



Title	Abstracts & Titles, No.43-No.46
Citation	Memoirs of the Faculty of Engineering, Hokkaido University, 12(2), 183-213
Issue Date	1968-02
Doc URL	http://hdl.handle.net/2115/37857
Type	bulletin (other)
File Information	12(2)_183-214.pdf



[Instructions for use](#)

Appendix

Abstracts & Titles, No. 43—No. 46

BULLETIN
OF THE
FACULTY OF ENGINEERING
HOKKAIDO UNIVERSITY

NOTICE

Papers and Reports	Author	Page
No. 43 (May 1967)		
1. On the Motion of the Body-Wheel System of the Automobile (I) —Mechanics of the Front Wheel System—	T. Irie, Y. Ueda	1
2. Studies on a Tapered Line Used as a Matching Section	S. Murata, T. Katayama	29
3. Space-Charge Fields Produced by Thin CEF-Type Electron-Beam Bunching	I. Sakuraba, K. Koyanagi	49
4. Characteristic Ripple Effects on the Gain Characteristics in CEF-Type Forward-Wave Amplifiers	M. Senda, I. Sakuraba	55
5. A Study for Mass Transfer in Liquid —An Investigation on the Penetration Theory Having a Mixing Region—	M. Kugo, T. Shibata, M. Furukawa	67
6. A Continuous Coking Process of Tar Pitch —With a Single Reactor—	M. Kugo, O. Uemaki	81
7. A Study on the Micellar Structure in Cellulose (I) —An X-Ray Study on the Micellar Structure in Native Cellulose Fiber Using a Homogeneous Reaction of Nitration—	S. Watanabe, T. Akahori	95
8. Determination of Crystallinity in Cellulose Fiber by X-Ray Diffractometric Method	S. Watanabe, T. Akahori, H. Matsubara	111
9. On the Cracking of Glass Depending on the Thermal Gradient (I) —Measurement of Crack Velocity—	M. Yoshida, I. Ikeda	131
10. Studies on the Longitudinal Diffusion of Water Flow in a Pipe (I) —Measurement of Diffusion Coefficient by the Salt Velocity Method—	M. Kashiwamura, K. Ishizaki	157
11. Studies on Density Current (II) —On the Outflow Pattern of Lighter Fluid—	M. Kashiwamura, S. Yoshida	167

**On the Motion of the Body-Wheel System
of the Automobile (I)**
— **Mechanics of the Front Wheel System** —

Toshihiro IRIE
Yutaka UEDA

Abstract

In a Wish-Bone type suspension of an automobile, generally, wheel alignment changes with the so-called jounce or rebound stroke. The motion of the front wheel system has such an important effect on the performance of the automobile that it has been studied for a long time, but there are few systematic studies treating the front wheel system in connection with the entire system including the body and the rear wheel system.

In this paper, for the purpose of studying these problems mathematically, six coordinate (body, road, King-pin, wheel, upper and lower arms) systems and equations of transformation on them were introduced. And the link system of the front wheel was divided into four parts (wheel, King-pin, upper and lower arms), on each of which equations of motion and geometrical conditions were given. Some diagrams on the quantities obtained from the theoretical calculation were presented and the flow of the information (geometric quantities and forces) in the system was illustrated by giving some block diagrams of the front wheel system and the entire system of the automobile.

Studies on a Tapered Line Used as a Matching Section

Shigeaki MURATA
Tatsuo KATAYAMA

Abstract

A tapered line or a non-uniform line have found considerable applications in microwave circuits during recent years. The tapered line is characterized by a non-constant characteristic impedance of the line along the longitudinal direction, that is, along the direction of propagation of electromagnetic waves.

One of the most common uses for such a line is in the matching of transmission lines of unequal characteristic impedance over a broad band of frequencies.

In this paper, the differential equations of a tapered line involving voltage and current, expressed as functions of the position x , are solved approximately in the case of TEM mode for assumed variations of the series inductance and parallel capacitance per unit length along the longitudinal direction x . The variation of characteristic impedance

is not assumed but deduced from the solutions of the differential equations. Based on the above the equivalent circuit for the matching section consisting of a piece of tapered line is determined, and the reflection coefficient and transmission coefficient are determined.

The solutions of differential equations involve coefficients that must be determined from numerical calculations by an electronic digital computer. The result of this will be given in the next paper.

Space-Charge Fields Produced by Thin CEF-Type Electron-Beam Bunching

Ichiro SAKURABA
Kojiro KOYANAGI

Abstract

This paper deals with the space-charge field produced by thin CEF-type electron-beam bunching.

The azimuthal radio-frequency field greatly exceeds the radial radio-frequency field if the circular propagation constant is a small fraction of (r_0/σ) and $(r_0/\sigma) \gg 1$, where r_0 is the radius of the center-of-the-beam electron and σ is the radial width of the electron ribbon.

The Nunn-Rowe space-charge parameter consists of the reduced plasma angular frequency and the spatial angular velocity of an electron with a radius of r_0 .

Characteristic Ripple Effects on the Gain Characteristics in CEF-Type Forward-Wave Amplifiers

Masahiko SENDA
Ichiro SAKURABA

Abstract

This paper deals with the characteristic ripple and gain characteristics of CEF-type forward-wave amplifiers in a special case where $Q=0$, $d=0$, $\beta_r=20$, and $C=0.05$.

A detailed investigation of the incremental propagation constants shows that the real parts possess a dependency on the electron injection velocity parameter b :

1. In the region where $-1.4 \geq b \geq 0.8$, x_1 which is greater than zero, is associated with the wave that exponentially increases with the increasing spatial angle, while x_2 is associated with the exponentially decreasing wave. Thus y_1 and y_2 possess the same value over the range of b for which x_1 and x_2 differ from zero. For values of b lying beyond this interval, y_1 and y_2 have separate and distinct values. This interaction is due to the coupling between a synchronous space-charge wave and a forward wave.

