acid solution. During these experiments, the time variation of impedance was measured to examine the changes in film structure. The equivalent circuit of hydrated films was found to consist of the capacitance, C_b, of the barrier oxide layer, combined in series with a parallel combination of capacitance and resistance components, C_h, of the hydrated oxide in the pores. The changes in C_h^{-1}, R_h, and C_b^{-1} with time agree quite well with those estimated from the gravimetric analysis.

The 2nd Battery Material Symposium, Graz, Austria, Sept. 16-17, 1985

Acid-Base Properties of MnO_2 with and without Heat Treatment

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Two kinds of MnO_2 samples with and without heat treatment were suspended in NaOH solutions containing $NaNO_3$, and the suspensions were titrated with HNO_3. The results were analysed by considering the following ion exchange reactions at two different surface hydroxyl sites

$$\equiv MnOH_a + Na^+ \rightleftharpoons \equiv MnO^- \cdot Na^+ + H^+$$
$$\equiv MnOH_b + NO_3^- \rightleftharpoons \equiv Mn^+ \cdot NO_3^- + OH^-$$

where $\equiv MnOH_a$ is an acid and $\equiv MnOH_b$ is a base, and $\equiv Mn^+$ and $\equiv MnO^-$ are the charged sites to which NO_3^- and Na^+ are adsorbed. The net surface charge density $\sigma, = [\equiv Mn^+] - [\equiv MnO^-]$, was entimated from the results of the titration. The equilibrium conditions of these reactions can be expressed by the following equations with exponential terms including σ

$$K_a = \frac{[\equiv MnO^- \cdot Na^+] a_H}{[\equiv MnOH_a]\,[Na^+]} \cdot \exp(-A_a \cdot \sigma)$$
$$K_b = \frac{[\equiv Mn^+ \cdot NO_3^-] a_{OH}}{[\equiv MnOH_b]\,[NO_3^-]} \cdot \exp(A_b \cdot \sigma)$$

The values of the constants, K_a, K_b, A_a, and A_b, were determined by multi-parametric curve-fitting of experimental data, and the change in ion-exchange characteristics due to heat treatment was discussed in terms of the values of the constants.

The 2nd Battery Material Symposium,
Graz, Austria, Sept. 16-17, 1985

Adsorption of Zinc Ions on MnO_2 with and without Heat Treatment

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Two kinds of MnO_2 samples with and without heat treatment were suspended in Zu^{2+} ion solutions. The concentrations of Zn^{2+} ions in the solution were determined by atomic absorption spectrophotometry, and the amount of Zn^{2+} ions adsorbed was obtained from the difference between the concentrations before and after the adsorption. The surface concentration of adsorbed Zn^{2+} ions, Γ, increased with the increasing pH and the concentration of Zn^{2+} ions in solution, $[Zn^{2+}]$. The adsorption is considered to occur by exchanging n protons in the acid hydroxyl groups of the surface of MnO_2, $\equiv MnOH_a$, with a Zn^{2+} ion:

$$Zn^{2+} + (2-n)NO_3^- + n\equiv MnOH_a \rightleftharpoons (\equiv MnO)_nZn^{2-n}(NO_3^-)_{2-n} + nH^+ \quad (1)$$

The reaction product is a surface complex with a charge of $2-n$, to which NO_3^- ions are adsorbed as counter anions. The equilibrium condition of this reaction is given by

$$\beta_n = \frac{\Gamma \cdot [H^+]^n}{[Zn^{2+}]\,[NO_3^-]^{2-n}[\equiv MnOH_a]^n} \cdot \exp(B \cdot \Gamma) \quad (2)$$

where β_n is the equilibrium constant and B is a constant. By multiparametric curve-fitting, the values of β_n, B, and n were determined, and the change in Zn^{2+} adsorption behavior due to heat treatment was discussed in terms of the values of the constants.

