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Third International Symposium on  
Stochastic Hydraulics August 5-7,  
1980, Tokyo, Japan

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### **Model Assessment of Kalman Filter Algorithms for Runoff Prediction**

Kiyoshi HOSHI and Isao YAMAOKA

Operational comparisons are presented using the Kalman filtering techniques to predict 2- and 3-hour ahead flood hydrographs resulting from use of linear and nonlinear hydrologic response models.

For the representation of the dynamics of the rainfall-runoff process, a low-order autoregressive moving average process was taken as the linear discrete-time system, while the generalized storage equation was used to describe the nonlinear continuous-time behavior of the watershed.

A well-known linear Kalman filter was applied to the optimal estimation of the state variables of a linear model. For the approximate propagation of the states of a nonlinear dynamic system, the filter performance of the extended Kalman (first-order) filter was compared with that of the optimally driven (second-order) filter, which was primarily intended to eliminate the bias resulting from linearizing the nonlinear system involved in the extended Kalman filter.

The compared results of the three Kalman filter algorithms, when applied to several actual flood data in the Sorachi River Watershed, Hokkaido, Japan indicate that the optimally driven filter can markedly improve the filter performance in predicting the flood peak by the small expense of an increased computational load.

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Third International Symposim on  
Stochastic Hydraulics August 5-7,  
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### **Stochastic Response in a Nonlinear Runoff System**

Mutsuhiro FUJITA, Toshiyuki MICHIGUCHI and Isao YAMAOKA

The stochastic properties of the runoff were examined in this paper responding to the inputs from a stationary random process where the runoff system was described by a nonlinear partial differential equation. A quasi-steady approach, well-known as the kinematic wave approximation, was used for the runoff analysis of overland flows.

The results of the numerical experiments indicate that (1) the first two moments of runoff sequences show nonstationary for the time less than the time of concentration. For the time exceeding the time of concentration, the statistical properties show stationary; (2) the first two moments of stochastic responses can be expressed by the mathematical formulas for both linear and nonlinear runoff models; and (3) the autocorrelation function of runoff

sequences becomes zero at the lag time which is equal to the time of concentration.

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The Seventh World Conference on  
Earthquake Engineering, September 8  
-13, 1980, Istanbul, Turkey.

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**“Destructive Capability of Extreme Earthquake Motions  
Examined in Two Dimensions of Horizontal Plane”**

H. TAKIZAWA

Results of the destructive ratings for an ensemble of important strong-motion records are shown by total reflection of the effects of two-dimensional shaking and response on the horizontal plane. The structural systems used account for most of the significant trends in the dynamics of failure of flexural reinforced concrete as well as the biaxial interaction of yielding and hysteretic restoring forces. Two specific criteria relating the severity of motion to serious damage and ultimate collapse are then characterized by use of a bare-minimum measure of four parameters specifying the total oscillational energy, its time and frequency-domain accumulations, and its planar sprawl.

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The Seventh World Conference on  
Earthquake Engineering, September 8  
-13, 1980, Istanbul, Turkey.

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**“Effects of Localized Failure in Evaluating  
Ultimate Capacity of R/C Buildings”**

H. TAKIZAWA

A fully nonlinear formulation is presented for modelling the dynamic formation of a one or several story partial sway mechanism. After clarifying therein the role of fundamental system parameters, a series of quantitative examinations is made on the effects of this localized failure upon the capacity of R/C buildings resisting destructive earthquake motions under gravity loading. The study is intended to identify important trends of mechanics in the particular types of structural failure, and to characterize the criteria of their damage and collapse expedited seriously in comparison with the reference case of overall failure.

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1981 Annual Meeting of the Seismological Society of America, March 23-25, 1981 Berkeley, California U. S. A.

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**Observation of Long-Period Microtremors on the Extremely Deep Soil Deposits for an Evaluation of Seismic Input Motions to Large-Scale Structures**

Hiroshi KAGAMI

Hokkaido University, Sapporo 060 Japan

C. Martin DUKE and George LIANG

University of California at Los Angeles, California 90024 U. S. A.

An evaluation of seismic input motions to large-scale structures on the extremely deep soil deposits is presented by means of observations of long-period microtremors.

Recorded strong motions in Niigata City, during the 1964 Niigata Earthquake, had an acceleration as large as 100 gals in long-period range of 5-6 seconds. At the 1971 San Fernando Earthquake long-period seismic motions were also remarkable. Upon dynamic design process to large-scale structures, these large accelerations are strongly influential.

From this standpoint, observations of long-period microtremors were introduced and carried out in Niigata and Los Angeles Plains.

Through spectral analyses it is indicated in both Niigata and Los Angeles that the spectral amplitudes in the long-period range increase systematically from site to site as a function of the total thickness of soils. This result coincides well with that derived from the strong motion data, and suggests a way of prior evaluation of long-period seismic input motions to large-scale structures.

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8-th Regional Seminar on Earthquake Engineering, Sept. 1980, Varna, Bulgaria

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**Seismic Wave Amplification due to Dynamic Ground Characteristics in a Period Range of 1 To 10 sec**

Yutaka OHTA, Hiroshi KAGAMI, and Noritoshi GOTO

Dept. of Architectural Engineering, Hokkaido University

A study on amplification characteristics of earthquake ground motions in a period range of 1 to 10 sec is briefly described, as one basic investigation for dynamic earthquake-resistance of large-scale structures. The data were obtained by strong motion displacement seismographs with natural period of 6 sec, operated at about 100 local seismic stations of Japan Meteorological Agency. All the shallow and moderate-to-large earthquakes occurred in and around Japan in recent 15 years were selected for analysis. As a result it was concluded that the wave amplification in the period range of 1 to 10 sec is mainly due to the soil deposits from several hundreds to thousands meters in depth.