2. In the region where $1.1 \geq b \geq 1.9$, x_1 which is greater than zero, is associated with the exponentially increasing wave, while x_2 is associated with the exponentially decreasing wave. Then y_2 and y_4 possess the same value over this range of b for which x_2 and x_4 differ from zero. For values of b lying beyond this region, y_2 and y_4 assume separate and distinct values. This is due to the interaction between a slow space-charge wave and the forward wave.

3. At large negative values of b , in the region where the real parts of the propagation constants vanish, y_1 approaches zero, while y_2 approaches the complex conjugate of y_4 . It follows that y_1 is a synchronous space-charge wave, y_2 is a fast space-charge wave and y_4 is a slow space-charge wave and thus y_3 asymptotically approaches the cold-circuit wave phase velocity.

4. At sufficiently large positive values of b , for which the real parts of the incremental propagation constants vanish, y_2 approaches $-b$, while y_1 approaches zero. The graphical results also shows that y_3 and y_4 asymptotically approach the same positive and negative values. Thus y_3 and y_4 are the fast and slow space-charge waves, y_2 is the circuit wave and y_1 becomes the synchronous space-charge wave.

A plot of gain in db versus the velocity parameter b with the number of wave angle N as parameter has provided a general approach to the small-signal study of CEF-type forward-wave amplifiers. Among the important consequences of this plot, the following are particularly significant:

1. In the case of large N , the gain is largest when $b=0$ and steadily decreases as $b \neq 0$.

2. In the case of small N , the gain is largest when $b > 0$.

3. When the b value is approached, for which x_1 vanishes in the region of positive values of b , the small-signal gain can be obtained by characteristic ripple effects.

A plot of gain in db versus the electrical angle with the parameter b shows a spatial beating pattern:

1. At large negative values of b , where the real parts of propagation constants vanish, the net gain at any spatial angle depends on the vector sum of all four waves. The amplitudes of the beats increases with both the electrical angle and the velocity parameter, as the b value is approached for which x_1 vanishes.

2. The small-signal gain possesses a linear spatial variation when b is equal to or greater than zero. The growing-wave gain in the case of large N values is largest when

$b=0$ and steadily decreases as b assumes the successive values 0.4, 0.8, 1.2. When b assumes still larger values, the growing-wave character is almost absent from the gain function and the amplitudes of the spatial beats decreases as b takes on the successive values 1.6, 2.0, 2.4. This likewise is due to the characteristic ripple effect.

A Study for Mass Transfer in Liquid
— An Investigation on the Penetration Theory
Having a Mixing Region —

Masao KUGO
Toshiharu SHIBATA
Masataka FURUKAWA

Abstract

A new model for the interface mass transfer which is tentatively referred to a penetration theory modified with a mixing region is presented. This was checked experimentally by the acetaldehyde-toluene-water system.

For the mass transfer rate, the molecular diffusion may be a predominant factor, but it is suggested here that the concentration profile crumbled up to its average value by the induced mixing effect such as an eddy or interfacial turbulence etc. seems to have a fairly important role.

Considering the profile crumbling, the transferred solute during the contact time " t " is described as

$$W = \text{const.} / \left(1 + a \sqrt{\frac{\pi}{4Dt}} \right)$$

where " a " is a mixing region depth in the concentration layer, and "const" is the characteristic value which may be affected by the solute concentration.

A Continuous Coking Process of Tar Pitch

— with a single reactor —

Masao KUGO

Osamu UEMAKI

Abstract

Fluidized-bed technique was applied for coking tar pitch. In a previous paper a two-fluidized bed system which consists of a combustion chamber and coking chamber was used, and in the present investigation a single column in which combustion and coking were simultaneously carried out was used. As the fluidizing gas, steam instead of combustion gas was used to prevent diluting the produced gas. At high temperature over 800°C. the water gas reaction of coke with steam could not be avoided; as a result a considerable amount of H₂ and CO was produced by the consumption of the produced coke.

Merits of the single column reactor were the decrease of the heat loss which resulted in an increase of the amount of coke produced and easy operation control; the coke yield was more 10% over that of the double column system.

In addition from the results obtained, some considerations for reaction kinetics in water gas reaction were described.

A Study on the Micellar Structure in Cellulose (I)

— An X-ray Study on the micellar Structure in Native Cellulose
Fiber Using a Homogeneous Reaction of Nitration —

Sadayoshi WATANABE

Tadayoshi AKAHORI

Abstract

To date it has been generally accepted that the nitration reaction in cellulose in a sulfuric-nitric acid-water system with a large proportion of sulfuric acid and a small proportion of water gives a micellar-heterogeneous reaction, and that the nitration of a sulfuric-nitric acid-water system with a large proportion of water or the nitration reaction of an acetic-nitric acid system gives a micellar-homogeneous reaction (permutoid reaction).

But it was previously reported by Watanabe et. al. the former gives a fibrillar-heterogeneous reaction and the latter gives a micellar-heterogeneous type of reaction.

This present work was undertaken to study the micellar structure of native cellulose. The decrease of the micellar dimension and the decrease of crystallinity of cellulose I of mildly nitrated ramie prepared in an acetic-nitric acid system were measured by an X-ray diffraction method.

In the early stage of nitration the micellar dimension of cellulose was observed to show a great decrease relative to the decrease in the crystallinity thereof. With the progress of nitration the decrease in crystallinity of cellulose becomes predominant over the decrease in the micellar dimension thereof.

From this result the possibility that there are portions of different crystallinity within a micell of native cellulose and that the inner part has a high crystallinity and outer part has a relatively low crystallinity was suggested.

Determination of Crystallinity in Cellulosic Fiber by X-Ray Diffractometric Method

Sadayoshi WATANABE

Tadayoshi AKAHORI

Hiroaki MATSUBARA

Abstract

The conventional method used hitherto for the measurement of the crystallinity in cellulosic fibers is an X-ray method using a specimen of powdered fibers. In this method, the powdered fibers are necessarily oriented in a direction parallel to the specimen surface. As the intensity of interference increases with the decreasing spiral angle of the fiber, it is impossible to obtain the true crystallinity of the fibers. Thus the authors devised a special method to measure the intensity of diffraction, independent of plane orientation, and the new technique is proposed for determining the crystallinity as follows.