36th ISE Meeting, Salamanca, Spain,
Sept., 1985

Hot-water Hydration of Porous Anodic Oxide Films on Alminium-Analysis of Film Struture by Anodic Polarization

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Porous anodic oxide films formed on Al in an oxalic acid solution were hydrated for various periods by the reaction with hot water. As reported earlier, hydrous oxide is formed on the entire surface of the pore-walls to fill up the pores in about 10 min, and then the hydration slowly continues from the outer surface so that the outermost part of the film becomes completely hydrated. Using gravimetric data and assuming the composition and density of the hydrous oxide to be $Al_2O_3 \cdot 2H_2O$ and 2.6, the thickness of the fully hydrated portion of the film, H_{hy}, the thickness of the film portion containing the unhydrated pore-wall, H_{ox}, and the thickness of the unhydrated pore-wall, δ, were calculated. In another series of experiments, the hydrated films were re-anodized with constant currents, i_r, of 0.01 and 0.5mA/cm^2 in a neutral borate solution to examine potential-time characteristics. For the smaller anodizing current, the steady potentials are related to the thicknesses of the barrier layers remaining unhydrated; they agree well with

those estimated from capacitance measurements. Re-anodizing with the larger current causes dehydration of the hydrous oxide in the pores at the barrier layer/hydrous oxide layer interface, and voids produced by the dehydration are filled up with new oxide formed by the transport of Al^{3+} ion through the barrier layer. The growth of the barrier layer is reflected in the voltage-time characteritsics. The transport number of Al^{3+} ion, $T_{Al}{}^{3+}$, was found to be 0.24. Using this value, H_{ox} was estimated from the voltage-time curve. The values of H_{ox} obtained as a function of the hydration time, t_h, were in good agreement with those estimated by gravimetry.

International Symposium on New Trends in the Photochemistry of Polymers, Stockholm, Sweden, August 26-29, 1985

APPLICATION OF THE ELECTRON SPIN ECHO TECHNIOUE TO IRRADIATED POLYMERS —— SPATIAL DISTRIBUTION OF FREE RADICALS ——

Hiroshi YOSHIDA
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The bond dissociation of polymers results in the pairwise formation of free radicals. The pair-correlation of the radicals will be retained when they are trapped in the polymers, and control the degradation and crosslinking reactions. However, the local distribution of radicals in polymers has not wholly been elucidated because of the lack of adequate experimental technique.

We have studied the paramagnetic relaxation of alkyl radicals in γ-irradiated polyethylene by the newly-developed elelctron spin echo technique. The radicals show the longitudinal relaxation expressed as $1-\exp(-kt^{0.62})$ at 77K. The rate constant k increases linearly with the radical concentration with a large intersect. The results indicate that the radicals are trapped pairwisely and that the transfer of spin-energy to the counterpart is an effective path of the relaxation. The average distance between the paired radicals is estimated to be 3.5nm.

International Meeting on Pulse Investigation in Physics, Chemistry and Biololy, Lodz, Poland, September 17-21, 1985

APPLICATION OF PULSE RADIOLYSIS THEHNIQUE TO SEVERAL REACTIONS OF ORGANIC RADICAL IONS

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The pulse radiolysis is a powerful technique to generate short-lived intermediates and to study their dynamic behavior. We applied this technique of time-resolution of 10 ns to several reactions involving organic radical ions.

(*1*) *Charge Transfer Reactions*. In 2-propanol solution, biphenyl anion gave the absorption at 400 and 600nm. In the presence of styrene or its derivative as the second solute, the anion decay was enhanced by the electron transfer to the second solute. The free energy relationship of the electron transfer was found to be in accordance with the Marcus theory. The rate constant of the positive charge from biphenyl radical cation was determined in dichloroethane, and was found to be much larger than that of the electron transfer. (*2*) *Substitution Reactions*. Fluorenone anion generated in hexamethylphosphorictriamide solution reacts with organic bromides (RBr) and produces R-adduct radical. The rate constant of this reaction indicates the SN2 nature of the reactions. However, the substitution of dimethyl fumarate anion was found to be of the electron transfer nature. (*3*) *Dimerization of Radical Anions*. Benzophenone anion generated in 2-methyltetrahydrofuran solution at 182K showed the formation of anion dimer when the anion lifetime was prolonged by the presence of counter cations.