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7-th World Conference on Earthquake  
Engineering, Sept. 1980, Istanbul,  
Turkey

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### **An Engineering Seismological Study on the 1976 Çaldıran Earthquake in Turkey**

Yutake OHTA<sup>1)</sup>, Noritoshi GOTO<sup>1)</sup>, Kazuyuki SATOH<sup>1)</sup>,  
Oktay ERGÜNNAY<sup>1)</sup>, and Ahmet TABBAN<sup>1)</sup>

- I) Department of Architectural Engineering, Faculty of  
Engineering, Hokkaido University, Sapporo 060 JAPAN  
II) Earthquake Research Institute, Ankara, Turkey

The 1976 Çaldıran earthquake gave a unique opportunity to elucidate the total features from the seismic source process to spatial damage distribution. A joint research group between Turkey and Japan was organized and a detailed investigation has been continued.

By use of the seismological and field experimental data, a model for seismic intensity analysis, taking into consideration the finiteness of earthquake fault, slip distribution, further site geology was applied to this earthquake. The superiority of this new model was clearly demonstrated by comparison between the observed and calculated intensities. The most probable source parameters, which are determined by a sensitivity analysis of the new model, show good agreement with those estimated by the WWSSN data. A disaster analysis, combined loss of human lives with structural damage ratio are highly correlated with the observed values. Engineering seismological significance of the new model was also discussed.

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7-th World Conference on Earthquake  
Engineering Sept. 1980, Istanbul,  
Turkey

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### **Observation of Long-Period Microtremors with Special Reference to an Evaluation of Long-Period Seismic Motions on the Extremely Deep Soil Deposits**

Hiroshi KAGAMI<sup>1)</sup>, C. Martin DUKE<sup>1)</sup>, George LIANG<sup>1)</sup>  
and Jun HORITA<sup>1)</sup>

- I) Department of Architectural Engineering, Faculty of  
Engineering, Hokkaido University, Sappore 060 JAPAN  
II) School of Engineering and Applied Science, University of  
California at Los Angeles, California 90024 U. S. A.

Long-period microtremors observations were carried out in Niigata Plain and Los Angeles Basin to evaluate predominated long-period strong motions recorded on extremely deep soil duposits during the 1964 Niigata Earthquake and the 1971 San Fernando Earthquake.

Through simultaneous and repeated observations, it is indicated that amplitudes of micro-

tremors in long-period range increase systematically from bedrock outcrop to deposit sites corresponding to the depth to bedrock. This relationship coincides with that derived from accelerograms obtained on extremely deep soil deposits in each area. These indicate that long-period microtremors observation is a powerful tool to clarify deep ground conditions and to estimate long-period seismic motions.

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7-th World Conference on Earthquake  
Engineering, Sept. 1980, Istanbul,  
Turkey

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### **A Field Survey on Human Response During and After an Earthquake**

Yutaka OHTA and Hitomi ŌHASHI

Faculty of Engineering, Hokkaido University, Sapporo 060 Japan

From the viewpoint that human behavior during an earthquake has a significant influence upon increasing and reducing earthquake disasters which might be suffered, a field survey on human responses during and immediately after an earthquake, and on subsequent daily lives was conducted at the 1978 Miyagi-ken-oki Earthquake. By means of questionnaire and interview, it was clarified that some of the human behaviors are strongly correlated with the seismic intensity, and some are controlled by the circumstances of family constituents, housing plans, and the existence of fire sources in use. A schematic model for explaining the total process of human behavior during the quake was tentatively proposed.

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1981 Annual Meeting of the Seis-  
mological Society of America, March  
23-25, 1981, Berkeley, California, U.S.A.

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### **A Study on Renewal of the Instruments for Strong Motion in Japan**

Shigeyuki OKADA, Noritoshi GOTO, and Yutaka OHTA

Hokkaido University, Sapporo 060 JAPAN

An experimental study on the improvement of strong motion seismometry has been continued from an engineering seismological point of view, since the wellknown SMAC type accelerometer, is becoming far less than satisfactory because of its limitation of dynamic and frequency ranges and lack of absolute or common time recordings. In order to overcome the above shortcomings, in the course of these studies two different types of strong motion seismographs have been proposed. This paper describes the specifications and characteristics of these new equipments.

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The Second International Symposium  
on Drying at McGill University,  
Montreal, July 6-9, 1980

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### **Mechanism of the Vapor Transfer in a Moist Granular Bed under a Temperature Gradient**

Masashi KURAMAE

Department of Sanitary Engineering, Hokkaido University, Japan

This paper deals with the problem of the vapor transfer mechanism in a moist granular bed under a temperature gradient. First, the temperature gradient ratio  $\xi$  was defined as the ratio of the temperature gradient in air filled void to that of the overall granular bed. Then, the dependence of the properties of the composite materials, its porosity, liquid content and temperature on  $\xi$  was analyzed by the series-parallel heat conduction model. Moisture flow experiments under a temperature gradient were also performed by using NaCl as a tracer. As a result, it was suggested that the value of the  $\xi$  has a significant effect on the vapor transfer ratio in a partially saturated granular bed, where the transfer takes place accompanied with repeated vaporization and condensation.

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5th International Clean Air congress,  
Buenos Aires, Argentina, October 20  
-26, 1980

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### **Sampling Consideration in Air Quality Monitoring**

Rikita INOUE\*, Yuji WATANABE\*\*, Nobutaka OKUYAMA\*\*  
and Kazutoshi KISAICHI\*

On the basis of a number of actual cases, a study was made on the relationship between the sampling interval and the estimated accuracy of statistical values of the population obtained from sampled statistical values in the case of sampling made on air pollution concentration at equal time intervals.

