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(International Colloquium on Material Science, Cracow, Poland 6–10 December, 1973), Cracow Section of Poland Science Academy.

**“On the Distribution of Ni in the Oxide Scale Formed on
A Co-0.45wt%Ni Alloy at Elevated Temperatures.”**

K. Nishida, T. Narita, and N. Oya

A Co-0.45%Ni alloy was oxidized to examine whether Wagner's new theory (1969) is applicable to the scale.

Kinetics of oxidation of this alloy obeyed a parabolic rate law and Ni concentrated in the vicinity of the alloy/scale interface of the scale, but the substrate thereof showed no change. The observed distribution profiles of Ni in the scale agreed very well with those calculated according to Wagner's equations.

The ratios of self-diffusivities of both metals in the scale (D^*_{Co}/D^*_{Ni}) were determined by a comparison between observed and calculated concentration profiles of Ni and they were changeable from 4.4 at 1000°C to 2.9 at 13000°C.

These values agreed with those obtained from the diffusion experiment by Crow.

Therefore, it is concluded that the theory proposed by Wagner is applicable in this case.

IVth International Conference on
Crystal Growth, Tokyo, Japan, 24–29
March, 1974

Growth and Perfection of Ice Crystals

Akira Higashi

Department of Applied Physics, Faculty of Engineering

Attempts were made to grow perfect, or nearly perfect, ice single crystals for solid state studies. Dislocation densities as low as 10^2 cm^{-2} were found in crystals grown by the modified Bridgman method whereas using the Czochralski method the lowest densities found were of the order of 10^4 cm^{-2} . The

configurations and structures of dislocations in the crystals grown by the different techniques and under various conditions were examined by X-ray diffraction topographs. Characteristic features of dislocation images in topographs are interpreted as showing that the Peierls trough is shallow for dislocations having a $1/3 \langle 11\bar{2}0 \rangle$ Burgers vector on the basal plane. Thus, dislocations in the basal plane extend perpendicular to the growth interface due to the preferential line tension when the crystal was grown in the direction perpendicular to the c -axis. The generation of dislocation densities of the order of 10^4 cm^{-2} in Czochralski grown crystals is mainly attributed to those inherited from the large area of seed crystals and in addition to the thermal stresses caused by steep temperature gradients in the crystal. Reduction of dislocation densities to the order of 10^2 cm^{-2} in Bridgman grown crystals is achieved by limiting the inheritance of dislocations or by the selection of a single mosaic from the seed crystal through a neck of the growth cell. Dislocation loops of $[0001]$ Burgers vector and stacking faults found both in NH_3 -doped ice described.

ICO Conference on Optical Methods in
Scientific and Industrial Measurements,
Tokyo, 25–30 Aug. 1974

Measurement of the Intensity Distribution of an Object by a Strip Telescope

Kazumi Murata and Naoshi Baba

Department of Applied Physics, Faculty of Engineering

In order to measure the intensity distribution of an object at a great distance, a strip telescope with a long, narrow aperture was studied. The restoration of the highly resolved image from the blurred ones observed with a strip telescope was theoretically investigated. Some computer simulations were conducted to verify the theory. A diffractometer with a rotatable slit aperture was used in the experiment as a model of a strip telescope. The intensity distributions of the synthesized images are two-dimensionally displayed with a precise flying spot scanner. The utility of the strip telescope is also discussed.

ICO Conference on Optical Methods in
Scientific and Industrial Measurements,
Tokyo, 25-30 Aug. 1974

Some Simple Methods for Making a Holographic Differentiation Filter and Its Related Applications

Yukihiro Ishii and Kazumi Murata

Department of Applied Physics, Faculty of Engineering

Differentiation filters are considered from a new view-point. A moiré pattern is obtained by recording incoherently two interference fringes whose spatial frequencies are slightly different. This pattern serves as a first-order differentiation filter. The second-order differentiation filter is synthesized with a triple exposure technique. The second-order differentiation is also performed by utilizing the nonlinear characteristics of the photographic emulsion on which the exposure corresponding to making the first-order differentiation filter is recorded. As applications of the first-order differentiation filter, the differentiation of a phase object and the subtraction of two letters are experimentally performed.