Proceedings of the 3rd Symposium on Empirical Foundations of Information and Software Science, Roskilde, Denmark, October 21-24, 1985

DOCUMENT INFORMATION SYSTEM IN SCIENTIFIC RESEARCH

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Scientific documents consist of bibliographic and textual information as well as various forms of complicated information such as figures, tables, graphs and images. A future scientific information system will be connected to a huge integrated database and constructed as a scientific workstation with advanced functions for data processing of various forms of multi-media knowledge information. Such an information system requires some specific abilities for processing of non-coded information of variable length, set-valued information and structural information, in addition to usual coded elementary information.

In this paper, we discuss design and implementation problems in constructing a document information system, as a prototype of such information systems, with the function of text processing, a typical example of complicated information processings. Future directions of an advanced scientific information system are also suggested.

Proceedings of the 3rd Symposium on Empirical Foundations of Information and Software Science, Roskilde, Denmark, October 21-24, 1985

DATABASE MANAGEMENT IN RESEARCH ENVIRONMENT

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Database management in a research environment is to assist scientific researchers, who are often nonprofessionals in database administration, when they are constructing their research-oriented database. Reported here is a support environment which takes advantage of a general-purpose Information Retrieval System (ORION) and Database Management System (ADABAS) as basic softwares. Tools provided for the environment as its integral part have made rapid prototyping and its successive refinements feasible. However, it is suggested that some further augmentation such as integration of IRS and DBMS, management of programs and knowdedge -based instruction is necessary.

International Symposium on Fluid Control And Measurement, Tokyo, Japan, 2-6 Sept. 1985

Investigation of Interfacial Wave Generation Through a Flow Visualization Technique and an LDA Method

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Using a flow visualization technique and a new laser-Doppler anemometry (LDA) syster in which the optical probe can operate underwater, the growth mechanism of three typical types of interfacial waves were investigated in a horizontal and statically stable salt-fresh water flow system. The visual observation shows that these three waves are identical to the deformation of interfaces due to the three types of coherent vortices which grow at different liquid levels with regards to the interface ; one of these vortices that grows at the interface corresponds to a Kelvin -Helmholtz instabity wave at its nonlinear stage, and the other two vortices appear in the shear layer just above and below the interface through symmetric shear instability. It was confirmed that generations of these vortices are based on shear instability through the linear stability theory using the volocity profile obtained by a dye method and the new LDA system.

The Sixth International Conference on Electronic Properties of Two-Dimensional Systems, Kyoto, Japan, 9-13 September 1985

Surface Bipolaron Formation in the Two-Electron-Plus-Ripplon System

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Using a variational method of the Pekar type, we examine the formation of surface bipolaron by coupling of two electrons to ripplons, the symmetry property of the system being taken into account. It is found that the surface bipolarons with an odd as well as an even parity can exist as the ground state for certain ranges of the electron-ripplon coupling constant and the strength of the Coulomb repulsion.

Artificial Intelligence and Advanced Computer Technology Conference September 24-26, 1985, West Germany

Partitioning production memory into procedural modules

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In any programming system, it is important to have a method for decomposing large programs into nearly independent, manageable and comprehensible pieces. In the production system, it refers to partitioning production memory into procedural modules, which we call production modules in this paper.

Production systems have many advantages to represent decision-making knowledge for many kinds of problem-solving. Such knowledge, which is encoded in production memory, often has the hierarchical modular structure. Therefore, it is very important to consider the benefits of the hierarchically module-structured production memory.

On the basis of the above considerations, we have attempted to implement an experimental adaptive production system (APSH) which has a module-structured production memory. This paper describes the design and development of ASPH.