Especially this paper examines to what extent the mean and variance of sampled values represents the mean and variance of the population.

As the daily cycles and their high harmonics are detected by the spectrum analysis of the time series of measured values of air pollution concentration, the selection of the time interval of measurements to be multiples of any of the divisors of 24 should be avoided for intermittent sampling.

The selections of hours other than multiples of 2 or 3 as the sampling interval will lead to a kind of proportionate stratified sampling in which stratification is made at each time of the day. In this case, the variance of sample means is approximated by the following

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formula.

$$\sigma_0^2 = \frac{(\sigma^2 - \sigma_{24}^2) m}{N}$$

where  $\sigma_0^2$  is the variance of sample means,  $\sigma^2$  is the population variance,  $\sigma_{24}^2$  is the variance of the mean values of each hour,  $N$  is the total number of data, and  $m$  is the sampling interval.

Also, as to the variance of the sample variances may be conservatively approximated by

$$\frac{(\mu_4 - \sigma^4) m}{N}$$

where  $\mu_4$  is the fourth-order moment around the mean.

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Fourth Joint Meeting MMIJ-AIME,  
1980, Tokyo, 8-Nov., 1980

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### **Relief Boring for Preventing Gas Outburst in Akabira Coal Mine**

S. KINOSHITA, Y. ISHIJIMA, T. GOTO, N. ODA

In order to ascertain the effectiveness of the stress relief boring in controlling gas outburst, both field tests and laboratory investigations have been conducted. As a result of the field study carried out in Akabira Coal Mine, it was found that the relief boring contributes to relieving the pressure and the stored energy in the highly stressed zone expected to exist at a 5 to 6 m depth behind the working face of a coal drift, and that if the release of energy is sufficient, the load carried by the highly stressed zone is transferred into the intact coal behind the face, say, to a depth 10 to 15m.

Simulation by using the finite element method confirmed the field results on the mechanical disturbance in the coal seam induced by the boring.

The effectiveness of the relief boring is postulated to result from the creation of the considerable extent of disturbance caused by it.

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The Aus. I. M. M. Illawarra Branch  
Ignitions, Explosions and Fires in  
Coal Mines Symposium, May 1981  
Wollongong, Australia

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### **Underground Ventilation Network Analysis by Using Graph Theory**

Toshiro ISOBE and Yuusaku TOMINAGA  
Department of Mineral Resources Development Engineering

Mine ventilation control is one of the most important technics to limit hold the disastrous region within a limited area, so that underground workers will have sufficient time to



escape from the danger district at the time of emergencies (Ignitions, fires and so on). The purpose of this paper is to introduce simultaneous control of mine ventilation by using a micro computer connected to various kinds of sensors. In this study, basic of mine ventilation and graph theory are used for preparing computer programs when the characteristic curves of fans and temperature distribution in an underground roadway network are given.

Results considered in this paper are as follows ;

1) The Relation between the quantity of air leakage into the gob and resistance change of each roadway branch, 2) On the ventilation quantity in relation to connected branches, 3) Relation between the temperature change at the surface and properties of branches in an underground roadway network, and 4) Simulation of depression and air quantity in a network in emergencies.

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Fourth Joint Meeting MMIJ-AIME  
Tokyo, Nov. 4-8 1980

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### **Fundamental Aspects on Spherical Agglomeration in Water**

T. TAKAMORI, T. HIRAJIMA and M. TSUNEKAWA

The effects of each variable in an agglomeration-in-water on formation and growth of agglomerates were clarified in the present paper. The porosity change of agglomerates, which was measured through the agglomeration, indicated that porosity decrease was closely related to the formation and growth of agglomerates. And, when a degree of saturation ( $S$ ), which was the volume ratio of bridging liquid versus void volume of agglomerates, increased beyond a certain critical " $S$ " value, the total number of agglomerates began to decrease rapidly.

The relation between porosity change and net agitation energy consumption was found to be represented by a modified Kawakita equation, and it was confirmed that " $b$ " in the equation indicated the easiness of compaction of agglomerates. And, there was a good agreement between the tendencies of size of the agglomerates measured in the experiments and the calculated tensile strengths of agglomerates under the same condition as in the present experiment.

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Symposium on Ignitions, Explosions  
and Fires, March, 1981.  
Wollongong University, Australia

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### Theoretical and Experimental Research on the Occurrence of Spontaneous Combustion of Coal Seams

Toshiro ISOBE and Kiyoshi HIGUCHI

A hypothesis that the cause of spontaneous combustion of coal depends on the accumulation of heat produced by oxidation is introduced. The authors derived the equation expressing the temperature change in a pile heap of fine coal. To solve the equation, thermal conductivity, specific heat and rate of heat generation of fine coal (-48 mesh) were measured at various temperatures in a range of 20-65°C. The equation was solved numerically and the volume of fine coal which would ignite spontaneously was estimated as the function of ambient temperature. Using 170kg of fine coal, several experiments for confirmation were conducted. At the ambient temperatures of 60°C and 50°C, coal began to ignite spontaneously about 60 and 110 hours later respectively. In addition to this, the measured temperatures in the coal heap agreed with the calculated ones comparatively well.

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4th Joint Meeting MMIJ-AIME,  
Tokyo, Japan, 4-8 November 1980.

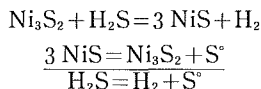
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### Use of Hydrogen Sulfide as a Source of Hydrogen

Hirohichi KIUCHI, Kimio FUNAKI, and  
Tokiaki TANAKA.