After cellulosic fibers under 200 mesh were mixed with a certain amount of copper powder, it was pressed into a block with a die. Various inclined surfaces for the direction of pressing were cut from the block. The intensity of diffraction from these various surfaces of the block were measured, and then the integral intensity of (002) of cellulose was compared with that of (111) of copper. The absolute intensity of diffraction where there is no effect of plane orientation was obtained from these results.

The crystallinity of several fibers were compared with 1.00 for bleached cotton linter. 0.95, 0.92 and 0.84 were obtained for purified flax, purified ramie and sulphite pulp (Yezo spruce), respectively. The above method was also applied for determining the crystallinity of various rayons. Polynosic fiber, ordinary Viscose Rayon and H. T. Rayon were found to have a crystallinity of 0.64, 0.51 and 0.56, respectively.

On the Cracking of Glass Depending on the Thermal Gradient (I)

— Measurement of Crack Velocity —

Mitsunori YOSHIDA
Ikuo IKEDA

Abstract

To date, the crack velocity in a glass plate has been measured by various methods, such as using high speed photography, measurement of the destruction velocity of electrodeposition-film on the glass surface, or the schlieren optical method, etc..

In this paper, one of the methods applied for measuring variations of electric resistance on a glass specimen was used. A vacuum evaporation-film coating was given to the glass surface. In this measurement, attempts were made to obtain the elastic constants coming from the destruction of the glass.

In several papers the relation between the variation of the resistance and the destructive sound of glass has been discussed and an assumption has been made in which the crack velocity was given as approximately 1500 m/sec. In this paper as shown in Fig. 9 the maximum crack velocity was assumed to be approximately 1500~2000 m/sec. This value is approximately half value of the cracking sound velocity in glass. It was noted as a point of interest that the cracking velocity was not uniform and it seems to depend on the cracking length.

Studies on the Longitudinal Diffusion of Water Flow in a Pipe (I)

— Measurement of Diffusion Coefficient by the Salt Velocity Method —

Masakazu KASHIWAMURA
Kenji ISHIZAKI

Abstract

This report is the first among a series of studies on longitudinal diffusion of water flow in a straight circular pipe.

One of the authors has previously measured the velocity of water mass in a natural river by the use of a salt velocity method, and several coefficients of longitudinal turbulent diffusion were calculated by the process proposed by him.

In this report, the same method and the same calculating process were applied to a

circular pipe. The coefficients were obtained as 10~15 in c.g.s. when the cross-sectional mean velocity was in a range of 50~100 cm/sec.

Studies on Density Current (II)

On the Outflow Pattern of Lighter Fluid

Masakazu KASHIWAMURA
Shizuo YOSHIDA

Abstract

In the work described in this second paper on density currents, the authors have concentrated on the transition of flow patterns of lighter fluid, from a potential flow to a turbulent jet flow, when it passes through an outlet.

It has been reported by various researchers that the river flow shows a parabolic jet stream at the river mouth. Some of these workers have attempted to explain this phenomenon by the plane jet theory without taking into account the density difference between the river water and the sea water.

One of the present authors, however, discovered at the Ishikari River in its normal discharge that the outflow of the river water does not assume a parabolic flow but shows a certain flow pattern resembling a potential flow, in which the interval of any two stream lines increases exponentially with the distance from the mouth.

The existence of these two modes of flow pattern suggests that the outflow is transformed from one type to the other through a certain hydraulic condition, which seems to be related to the density difference between two fluids, for example, fresh water and salt water; in addition it also seems to be related to the amount of the discharge, and to the magnitude of the outflow.

In order to clarify this hydraulic condition, a model experiment was conducted by the authors. As a result, it was revealed that a combination of theoretically deduced two dimensionless factors $\theta(=\nu\epsilon g)^{1/3}/U$ and $R(=Ub/\nu)$ dominate the hydraulic condition of transition, where ν is the coefficient of kinematic viscosity of water, ϵ is equal to $1-(\rho_1/\rho_2)$, in which ρ_1 is the density of lighter fluid and ρ_2 is the density of the other fluid, g is the gravitational acceleration, U is the cross-sectional mean velocity of lighter fluid at the outlet and b is the breadth of the outlet.

Flow patterns were classified into five types from the exponential (stable) pattern to the parabolic (unstable) jet pattern.

If both θ and R decrease, the outflow changes from exponential to parabolic. This result shows good agreement with the experience that the flow approaches the exponential type when the density difference becomes large, or the velocity decreases, or the outlet breadth increases.

NOTICE

Papers and Reports	Author	Page
No. 44 (September 1967)		
1. An Electrochemical Test of Pitting Corrosion in Stainless Steel	T. Notoya, N. Sato, T. Ishikawa, G. Okamoto	1
2. On the Vibration of a Wagon Travelling at High Speed	T. Irie, G. Yamada	13
3. Speed Control of Wound Rotor Type Induction Motor by Static Scherbius System and Rectiflow System	S. Fukuda, H. Fujiwara, Y. Ito	29
4. Generating Units Commitment in Daily Dispatch	S. Yamashiro, E. Miyamoto, T. Koike	47
5. Directivity of Linear-Photoelectron-Beam Systems in Optical Heterodyne Detection Processes	I. Sakuraba, H. Chida	59
6. Beam Stiffness in CEF-Type Devices with Space-Charge Effects Included	K. Koyanagi, I. Sakuraba	67
7. Studies on the Surface States of CdS Single Crystals by Field Effect	M. Maeda, M. Doken, H. Sato	73
8. Studies on the Surface States of Silicon MOS Diode	M. Maeda, K. Kobayashi, M. Mizuno	93
9. Studies on the Noise of Silicon MOS Diode and Its Origin	M. Maeda, T. Muranoi	113
10. Attenuation of Light Beam by Snow in the Atmosphere	K. Sakakibara, N. Kodama, K. Kanaya, M. Suzuki	139
11. Studies on the Oxo Synthesis (II) —The Influences of the Reaction Temperature and the Amount of the Catalyst in the Oxonation of Octenes with Cobalt Naphthenate Catalyst—	M. Matsubara, Y. Doi, N. Tomita, K. Aomura, H. Ohtsuka	157
12. Studies on the Oxo Synthesis (III) —The Influences of the Amount of the Catalyst in the Oxonation of Octenes with Cobalt-Kieselguhr Catalyst—	M. Matsubara, Y. Kawabe, N. Tomita, K. Aomura, H. Ohtsuka	167
13. Thermodynamics of Polymer Solutions	M. Onodera, Y. Miyake	179