1986 International Conference on Coal Science, Sydney, Australia, October 28 -November 1, 1985

Mechanism and Rate of Semi-Coke Formation during Coal Liquefaction

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In an effert to develop a generalized reaction model for coal liquefaction accompanied by the retrogressive semi-coke formation, the semi-coke formed during liquefaction was experimentally defined as a lumped product separated from products by rehydrogenation of the pyridine-insoluble fraction in the products. Systematic experiments were carried out by starting the reaction not only with coal but also with preasphaltenes, asphaltenes or oils. The results revealed that the preasphaltenes play the most important role in the retrogressive reactions and further that the semi -coke formation from preasphaltenes dose occur via an intermediate species which can be lumped with the thermal fragments from coal. A generalized model was proposed by coupling such retrogressive reaction paths with our earlier model. The optimum sets of apparent rate constants of retrogressive and progressive reactions were determined for three different coals. The rate constants of semi-coke formation were found to be in an order of magnitude of 1.61×10^{-2} to 3.83×10^{-2} min^{-1} which depended on coal properties as well as the reaction temperatures.

International Coal Symposium, Melbourn, Australia, November 6, 1985

Advances in in-situ High Temperature High Pressure NMR and ESR

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We have developed a technique of high temperature ^1H-NMR which allows for the direct monitoring of the structural change and the change of molecular motion related to the fluidity of the system while the carbonization reaction occurs. The technique was further developed to enable monitoring under high pressure conditions. Such direct observations at the working temperature will provide some answers to difficult questions as to what actually occurs in coal liquefaction reaction under high pressure.

A simple high pressure, high temperature ESR cell was constructed and developed at Hokkaido University and used to monitor free radicals in the early stages of carbonization of pitch. Typical results obtained for liquefaction of coal under H_2 pressure are also presented using by this technique.

The combination of high temperature, high pressure ESR with high pressure DTA and PDA

is also a promising technique with which to understand the process of stabilization of free radicals and evaluate catalytic activities for coal liquefaction as well as for carbonization.

Proceedings of 1985 International Conference on Coal Science, Sydney, 28 -31, October, 1985

Mechanism of Coal Liquefaction by High-Temperature High-Pressure ^{1}H NMR and ESR

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Changes in chemical reactions during coal liquefaction of Yallourn brown coal and Akabira bituminous coal were monitored by using high-temperature and high-pressure ^{1}H-NMR.

A simple high-temperature and high-pressure ESR cell was constructed and the variation in concentration of free radicals during coal liquefaction reactions was monitored under the same experimental conditions for NMR. With liquefaction and coking reaction, typical spectra of NMR and ESR were obtained and were classified by the reaction steps, namely, swelling, liquefaction and coking stages, respectively.

The combination of high-temperature and high-pressure NMR and ESR is promising for understanding the chemistry of coal liquefaction reactions.

Japan-China Symposium on Coal and Cl Chemistry, Taiyuan, China 1985

SEPARATION OF COAL HYDROGENATION LIQUIDS AND RELATIONSHIP BETWEEN THEIR FRACTION AND CHEMICAL STRUCTURE

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Separation behaviours of HPLC equipped NH_2 column, GPC and distillation were clarified on Ra-Rn-Cal diagram. Kerosene, light oil and residue oil from coal hydrogenation liquid were also characterized on this digram and the constitution contained in these distillation fractions were compared with the separation rules obtained from the order of separation during distillation.

Proceedings of the 5th Engineering Foundation Conference on Fluidization, Elsinore, Denmark, May 18-23, 1986

Prediction of the Steady State of Continuous Gas Fluidized Beds of Segregating Binary Solid Particles

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When a gas fluidized bed of size- and density- different binary particles is operated with solids flowing through it continuously, the segregation pattern of the bed and the discharge composition vary with time depending on the initial bed composition and the height of the solid discharge. However, regardless of the initial bed composition, a steady state is reached when the composition at the discharge height becomes equal to the feed composition.

Based on the above fact the break-through curves were predicted by a psuedo-steady state model which assumes an invariable segregation pattern for a short time and employs the simplified Naimer-Chiba-Nienow model for predicting the batch segregation pattern on the basis of bubbling bed characteristics. The model predictions agree well with the observed break-through curves, particularly for lower discharge heights.