Department of Metallurgical Engineering, Faculty of  
Engineering, Hokkaido University, Sapporo 060 Japan

In this research, the two-stage thermochemical cycle is proposed as described below, and experimental studies were made on the cycle.



In the case where  $\text{Ni}_3\text{S}_2$  alone was used without inert additions, the sample was sintered or partly fused due to the melting point depression resulting from the thermal decomposition of formed NiS. Such sintering could be prevented by mixing the nickel sulfide powders with  $\text{Al}_2\text{O}_3$  or  $\text{MoS}_2$ . Thus, the cyclic reactions were shown to provide a stationary high decomposition rate of  $\text{H}_2\text{S}$ . Polysulfides, such as  $\text{MS}_2$ , have been previously used in this kind of cycle. This research showed that the use of lower sulfides such as  $\text{Ni}_3\text{S}_2$  may be regarded as rather promising based on a thermodynamic investigation of the respective reactions comprising the cycle. The comparison between the sulfurization reactions of NiS to  $\text{NiS}_2$  and of  $\text{Ni}_3\text{S}_2$  to NiS further showed that the latter was superior to the former with respect

to the kinetics of reaction and resulting  $H_2$  concentration.

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Society of Automotive Engineers International Off-Highway Meeting  
MECCA, Milwaukee, USA, September  
8-11, 1980

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### **Unique Measuring Method of Indicator Diagrams Using Strain History of Head Bolts**

Noboru MIYAMOTO, Tadashi MURAYAMA and Shin-ichi GOTOH

To obtain accurate indicator diagrams without the use of pressure transducers, the strain and the displacement of the various parts of the engine structures that would have some relationship with pressure variation in the cylinder were measured and analyzed mathematically.

By measuring the strain of the cylinder head bolts, the horizontal displacement of the crank shaft end, and the vertical displacement of the intake valve stem, we noted that indicator diagrams could be obtained easily without a passage transmission from the interior to the outside of the combustion chamber.

Accurate indicator diagrams were estimated by applying the pressure-strain diagrams obtained from the static pressure tests in the cylinder to the strain variation of the cylinder head bolts. In this case, the accuracy of the estimated indicator diagrams could be improved by providing the cylinder head system with a one degree of freedom vibration system. The propriety of this measuring method was examined and proved in the experiments.

It was shown that this method can be applied not only for single cylinder engines, but also for multicylinder engines.

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Society of Automotive Engineers International Off-Highway Meeting  
MECCA, Milwaukee, USA, September  
8-11, 1980

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### **Combustion Behaviors under Accelerating Operation of an IDI Diesel Engine**

Tadashi MURAYAMA, Noboru MIYAMOTO, Toshio TSUDA  
Masao SUZUKI and Shin-ichi HASEGAWA

In a four-cycle, naturally aspirated, pre-chamber diesel engine, the combustion characteristics such as the rates of fuel injection, the ignition lag, the rates of heat release, the combustion peak pressure, the maximum rates of pressure rise, and the smoke density, were investigated for over 70 consecutive cycles under acceleration, with the aid of an on-line

data handling system developed for this experiment.

An investigation on the effects of operating conditions such as the fuel injection timing, the fuel spray angle, the wall temperature of the combustion chamber, and the coolant temperature, on the combustion characteristics were also carried out.

As a result, it was clarified that the fuel injection timing as well as the coolant temperature were important factors for improving the acceleration and the combustion characteristics during acceleration except for the time just after the beginning of acceleration were estimated from the data obtained for steady-state operation corresponding to acceleration.

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Fourth International Symposium on  
Alcohol Fuels Technology, October 5  
-8, 1980, Guarujá, São Paulo, Brasil

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### **Methanol and Formaldehyde Kinetics in the Exhaust System of a Methanol Fueled Spark Ignition Engine**

Kenichi ITO and Toshiaki YANO  
Department of Mechanical Engineering Hokkaido  
University, Sapporo, 060 Japan

A detailed chemical kinetic model has been proposed to explain the mechanism of formaldehyde formation in a methanol fueled spark ignition engine. A reaction scheme model for the oxidation of methanol and formaldehyde in engine exhaust gases in a temperature range of 600–1100°K consists of 94 elementary reactions involving 24 chemical species.

To evaluate the validity of this mechanism, the calculations were compared with experiments using a heated reactor tube set at the engine exhaust port. The agreement between experimental and calculated results indicated that the introduced reaction scheme was reasonable for approaching formaldehyde formation. It was possible to theoretically predict the reaction behavior of methanol and formaldehyde in the exhaust tube. Formaldehyde formation can be explained in that the unburned methanol, moving away from the cylinder quenching layer, is mixed with hot bulk gases during the exhaust stroke and is slowly oxidized at about 800°K in the exhaust process.

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9th International Symposium on the  
Reactivity of Solids, Cracow, Poland,  
September 1-6, 1980

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### Application of DTA to the Reactivity Measurements of Solids

Tadao ISHII

Department of Applied Chemistry, Faculty of Engineering,  
Hokkaido University, Sapporo 060, Japan