An Electrochemical Test of Pitting Corrosion in Stainless Steel

Takenori NOTOYA, Norio SATO
Tatsuo ISHIKAWA, Go OKAMOTO

Abstract

A method for anti-pitting corrosion test of stainless steel was developed by means of a potentiostat, which was carried out by observing the changes in anodic current after adding Cl⁻ ions during electrolysis at a constant potential in the passive region. Four types of current-time curves were obtained; type A showing no change, type B occasional current peaks, type C zigzag increase in current with time, and type D monotonous increase in current after a break with incubation time. These types of current time curves appear to be related to the form and number of corrosion-pits, rendering it possible to evaluate the anti-pitting corrosion of austenitic and ferritic stainless steel. The results are in agreement with that of the Streicher test.

On the Vibration of a Wagon Travelling at High Speed

Toshihiro IRIE
Gen YAMADA

Abstract

Prior to the adoption of high speed wagons for aerial ropeways, thorough research on the motion of wagon and the strength of ropeway structure must be carried out to ensure safety and passenger comfort.

In this paper, in an attempt to study these problems theoretically, a series of fundamental equations of motion of a wagon travelling on a rail was introduced, and the expressions for the tension of haul ropes, the reaction and moment acting on the rail were presented. The equations of motion of the wagon were simplified into linear differential equations and the pitching and rolling motion of the wagon travelling on a 2-span ropeway including a main cable support was treated mathematically.

It was found from the results of calculations on a ropeway, that the vibration of the wagon increases when the travelling speed of the wagon becomes larger and that the maximum angular displacement of its rolling motion increases when the horizontal bent angle between the main ropes on both sides is large and the length of main cable

support is small. It was also found that the pitching motion is hardly affected by the bent angle. A diagram on the maximum angular displacement of the pitching and rolling motion was presented and it was proposed that some examinations on such diagrams should be required in planning and designing the ropeways.

Speed Control of Wound Rotor Type Induction Motor by Static Scherbius System and Rectiflow System

Shoji FUKUDA
Hajime FUJIWARA
Yuzo ITO

Abstract

The static Scherbius system is a speed control system combining an induction motor, silicon rectifiers and a power inverter utilizing silicon controlled rectifiers. The Rectiflow system is also a speed control system combining an induction motor, silicon rectifiers and a DC current motor.

These two methods are capable of recovering slip power which is impossible by conventional rheostatic control of wound rotor type induction motors. The two methods render it possible to attain a high efficiency over wide range of speed control, and a wide application is expected.

However the problem of effect of higher harmonics occurring when rectifiers are inserted on the secondary side of an induction motor still remains unsolved. More work on this point will be required.

In this paper the torque and mechanical out put of an induction motor was calculated approximately which is based upon a fundamental component with due consideration to the non-linearity of a rectifier which causes higher harmonics. The results of a comparison between the calculated values and measured values were presented.

Generating Units Commitment in Daily Dispatch

Susumu YAMASHIRO
Eiichi MIYAMOTO
Toichiro KOIKE

Abstract

In regard to the economic operation problems of a power system, considerable work has been done regarding the economic load dispatching. However, in spite of the fact that the determination of an optimal combination of units for operation seems to be a prerequisite, little has been written regarding the theoretical or numerical analysis of this problem. When the system load is off-peak, a certain number of units would be operating near their minimum outputs. These should be taken-off line. Thus the system operators must determine which units should be taken-off line and for how long. If they simply remove the older or less efficient units, this decision is not always correct. They must examine all the possible combinations of units and determine the optimal combination not by the fuel cost, but by the system operation cost.

Thus this problem was analyzed in this paper in an attempt to determine most economical operation pattern (which unit should be taken-off and for how long in daily dispatch).

Considering the load levels from off-peak to peak load and applying the dynamic programming method, the optimal operation pattern together with the unit start-up and shut-down can be obtained.

Directivity of Linear-Photoelectron-Beam Systems in Optical Heterodyne Detection Processes

Ichiro SAKURABA
Hiroyuki CHIDA

Abstract

This paper deals with the directivity characteristics of linear-photoelectron-beam systems in an optical heterodyne process.

The equivalent resistance of systems with directivity included was given by

$$R'_{\text{eq}} = D^2(\theta_1, \theta_2) R_{\text{eq}},$$

where $D(\theta_1, \theta_2)$ is the directivity factor and R_{eq} is the equivalent resistance. When two incident light waves are plane waves with wave vectors which form angles θ_1 and θ_2 with the photosurface, the directivity factor is given by

$$D^2(\theta_1, \theta_2) = (\sin \Delta k \cdot d / \Delta k \cdot d)^2,$$

where $\Delta k = (1/2)(k_1 \sin \theta_1 - k_2 \sin \theta_2)$ and the photosurface is a strip with a width d .

In the case of non-parallel light beams, the required condition for negligible reduction, $D^2(\theta_1, \theta_2) \geq 0.5$, is

$$\delta\theta \leq \lambda_1/2d.$$

Because the photosurface dimension is generally much larger than an optical wavelength λ_1 , this is a very severe angle limitation.

In exactly parallel beams, the angle at which they are incident upon the photosurface is not important.

Beam Stiffness in CEF-Type Devices with Space-Charge Effects Included

Kojiro KOYANAGI
Ichiro SAKURABA

Abstract

This paper deals with the beam stiffness in CEF-type devices with space-charge effects included.