DTA as a non-isothermal technique was applied to the study of the reaction processes in the initial reaction step which plays an important role in the reactivity of solids. The following three reaction systems were selected. MgO-Al<sub>2</sub>O<sub>3</sub>-NaF system: the promoting action of NaF additive in the initial step for the reaction, MgO+Al<sub>2</sub>O<sub>3</sub>=MgAl<sub>2</sub>O<sub>4</sub>, is due to the following reactions; 2Al<sub>2</sub>O<sub>3</sub>+3NaF  $\xrightarrow{(MgO)}$  3NaAlO<sub>2</sub>+AlF<sub>3</sub> (1), 3MgO+2AlF<sub>3</sub>→3MgF<sub>2</sub>+Al<sub>2</sub>O<sub>3</sub> (2), 3MgF<sub>2</sub>+4Al<sub>2</sub>O<sub>3</sub>→3MgAl<sub>2</sub>O<sub>4</sub>+2AlF<sub>3</sub> (3), and MgF<sub>2</sub>+NaF→NaMgF<sub>3</sub>(eutectic mixture with MgF<sub>2</sub>) (4). Cr<sub>2</sub>O<sub>3</sub>-MgO system: the initial rapid reaction at Cr<sub>2</sub>O<sub>3</sub>-MgO contacts in O<sub>2</sub> atmosphere under the catalytic effect of MgO, Cr<sub>2</sub>O<sub>3</sub>+3/2O<sub>2</sub>  $\xrightarrow{(MgO)}$  2CrO<sub>3</sub> (5), and MgO+2CrO<sub>3</sub>→MgCr<sub>2</sub>O<sub>4</sub>+3/2O<sub>2</sub> (6). TiO<sub>2</sub>(anatase and rutile)-CaSO<sub>4</sub> system: the formation of CaTiO<sub>3</sub> through some intermediate in the initial step, TiO<sub>2</sub>+CaSO<sub>4</sub>⇌(TiO<sub>2</sub>·CaO·SO<sub>3</sub>)→CaTiO<sub>3</sub>+SO<sub>3</sub> (7), the more stable in anatase form up to higher temperatures, resulted in higher reactivity of TiO<sub>2</sub>. Similar results were obtained for the TiO<sub>2</sub>-BaSO<sub>4</sub> systems.

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International Conference "Radiation  
Processing for Plastics and Rubber"  
15-17, June 1981 Brighton, United  
Kingdom

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### Application of a New NMR Technique to a Study of Cross-Links

J. SOHMA, M. SHIOTANI, and T. YOSHIDA\*

Magic angle spinning combined with the cross-polarization (MASCP) technique, by which a highly resolved <sup>13</sup>C-NMR spectrum is obtained from a solid sample, was successfully applied to a  $\gamma$ -irradiated ethylene-propylene rubber (EPR), in order to specify chemical bonds at the cross-links produced by  $\gamma$ -irradiation. Relative concentrations of the cross-links at the different sites were also estimated from the observed <sup>13</sup>C-NMR spectra. Concentration of the cross-links estimated by the NMR was much higher than that determined by a gel fraction measurement and a plausible origin of the discrepancy was discussed.

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\* Government Industrial Development Laboratory, Sapporo

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Third International Conference on  
Advances in the Stabilization and  
Controlled Degradation of Polymers  
1-3 June 1981 Lucern, Switzerland

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### **Mechano-radicals as a Key to Study of Mechanical Degradation of Polymers (Invited Paper)**

J. SOHMA

Mechano-radicals initiate chemical reactions which lead to degradation of polymers and therefore the mechano-radicals play crucial roles in mechanical degradation. Examples of mechano-radicals are mentioned on polyethylene and polypropylene. A model was proposed in an attempt to explain the existence of the critical size of molecules for the mechano-radical formation. It was experimentally verified that PMMA mechano-radicals started a cyclic reaction leading to self-degradation of polymers even after the cessation of the mechanical actions. The mechano-radicals were found to be reactive with oxygen to form peroxy radicals, and these peroxy radicals initiate cyclic reactions, which brought about gauge rise to self-degradation. This is a combined effect of mechanical and chemical degradations. The mechano-peroxy radicals act as chromophores for photoabsorption and accelerate photo-degradation. This is another combined effect between mechanical and photo-degradations. The main-chain scissions induced by either ultrasonic irradiation or high speed stirring in polymer solution were demonstrated by ESR combined with the spin-trapping technique.

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IUPAC 27th International Symposium  
on Macromolecules, Florence, Italy, 7  
-12 September 1980

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### **Chain Conformation and Local Ordering in Amorphous Polymers**

Akira ODAJIMA and Mikio NUMAKAWA  
Department of Applied Physics, Faculty of Engineering,  
Hokkaido University  
Osamu YODA  
Takasaki Radiation Chemistry Research Establishment,  
Japan Atomic Energy Research Institute,  
Takasaki

The local chain conformation and packing in amorphous solid of polymer are studied by the analysis of the radial distribution function (RDF) for ethylenepropylene random copolymer (EPRC) and  $\gamma$ -ray irradiated polyethylene (PE). A new method is presented in order to remove the contribution of H-atoms to the observed RDF in C- and H-atoms systems, and the C-C pair RDF's for EPRC and amorphotized PE are derived.

From the C-C pair RDF, the intrachain and interchain coordination numbers are obta-

ined in a range of 6Å. The result indicates that the conformational probabilities for trans and gauche states in the these chains are nearly equal between the amorphous bulk state and the isolated chain state.

The intrachain order of them increases with the decreasing temperature in such a way that is predicted to be in an isolated state. The interchain order in EPRC also shows an increasing at  $-140^{\circ}\text{C}$ , compared with that at room temperature, but shows nodetectable change in the irradiated PE. The latter seems to be due to the interchain cross-linkings.

19th Symposium Engineering Aspects  
of Magnetohydrodynamics, The Unive-  
rsity of Tennessee Space Institute  
Tullahoma, Tennessee, U. S. A. June  
15-17, 1981

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**Experimental Study of the Effects of the Transversally  
Shaped Configuration of the Magnetic Field  
Upon the Output Performance of an MHD Generator**

Naoyuki KAYUKAWA, Yasutomo OZAWA and Yoshiaki AOKI  
Energy Conversion Research Institute

**Abstract**

Effects of applying a transversally shaped configuration of magnetic field upon the output performance of a Faraday type MHD generator were investigated experimentally by using shock heated plasma seeded with  $\text{K}_2\text{CO}_3$ . The strength of the magnetic field beyond the boundary layer region of electrodes was sharply reduced by immersing mild steel bars both within the electrode and insulator walls made of an acrylic resin.

It was observed that the apparent conductivity, the output power, the effective internal resistance and the anode potential drops were markedly improved in comparison with those of the MHD generator with the conventional uniform distribution of the magnetic field. It could certainly be said that these effects were due to the reduction of Hall's effect within the cold boundary layers and also due to the guiding effect for the output current toward the electrode by the transverse component of the magnetic field.

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Japan-United States Heat Transfer  
Joint Seminar, Tokyo, Japan, Septe-  
mber 30-October 2, 1980

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### **A Study of Metal Vapour Condensation**

R. ISHIGURO, K. SUGIYAMA and T. HISAMATSU  
Department of Nuclear Engineering, Faculty of Engineering  
Hokkaido University, Sapporo, Japan

Studies of metal vapour condensation are briefly reviewed including recent results of intensive mass transport conditions. Information on an experiment presently being conducted in the author's laboratory with potassium vapour is also included.

The experiment covers vapour temperatures from 580 to 670 K, and vapour pressures from 53 to 530Pa. Scrupulous cautions were taken in the design and operation of the experimental apparatus for correct measurements of condensation surface temperature and for minimizing noncondensable gas in the vapour. The condensation coefficients obtained by the measurement fell between 0.9 and 1.0 except in the data taken under conditions of intensive condensation. For the intensive cases, the data were compared with Necmi and Rose's results, which were obtained by using mercury.

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International Tsunami Symposium  
1981 at Sendai-Ofunato-Kamaishi  
Japan May 25-28, 1981

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### **Tsunami Response of the Tsugaru Straits**

Susumu TAKAHASHI and Isao YAKUWA

Numerical calculations were carried out by using model tsunamis that were designed on the Pacific Ocean in order to obtain the tsunami response of the Tsugaru Straits and Mutsu Bay.

Some suitable digital bandpass filters were used to separate each model tsunami wave into secondary undulations.

As a result of the calculations, many secondary undulations appeared and most of them agreed well with the undulations obtained from actual tsunami waves that had been recorded at several tide gauge stations along the coast of the straits.

Moreover, the existence of unknown undulations which have very long periods were predicted.



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International Symposium on Atomo-  
spheric Corrosion, October 6-10, 1980  
Hollywood, U. S. A.

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### **Atmospheric Corrosion Testing in Japan**

Toshio FUKUSHIMA, Norio SATO\*, Yoshihiro HISAMATSU,  
Iwao MATSUSHIMA and Yoshio AOYAMA

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Atmospheric exposure tests of metals were conducted over a period of five years since 1960 at seven sites, and the regression equations expressing the correlation between corrosion rates and environmental factors were derived from the results of these tests. As a result of the tests conducted at structural steel exposed at 37 sites for ten years, the corrosion loss was maximal, 0.90mm; in industrial districts along the seashores, and the corrosion loss was a minimal 0.10mm in inland and rural districts. However, the corrosion loss of weathering steel was almost a half of the former as a result of the same tests. In another report, the effects of the angle inclined to the horizontal plane and the orientation of the plate specimens are demonstrated to be important factors in the structural designing. The mechanism of corrosion resistance of weathering steels was investigated using steel specimens. On the other hand, interfacial reaction products between solutions of NaOH and ferric-ferrous salt were used in the work called "artificial rust study". Exposure tests of aluminium and its alloys were conducted for 20 years since 1955 in 15 districts. The results showed that the deterioration of both tensile strength and elongation of the specimens were small in values and the depth of pitting was 0.004-0.277mm in average.

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International Conference on Transport  
in Nonstoichiometric Compound,  
August 27-30, 1980 Krakow-Mogila-  
necy, Poland

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### **Two-Phase Oxide Growth in Pure Metals**

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Hokkaido University

A generalization of the theory of Yurek, Hirth, and Rapp (1974) for the simultaneous formation of two oxide phases on a pure metal under diffusion-controlled conditions has been developed. The generalized formulation enables a worker to determine of quasisteady-state growth kinetics following step function changes in the experimental conditions such as ambient temperature or oxygen partial pressure. Numerical evaluation of the coupled growth equations for the individual phases is required to deduce the general predictions of the theory.

However, in the asymptotic limit in which there is a long lapse time following any change in the experimental conditions, a simple analytical evaluation of the functional dependence of the rate constant for two-phase growth on the relevant parabolic rate constants for growth of the individual phases under single-phase growth conditions is possible. In this asymptotic limit, the analytical expression so obtained for a particular case of cation vacancy diffusion agrees completely with the results deduced by Yurek, Hirth, and Rapp. Specific application of these analytical results to the case of homogeneous-field parabolic growth and the case of parabolic growth under local space-charge-neutral conditions serves to illustrate the type of results to be expected when utilizing microscopic physical theories for parabolic oxidation.

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10th World Congress on Metal Finishing,  
October 12-17, 1980, Kyoto, Japan

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### **Surface Analysis of Stainless Steels Prepared with Variows Surface Treatments**

Masahiro SEO and Norio SATO  
Corrosion Research Group, Faculty of  
Engineering, Hokkaido University

The composition depth-profiles of the surfaces of 304 and 316 stainless steels prepared with a variety of surface treatment have been measured by a simultaneous use of argon ion sputter-etching and Auger electron spectroscopy.