The stiffness factor S is given by

$$\begin{aligned} S^2 &= 2 \left(\Omega_0^2 - \frac{1}{2} \omega_p^2 \right) \\ &= \Omega_0^2 (2 + Q), \end{aligned}$$

where Ω_0 is the unperturbed spatial angular velocity of the electron, ω_p is the plasma angular frequency of the electron beam, and Q is the Nunn-Rowe space charge parameter. The second term in the right member arises from the presence of space charge in the beam and this shows that the effect of space charge reduces—ever so slightly—the beam stiffness.

Studies on the Surface States of CdS Single Crystals by Field Effect

Masao MAEDA
Masanobu DOKEN
Hirokazu SATO

Abstract

One of the most prominent tools for the investigation of surface properties of a semiconductor is the transverse field effect which gives the energy levels of surface states, their density and their capture cross section for the majority carriers. In this paper, the surface states of CdS single crystals (wurtzite type) prepared by the sublimation method were studied by the transverse field effect.

The field effect was not observed on mechanically polished surface, but was observed on a chemically polished surface. The polishing solution was a mixture of 100 ml of 85% H_3PO_4 and 10 g of $\text{K}_2\text{Cr}_2\text{O}_7$. This mixture was used at about 187°C for several minutes.

From the pulsed field effect, five discrete surface states were observed. The surface states of as-grown surfaces of platelet crystals were also investigated. An irreversible change was observed on the red CdS crystals. This was considered to be the effect of atmospheric oxygen.

Studies on the Surface States of Silicon MOS Diode

Masao MAEDA
Keizo KOBAYASHI
Masatoshi MIZUNO

Abstract

The studies on the surface states at the interface between silicon dioxide and silicon are very important in the fabrication of electronic devices. A considerable amount of work has been reported on this subject, but the density, the energy level and origin of

the surface states are not fully understood. In the present report, the surface states of silicon MOS diode oxidized at a high temperature range were studied by the use of the MOS capacitance method. The surface states lie at 0.06, 0.25 and 0.35 eV above the centre of the forbidden band, and their density is of the order of $10^{11} \text{ cm}^{-2} \text{ eV}^{-1}$.

Further, the influence of B. T. (bias-temperature) treatment, heat treatment and Na on contained in the oxide film were also investigated.

The main conclusions obtained are as follows :

- (1) Na ions, mobile charges in oxide film, are responsible for the surface states at 0.35 eV.
- (2) Recrystallization of oxide film does not change the energy level of the surface state.
- (3) Heat treatment at 200 C in vacuum does not change the energy level, but increases the surface state density.

Studies on the Noise of Silicon MOS Diode and Its Origin

Masao MAEDA
Tetsuo MURANOI

Abstract

Various instabilities of MOS structures, such as the noise and life time, are attributed to the surface states which lie at the interface between the semiconductor and the oxide film. The present paper describes experimental results concerned with the relation between the noise and surface treatment of Si MOS diode.

Two kinds of samples were prepared. The noise spectrum shows $1/f$ characteristics for both samples. The samples, which were chemically polished for a short time (2 min.), show a considerable peak in the noise-bias voltage diagram at a given bias voltage.

The C-V (capacitance-voltage) characteristics and pulsed field effect were measured in order to explain the relation between the noise and surface states. Experimental results obtained show that the surface states, which contribute to the noise peak, are in the shallow levels lying near the bottom of the conduction band. Further it was shown that longer polishing time gives a more stable surface.

Attenuation of Light Beam by Snow in the Atmosphere

Katsuaki SAKAKIBARA, Nobuyuki KODAMA,
Kouji KANAYA and Michio SUZUKI

Abstract

Light beam propagation was studied in the atmosphere in the presence of a snowfall. Snow particles passing through the beam attenuates the light, and then the intensity at the detector is affected by both the number and the attenuation constant of snow particles in the beam.

The following facts were observed;

- 1) The relation between the snow particle number in the beam and the appearance frequency is akin to the Poisson distribution
- 2) The average attenuation constant of snow particles is approximately 0.1 and 1.0
- 3) The relation between the field of vision and the density of snow particles in the atmosphere is not linear

The above and a few other phenomena were observed.

Studies on the Oxo Synthesis (II)

—The Influences of the Reaction Temperature and the
Amount of the Catalyst in the Oxonation of Octenes
with Cobalt Naphthenate Catalyst—

Mutsuya MATSUBARA, Yasunobu DOI, Nobu TOMITA,
Kazuo AOMURA and Hiroshi OHTSUKA

Abstract

The influences of the reaction temperature and the amount of the catalyst on the conversion rate and the product compositions in the oxonation of octenes with cobalt naphthenate catalyst were observed and discussed.

The sample octene was prepared by the same procedure as shown in the previous report.

The reaction apparatus was a rotary autoclave of 2 liters capacity.

The experiments were conducted under the following reaction conditions.

Sample octenes used: 145 g for each run.

Pressure of synthesis gas at the reaction temperature: 200 atm gauge.

Synthesis gas composition: $H_2: CO=50:50$.

Reaction time: The reaction mixture was maintained at the reaction temperature for one hour.

Reaction temperature: $120\sim 220^\circ C$ (the catalyst amount: 2 wt.% to the sample as cobalt metal).

Catalyst amount: 0.1~2 wt.% to the sample as cobalt metal (the reaction temperature: $160^\circ C$).

The oxonation products were hydrogenated at $300^\circ C$ and under a hydrogen pressure of 200 atm in the presence of the cobalt catalyst.

The experimental results were summarized as follows:

1. In the oxonation reaction, the overall conversion rate of octenes was about 90% below the reaction temperature of $160^\circ C$, 97~98% between $160\sim 190^\circ C$ and about 75% over $190^\circ C$. While the conversion rate to alcohol was around 35%, 60%, and 40% respectively.

2. The overall conversion rate was about 85% with 0.1 wt.% of catalyst, about 92% with 0.5 wt.% of catalyst and about 97% with 2 wt.% of catalyst. While the conversion rate to alcohol was almost negligible with 0.1 wt.% of catalyst, and it increased with the increase of the catalyst amount up to 50% and over.

The oxonation products always contained an appreciable amount of aldehydes (25~30%).