Chromium was enriched in the surface oxide films, whereas nickel was enriched at the film/substrate interface. The degree of Cr-enrichment in surface films depended on the surface treatment and increased in the following order; mechanical polishing with emery paper in water <chemical etching in mixed acid of 1%HF + 10%HNO<sub>3</sub><electropolishing in mixed acid of CH<sub>3</sub>COOH + HClO<sub>4</sub>(20:1)<chemical treatment in 10%HNO<sub>3</sub> or chemical passivation in 30%HNO<sub>3</sub>. The degree of nickel enrichment at the film/substrate interface increased with increasing degree of chromium enrichment in the film. The surface oxide films on 304 stainless steel were always thicker than those on 316 stainless steel, irrespective of the surface treatments. The aging of specimen for one week in a dessicator gave rise to the decrease in chromium-enrichment and to the increase in film thickness. Discussion was made on the relationship between pitting potential and surface composition of stainless steels.

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Symposium on Catalysis of Zeolites  
Ecully (Lyon), France September 9  
-11, 1980

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### **Ethylbenzene Hydroisomerization on PtHNaY Zeolites**

Masahiro NITTA and Peter A. JACOBS

Hydroisomerization of ethylbenzene was carried out in a continuous flow reactor using PtHNaY zeolites with varying proton and platinum contents as catalysts. Detailed product distributions were determined. The data obtained qualitatively can be explained using a classic bifunctional mechanism, the rearrangement of ethylcyclohexyl, methylethylcyclopentyl and dimethylcyclohexyl carbenium ions which are rate determining. Maximum xylene selectivity requires a high number of hydroxyl groups of intermediate acid strength. Selective o-xylene formation at short contact times is possible via an energetic favourable pathway if a protonated cyclopropane intermediate exists.

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The 8th International Conference on  
Computational Linguistics, Sept. 30  
-Oct. 4, 1980, Tokyo.

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### **Control Structures for Actions in Procedural Texts and PT-chart**

Yoshio MOMOUCHI  
Division of Information Engineering  
Faculty of Engineering, Hokkaido University

This paper describes a partial taxonomy of control structures for actions in procedural texts.

It analyzes natural language expressions for control structures in Japanese procedural texts and presents PT(Procedural Text)-chart for a formal representation framework of a procedural text.

A procedural text is one that describes a sequence of actions intended to achieve a goal. Control structures determine patterns of behavior for action sequences. We classify control structures into two groups, temporal and behavioral control structures.

A procedural text consists of a static (organization) structure and dynamic (control) structure. It is highly desirable that a formal representation framework of a procedural text has the scope and ability to represent both the structures. We construct a representation framework, PT-chart, which has the ability.

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6th International Conference on High  
Voltage Electron Microscopy, Sept. 1  
-3, 1980, Antwerp, Belgium

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### **Direct Observation of Radiation-Induced Segregation near Grain Boundary and Void in Copper Alloys**

T. TAKEYAMA, S. OHNUKI and H. TAKAHASHI  
Metals Research Institute, Faculty of Engineering  
Hokkaido University, Sapporo 060, Japan

Radiation-induced segregation on Cu-2at%Fe and Cu-2at%Ag alloys was studied by means of an energy dispersive X-ray microanalyzer (EDX) attached to a 200 kV STEM. Electron irradiation was carried out in a 650 kV high voltage electron microscope up to 10 dpa at 420~570K. Iron which is an undersized solute in copper segregated to grain boundaries and voids which are effective sink sites for irradiation-produced point defects, and then silver which is an oversized solute depleted in them. The result indicates the direct evidence of the interaction between point defect and solute atom and of the size effect. Moreover, it is suggested that the segregation and depletion of solutes affect the nucleation and growth of voids in changing of the defect flow to voids.

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Japan-U.S.A. Seminar on Materials  
-Results of Irradiation Work and  
Exploration of Ferritic Status, Oct. 27  
-30, 1980, Japan Atomic Energy  
Research Institute, Japan

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### **Study of Segregation in Alloys Irradiated by Ions and Electrons**

T. TAKEYAMA, S. OHNUKI and S. MARUYAMA  
Metals Research Institute, Faculty of Engineering  
Hokkaido University, Sapporo 060, Japan

Radiation induced segregation near defect sinks was studied by means of an energy dispersive X-ray microanalyzer attached to a 200 kV STEM. Irradiation was carried out under a 650 kV high voltage electron microscope up to 10 dpa for binary alloys and in 200 kV C<sup>+</sup> ion accelerator up to 57 dpa for austenitic and ferritic stainless steels. The segregation was observed in internal sinks, such as grain boundaries, voids, dislocation loops and precipitates. Radiation induced precipitation was caused by the segregation in unsaturated alloys. The type of segregation or depletion depended primarily on the difference of the size factor. However, unexpected segregation was detected in some alloys irradiated by ions. The segregation and depletion of the solutes could be affected by the nucleation and growth of voids.

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Japan-U. S. A. Seminar, Characteristics  
of Mechanical Properties of Body  
-Centered-Cubic Metals, March 23-27,  
1981, Honolulu, U. S. A.

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### **Nucleation of Crack and Micro-Structure Induced by Hydrogen**

T. TAKEYAMA and H. TAKAHASHI  
Metals Research Institute, Faculty of Engineering  
Hokkaido University, Sapporo 060, Japan

An investigation of the nucleation sites and their structures of microvoids and micro-cracks formed in pure irons of single and polycrystal and a Fe-C alloy in the process of the precipitation of hydrogen molecules was carried out by means of optical, scanning and transmission electron microscopy.