It was found that, when cobalt naphthenate was used as the catalyst for the oxonation, the cobalt catalyst derived from the naphthenate was quite inactive to the hydrogenation of the oxonation products.

Studies on the Oxo Synthesis (III)

—The Influences of the Amount of the Catalyst
in the Oxonation of Octenes with
Cobalt-kieselguhr Catalyst—

Mutsuya MATSUBARA, Yoshikiyo KAWABE, Nobu TOMITA,
Kazuo AOMURA and Hiroshi OHTSUKA

Abstract

The aim of this work was to observe the influences of the amount of the catalyst on the conversion rate of olefin and on the composition of the reaction products in the oxonation of octenes.

The reaction apparatus was a vertical cylinder of 2.4 liters capacity with a stirrer. The oxonation was carried out in a batch system.

The experiments were conducted under the following reaction conditions.

Oxonation temperature: 180°C.

The pressure of synthesis gas at reaction temperature: 200 atm.

Hydrogenation temperature: 300°C.

The pressure of hydrogen at hydrogenation temperature: 170 atm.

Duration of each run: The reaction mixture was maintained at the reaction temperatures of 180°C in the case of oxonation or 300°C in the case of hydrogenation, until the pressure drop of the synthesis gas or hydrogen was no longer observed.

The amount of the catalyst used for each experiment: 2.0~0.13 wt.% to the sample as cobalt metal.

The experimental results were summarized as follows:

1. The maximum yield of C₉-alcohols (86.3% of the reaction products) was obtained with around 0.25 wt.% of the catalyst, and in this case, the amount of saturated hydrocarbons was 7.8% of the reaction products. The amount of saturated hydrocarbons increased with the increase of the catalyst amount.

The C₉-aldehydes in the oxonation products were completely converted to C₉-alcohols in the presence of cobalt metal.

2. The alcohol produced was a mixture of C₉-alcohols derived from branched C₈-olefins.

The higher boiling products were separated from the C₉-alcohol fraction by distillation. According to infrared spectroscopic determination and chemical analysis of these products, these products seemed to contain an appreciable amount of ethers and ether alcohols.

Thermodynamics of Polymer Solutions

Masaji ONODERA

Yasuhiro MIYAKE

Abstract

The asymptotic method was applied to polymer solutions, which was previously established by one of us in the theoretical considerations of regular solutions, and an improved expression to heat of mixing and activity coefficients of polymer solutions were obtained. A comparison between the conventional approximations and the asymptotic method is shown in figures by considering the existing experimental data on the heat of mixing and the activity coefficients of the solvent.

NOTICE

Papers and Reports	Author	Page
No. 45 (December 1967)		
1. On the Motion of the Body-Wheel System of the Automobile (II) —Mechanics of the Rear Wheel and the Body System—	T. Irie, Y. Ueda	1
2. An Experimental Investigation to Produce Single Crystal of Fe-Si Alloy by Strain-Anneal Method --On the Apparatus and Some Results--	H. Nakae, K. Tagashira	19
3. Speed Control of an Induction Motor by "Double Exciting"	Y. Ito, H. Fujiwara, S. Fukuda	29
4. Paraxial-Ray Equations and Critical Perveance in CEF-Type Electron Beams	K. Koyanagi, I. Sakuraba	45
5. Low-Speed Cross-Correlation Radar Signal Detection System	M. Suzuki, N. Tsukamoto	53
6. Studies on Boron Trifluoride Complex Catalysts (III) --The Depolyalkylation of Benzene with Diisobutylene in the Presence of BF ₃ -complex Catalysts—	N. Yoneda, K. Suzuki, K. Aomura, H. Ohtsuka	67
7. Synthesis (OH, F)-Chrysotile in Alkali Solution under Pressure	H. Saito, I. Yamai, K. Ono	81

**On the Motion of the Body-Wheel System
of the Automobile (II)**

— **Mechanics of the Rear Wheel and the Body System** —

Toshihiro IRIE
Yutaka UEDA

Abstract

As a continuance from the preceding paper treating the mechanics of the front-wheel system, in this paper the mechanics of the entire system of the automobile including the rear wheel and body system was studied theoretically. A new rear-axle coordinate system was introduced in addition to the coordinate systems as presented previously for the convenience of mathematical treatment of the rear-wheel system. The equations of motion and geometrical and mechanical conditions on the rear-wheel and the body system were described in detail. And a block diagram of the entire system was presented in order to view the flow of the transmission of deflections, forces and moments, etc. through each member of the automobile.

**An Experimental Investigation to Produce Single Crystal
of Fe-Si Alloy by Strain-Anneal Method**

— **On the Apparatus and some Results** —

Hitoshi NAKAE
Kōsuke TAGASHIRA

Abstract

An apparatus to produce single crystals of Fe-Si alloy by strain-anneal method with a high temperature gradient furnace was designed. The process using this apparatus is as follows; the specimen which was primarily annealed after cold rolling was subjected to a strain of 3% in tension, then was lowered slowly into the high temperature gradient furnace which brought about a change from polycrystalline to single crystal. In this apparatus, 300°C/cm was attained as the maximum temperature gradient.

We successfully produced large single crystals for commercially pure Fe-Si alloys which contain an impurity acting as an inhibitor to prevent normal grain growth, lowering the specimens at the rate of 10 mm/hr into the furnace at 1100°C. The

orientation of grown single crystals were (110)[001] or thereabouts in general.

These orientations are identical to the common secondary recrystallization texture, i. e. Goss texture. The present method, however, failed to produce from a material with high purity and to produce single crystals with any desired orientations which are the next scheme.

Speed Control of an Induction Motor by "Double Exciting"

Yuzo ITO
Hajime FUJIWARA
Shoji FUKUDA

Abstract

Many methods for speed control of a wound-rotor induction motor have been devised. In this paper a method which is similar to the frequency control and the Scherbius system of induction motor is described. The rotor is supplied from a variable frequency inverter, with SCRs having the same output frequency as the rotor (sf) and the stator is connected to a 3-phase network which is constant voltage and frequency. For this reason this method is called "Double Exciting."