Hydrogen molecules precipitated in the metal and blisters or cracks were caused on the specimen surface during cathodic charging. The frequency of the blister nucleation was increased by the introduction of plastic strain and precipitates. Besides micro-voids, micro-cracks which seemed to be generated as a result of the growing micro-voids and were observed at greater depths in the metal membrane. In the vicinity of the micro-voids, plastic deformation occurred with a consequential increase in high dislocation density and cracks initiated from the voids along either  $\{110\}$  or  $\{112\}$  planes. Furthermore, in polycrystalline irons, micro-cracks were generated mainly at the grain boundaries and the interfaces of the cracks consisted of ledges on  $\{110\}$  or  $\{112\}$  planes besides the interface dislocations. The above results show that hydrogen would precipitate as molecules at misfit interfaces.

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International Conference on High  
-Temperature Corrosion, SanDiego, U.  
S. A., March 2-6, 1981

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### **The Oxidation of Binary Alloys to form Solid Solution Scales**

Keizo NISHIDA  
Metals Research Institute, Faculty of  
Engineering

In this paper historical development of the simulation on cation distribution in a solid solution scale formed on a binary alloy was introduced. Its applicability was discussed and a comparison of simulated values with practical data was presented.

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10th World Congress on Metal Finish-  
ing Kyoto, Japan, 12-17, Oct., 1980

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### **Calorizing of Ta Sheets and Their Oxidation Behavior**

Keizo NISHIDA and Mitsuo HACHINOHE  
Metals Research Institute

In order to improve the oxidation resistance of Ta sheets, the sheets were calorized in a quartz ampoule at 1000°C using Al vapor generated from a powdered FeAl<sub>2</sub> alloy and their oxidation behavior was examined in flowing air (1 liter/min) at 900-1300°C. For the optimal oxidation resistance at 1000°C, the preoxidation treatment at 1100°C for a short time (1 hr) was found to be most effective in the longrun for long usage.

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9th International Symposium on the  
Reactivity of Solids, Krakow, Poland,  
1-6, Sept., 1980

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### **High-Temperature Sulfidation of Some Fe-Mn Alloys Under Low Sulfur Pressures**

Keizo NISHIDA and Kazimierz GODLEWSKI  
Metals Research Institute, Faculty of Engineering

Three different Fe-Mn alloys (11, 29, and 48wt%Mn) were sulfided in a H<sub>2</sub>-H<sub>2</sub>S gas mixture ( $P(S_2)=10-10^{-3}$ Pa) at 973-1273K.

For 11 and 29% alloys, there are linear relations between  $\log k_p$  and  $\log P(S_2)$ , but for a 48% alloy the above stated relation consists of two slopes. Corrosion kinetics and scale morphologies for these alloys were discussed by using EPMA and thermodynamic data.

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15th Biennial Conference on Carbon  
June 22-26, 1981, Philadelphia, Pen-  
sylvania, U. S. A.

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### **High-temperature NMR Study of Carbonization Properties of Pitches and Vacuum Residues**

K. MIYAZAWA, T. YOKONO and Y. SANADA  
Coal Research Institute, Faculty of Engineering,  
Hokkaido University, Sapporo 060, JAPAN

Time-dependent <sup>1</sup>H-n. m. r. spectra of pitches and vacuum residues were observed at high temperatures in order to estimate kinetic parameters obtained from changes of aliphatic hydrogen fraction of these spectra, and a relation between the kinetic parameters and optical

textures of resultant cokes was examined.

It is found that from the viewpoint of changes of aliphatic hydrogen fraction all samples so far studied consist of at least two groups of kinetic species showing apparently different reactivities, i. e., fast-reacting species (subscript 1) and slow-reacting species (subscript 2).

As for all samples studied, activation energies of fast-reacting species and slow-reacting species are about  $1.7 \times 10^2$  and  $2.5 \times 10^2$  kJ/mol respectively. A close relation is found between the size of optical textures of resultant cokes and the ratios of the initial values of aliphatic hydrogen fraction,  $H_{a1110}/(H_{a1110} + H_{a1120})$ , and frequency factor,  $k_{20}/k_{10}$ . As mesophase development increasing these ratios are larger, these are expected to be good characterization parameters for optical textures of resultant cokes.

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15th Biennial Conference on Carbon  
June 22-26, 1981, Philadelphia, Penn-  
sylvania, U. S. A.

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### **Relationships between Hydrogen Donor Abilities of Pitches and Coals and Optical Textures of Cokes**

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It is thought that hydrogen may stabilize free radicals produced during pyrolysis. Consequently, viscosities of carbonizing systems are minimized. This facilitates the growth and coalescence of the mesophase. Thermal reactivities of cata-type compounds are larger than those of peri-type compounds. Therefore a relationship may exist between the average shape of constituent molecules of pitches and size of optical textures of resultant cokes. And average molecular weight may also be related to the viscosities of the systems.

The purpose of this study is to assess the correlations of size and shape of optical textures of cokes with hydrogen donor abilities, with ring compactness factors relating to the average shape of constituent molecules and with average molecular weights of parent materials.

It is found that there exists a good correlation between the abilities of pitches and coals to donate hydrogen to anthracene and acenaphthylene and optical textures. The ring compactness factor and molecular weight of parent pitch correlate with the size of the optical texture.

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Joint ISMAR-AMPERE International  
Conference on Magnetic Resonance,  
Delft University of Technology, The  
Netherlands August 25-29, 1980

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**NMR Studies of Whole Biological Bodies by  
the Temperature Gradient Method**

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Hokkaido University  
Sapporo, 060 Japan

By means of the new technique of Temperature Gradient NMR, proposed recently by the present author, we have detected signals of water in the cells of whole bodies of mammalian animals. These temperature gradient spectra are found to arise from the movement of the voluntary muscle which causes heat production in animals. From the analysis of the temperature gradient spectra of homoiothermal animals (mice) and cold blooded animals (frog), new information was obtained regarding the differences in the thermoregulation function among different species of animals.