The motor operates in the region of $s > 1$, so that the rotor revolves against the rotating field which is originated by the stator winding. Part of the slip power is fed back to the network through the stator.

The Starting is smooth and the starting current is low. The device has a continuous speed control from 0 to maximum, but it is confined within mechanical limitation and inverter power. From the approximate equivalent circuit, equations for calculating the characteristics of this method are described. Although the SCRs inverter has harmonics the motor is noiseless. The influence on the motor by harmonics is described and a comparison is made between the measured values and calculated values.

Paraxial-Ray Equations and Critical Perveance in CEF-Type Electron Beams

Kojiro KOYANAGI

Ichiro SAKURABA

Abstract

This paper deals with the paraxial-ray equation and conditions of no rippling in CEF-type electron beams.

If the perveance of the beam is adjusted to attain $r_0 = 3X_0$, there is no rippling of the beam. Here r_0 is the radius of the optical-axis electron and X_0 is the cathode-anode spacing of a hypothetical planar diode. The condition of zero rippling does not occur for zero space-charge, but rather for a particular value of the perveance, which is called Waters' critical perveance.

This relation for the critical perveance corresponds to $Q = -2$, where Q is the Nunn-Rowe space-charge parameter in CEF-type traveling-wave devices. This means that the radial resonant frequency of the edge-of-the-beam electron, $\sqrt{2} \Omega_0$, is always equal to the electron plasma frequency ω_p for a beam possessing critical perveance. The electrons within the beam have the radial resonant frequency $\sqrt{2+Q} \Omega_0$, where Ω_0 is the unperturbed spatial angular velocity.

Low-Speed Cross-Correlation Radar Signal Detection System

Michio SUZUKI

Nobuo TSUKAMOTO

Abstract

In this paper a low-speed cross-correlation system available for a one-dimensional radar signal detection system was presented. In practice, the simplicity of an equipment is of great importance, this system, which promised considerable improvement of signal-to-noise ratio, was found to be applicable especially in its simplicity. Interpretation of the operative principle, a concrete method of realizing it and some theoretical analysis were described. The experimental results obtained using the experimental device made in our laboratory were also presented.

Studies on Boron Trifluoride Complex Catalysts (III)

— The Depolyalkylation of Benzene with Diisobutylene
in the presence of BF_3 -complex catalysts —

Norihiko YONEDA, Katsuhiko SUZUKI
Kazuo AOYAMA, Hiroshi OHTSUKA

Abstract

The depolyalkylation of benzene with diisobutylene for preparing tert-butyl benzene was carried out in the presence of some BF_3 -complex catalysts ($\text{BF}_3\text{-H}_2\text{O}$, $\text{BF}_3\text{-H}_3\text{PO}_4$ and $\text{BF}_3\text{-H}_2\text{O-H}_2\text{SO}_4$).

In this report, the effect of reaction conditions, such as catalyst amount, BF_3 concentration of the catalyst, reaction temperature, feed velocity of olefin or time of maturing after olefin addition, were observed and discussed.

Among the catalysts used, the $\text{BF}_3\text{-H}_2\text{O}$ complex catalyst gave the best results. The optimum reaction temperature was 30–50°C.

It was observed that the catalytic activity of the $\text{BF}_3\text{-H}_2\text{O}$ complex was strongly influenced by its $\text{BF}_3/\text{H}_2\text{O}$ mole ratio. The catalyst was quite inactive where the $\text{BF}_3/\text{H}_2\text{O}$ mole ratio was 0.5 and lower. Where the $\text{BF}_3/\text{H}_2\text{O}$ mole ratio was between 0.5 and ca 0.8, the catalyst was active for the polymerization and depolymerization of diisobutylene, but only slightly active for the tert-butylation of benzene with diisobutylene. The catalytic activity for the depolyalkylation of benzene with diisobutylene became predominant, when the $\text{BF}_3/\text{H}_2\text{O}$ mole ratio of the catalyst was in close proximity with 1.

The life of the catalyst was also observed. Repeated use of the catalyst caused a gradual deterioration in its activity. The activity of the spent catalyst was restored to some extent by treating the catalyst with BF_3 .

Synthesis (OH, F)-Chrysotile in Alkali Solution under Pressure

Hajime SAITO
Iwao YAMAI
Kōhē ONO

Abstract

Chrysotile was formed from a raw material mixture in alkali solution at a stable region of chrysotile coexisting with brucite by previous work. This region was deter-

mined by the treatment of natural chrysotile with a 0.5 m. NaOH aq. solution, and was wider than that determined by Bowen and Tuttle in pure water. The wider region would be thermodynamically stable while not being dynamically stable.

In the same alkali solution, chrysotile was formed from sodium meta-silicate and magnesium fluoride, and the F-content of this product showed a comparable value with that obtained by exchange reaction between natural chrysotile and fluoride solution.

The small amount of exchanged fluorines compared with the amount of hydroxy radical in chrysotile and its structural consideration gave proof of the existence of only two hydroxy radicals which are readily exchanged with fluorines in one structural unit. These were coordinated on the silicate layer side in the structure.

NOTICE

Papers and Reports	Author	Page
No. 46 (January 1968)		
1. The Effect of Physical Variables on Floc Blanket Type Suspended Solid Contact Clarifier Performance	N. Tambo, H. Hozumi	1
2. Treatment of Waste Water from Potato Starch Plant	K. Kōyama, Y. Magara	17
3. On the Biological Indices of Water Pollution	R. Kuwahara, N. Ashidate, A. Togo, H. Tachibana, M. Saito	35
4. Analytical Method of Transient Room Temperature in Multiple Rooms	K. Ochifuji	63
5. Thermal Sensation Analysis and its Application to Air-Conditioning	K. Ihamoto, Y. Nishi	73
6. Turbulent Diffusion of Stack Effluent within a Friction Layer	Y. Watanabe, A. Nakamura	123

The Effect of Physical Variables on Floc Blanket Type Suspended Solid Contact Clarifier Performance

Norihito TAMBO
Hitoshi HOZUMI

Abstract

The aim of this investigation is to establish the underlying principles which control the different stages of the floc blanket type clarifier so that the operation of existing units may be improved. The aim also includes improvements in the designing efficiency.

In this study two kinds of testing palnts were used. One which has a 30 m³/day hydraulic capacity was used for preliminary experiments. Another with a 3 m³/day capacity was used under varying operation conditions.

The results obtained in this study are as follows:

1. The Change of flocculation intensity index follows the following relationship.

$$\varepsilon_0 \propto R^3$$

where ε_0 : effective energy dissipation per unit volume per unit time (erg/cm³·sec), R : rate of rotation of the impeller (r. p. s.).

2. The relationship between flocculation intensity index ε_0 and the floc diameter D under the agitation condition is as follows.

$$D \propto \frac{1}{\sqrt{\varepsilon_0}}$$

3. The collision coefficient C in the floc blanket is in the order of 10^{-1} with respect to flocculated microflocs.

4. The controlling factor which decides the thickness of floc blanket is the disturbance of the upflow current. A thicker blanket may damp out the inlet turbulence and thus give a better overflow quality.

Treatment of Waste Water from Potato Starch Plant

Kēichi KŌYAMA
Yasumoto MAGARA

Abstract

The potato starch industry is one of the staple food industries in Hokkaido, Japan. The waste water from these starch plants is the major cause of stream pollution,

although the waste is discharged in a certain season in this country. For 8 years, the authors have investigated several treatment processes for this waste; trickling filter, contact aeration process with rotary disk (Tachtropfkörper), aerated lagoon, anaerobic liquified process and long time aeration. It was found that each of these processes should be operated under limited conditions of BOD loading and each has a different efficiency of BOD removal. The aerated lagoon method is the recommended treatment for this waste to minimize stream pollution.

On The Biological Indices of Water Pollution

Rinji KUWAHARA, Noriatsu ASHIDATE, Akihiko TOGO,
Harukuni TACHIBANA and Masaru SAITO

Abstract

Since pollution along water bodies have begun to interfere with human activities, various attempts to study the degree of pollution with biological indicators have been made by many investigators.

Together with the chemical tests of water the coliform group as an indirect indicator of pathogenic bacteria constitutes one of the significant parts of the water examination. Fungi, protozoa, algae, etc., have also been studied as water pollution indicators.

In general, these pollution indicator organisms can roughly be grouped into two groups. The first group satisfies the sanitary point of view. It comprises the organisms which indicate the presense of pathogenic organs of water-borne diseases. As most of the water-borne diseases result from digestive organs, these organisms should be suggestive of faecal pollution. And the second meets the view-point of water utilization such as water quality control of public water basins and research for water resources. These organisms should be suggestive of the quantitative degree of organic pollution.

With the knowledge of the coliform group, faecal streptococci, eumycetes and nematodes, the authors made an attempt to consider the subject matters of biological water pollution indicators and the outlook into the future of the study.

Analytical Method of Transient Room Temperature in Multiple Rooms

Kiyoshi OCHIFUJI

Abstract

This paper deals with problems on transient room temperature in the case of multiple rooms.

With the assumption of the linear flow of heat and of nonradiation between the wall surfaces, the room temperature produced by heating is given by $\sum_k (\Delta_{ki}/\Delta) W_k$ in the Laplace range, where W_k is the thermal quantity in an optional room, and Δ_{ki}/Δ is the system function determined by the structure, the materials and the rate of ventilation.

However, to obtain a general solution for room temperature is almost impossible because of the complexity of the system function. Further, the author presents an approximate analytical method to obtain transient room temperature in multiple rooms.

Thermal Sensation Analysis and its Application to Air-Conditioning

Kan-ichiro IBAMOTO

and

Yasunobu NISHI

Abstract

For half a century or more, many attempts have been made to establish thermal conditions based on which optimal promotion of mental and physical state to a task may be produced. However, adequate scales of warmth have not yet been proposed inasmuch as the composition of thermal environment has been too complex to be specified simply with a few thermal factors.

Reviewing the earlier works on the subject, some of them were conducted from a medical point of view while others were carried out from an engineering angle; the former, being empirical scales based on experiments, may not be applicable under unusual conditions, and the latter, theoretical scales based on thermal equilibrium, have its drawback in physical accuracy.

This paper is concerned with the development of a rational comfort index and its application to heating and air-conditioning.

Part I deals with the fundamentals of heat and mass transfer between man and environment, and a rational shape factor for radiation will be induced.

In Part II, the heat balance equations between man and environment are established. In the calculation of the heat exchanges, man must be treated as a whole and mean values of each heat transfer coefficient and of each thermal factor must be used. For such simplification of the situation the physiological properties are consulted. Further, into the experiment each of these approximations is verified.

Part III deals with a rational comfort index and its application. This index evaluates each component of the thermal environment, such as ambient temperature, radiant temperature, humidity, air-movement, heat and vapor resistance and emissivity of clothing, work rate, and physical properties of air.

Turbulent Diffusion of Stack Effluent within a Friction Layer

Yuji WATANABE
Akira NAKAMURA

Abstract

A solution was obtained for the diffusion of matters into a boundary layer from an elevated point source of constant strength. T. S. Walters (1957) obtained a solution for an elevated infinite line source which lies at right angles to the mean wind velocity, taking the mean wind velocity $U(z)$ and the coefficient of diffusion Kz in the vertical direction at height z to be

$$U(z) = U_1 z^m / z^m \quad \text{and} \quad Kz = Az^n.$$

Further, the authors took the coefficient of diffusion Ky in the horizontal cross-wind direction to be

$$Ky = B^2 U_1 x.$$

In the present paper, a generalized case is considered at an elevated point source; Bosanquet and Pearson's solution is derived from it as a special case.

Expressions are obtained for the maximum ground-level concentration C_{\max} and for the distance x_{\max} down-wind from the source at which the ground-level concentration C attains its maximum value C_{\max} . An expression is also obtained for C/C_{\max} with x/x_{\max} .