Eighth International Congress on Elec-
tron Microscopy, Canberra, Australia,
25-31 August, 1974

The Effect of Carbon on the Annealing of High Voltage Electron-Irradiated Iron

T. Takeyama and H. Takahashi

Vacancies and interstitials were produced in a solution-quenched Fe-0.025wt%C alloy by using electrons ejected from a high-voltage electron microscope, and the effect of excess point defects on the aging behavior was studied. The specimens were irradiated at room temperature by 650kV electrons at 650kV HVEM in a fluence of 1.7×10^{21} e/cm² and then heat-treated. The specimen aged below 240°C showed no visible precipitates in the irradiated area, but many small ϵ -carbide or cementite particles were observed in the non-irradiated area. As a large number of vacancies were introduced in the irradiated area, it appears that supersaturated carbon atoms

migrate to individual vacancies and are trapped by them to form C-V pairs (V: vacancy), resulting in the suppression of the carbide precipitation. The dissociation of the C-V pair and the precipitation of the cementites in the irradiated area were observed at temperatures above 240°C. An unusual growth of cementite particles was observed in the irradiated area after aging above 240°C. In this case, carbon atoms leaving the traps and vacancies may contribute to the growth of the cementite.

IOC Conference on Optical Methods in
Scientific and Industrial Measurement,
Tokyo, 25–30 August, 1974

Laser Heterodyne Measurements of Extremely Low Velocities of Moving Bodies

Yoshihiro Ohtsuka and Tadao Ozawa

Department of Engineering Science, Faculty of Engineering

A method for measuring low velocities is described. A directional laser Doppler Velocimeter is employed so that the generated carrier beat signal may be modulated by Doppler shifts due to a moving body. The Doppler shift in question is recovered by phase demodulation techniques that are capable of excluding the unwanted low frequency fluctuations due to instruments. This processing is simply done by comparing the modulated beat signal with the reference carrier beat-signal at the phase demodulating stage. The velocity as low as 0.07 $\mu\text{m/s}$ is measured using a solid test specimen moving in a sawtooth or triangular mode.

Fifth International Heat Transfer Conference, Tokyo, Japan, September 3–7,
1974

Natural Convection and Evaporation from A Free Surface of Liquid Sodium

Ryoji Ishiguro, Toshiaki Kumada and Toshio Abe

The free surface of liquid sodium is a narrow rectangle surrounded by a

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large isothermal plate on the same level, the temperature of which is fairly lower than the sodium. Numerical calculations of the convection are performed for a range of Rayleigh number up to 1.6×10^5 . The temperature fields are observed by an interferometer. The evaporation rates are measured. The analogy between Nusselt and Sherwood number is valid for a small difference of the temperature between the free surface and the surroundings. Otherwise, sodium fog is formed in the cover gas and Sherwood number becomes larger.

1974 INTERNATIONAL LASER
RADAR CONFERENCE –Sixth Con-
ference on Laser Atmospheric Studies–
Sep. 3–6, 1974 Sendai JAPAN.

Light-Beat Method to Process Phase Fluctuations of a Laser Light Beam

Yoshihiro Ohtsuka and Issei Sasaki

Department of Engineering Science, Faculty of Engineering

A method of real-time processing of phase fluctuations of a laser beam is described. A beat photocurrent whose phase undergoes random fluctuations is generated by two laser light beams at different frequencies, propagating through a turbulent atmosphere. The phase fluctuation component of the beat can be recovered in real-time over a wide extent of phase angle, not restricted within 2π , by a specially designed circuit. Probability density functions, auto-correlation functions, and variances of the phase fluctuations are displayed in real-time as most basic quantities of the fluctuations.

15th Corrosion Science Symposium,
10–13th September 1974, University of
Cambridge, Cambridge, England.

Ellipsometry of Anodic Oxide Films on Fe-Ni Alloys in Neutral Solution

K. Kudo and Y. Ohtake

Abstract

Ellipsometric and electrochemical measurements were made of the anodic

passivation films on Fe-Ni alloys containing 10–90% Ni in borate buffer solution of pH 8.42. The optical constants for films calculated from the locus of ellipsometric parameters during oxidation are in a range of $(2.6-2.85) - (0.3-0.45)i$ depending on the substrate composition. The thickness as estimated increases linearly with rise of the potential, and at a constant potential the thickness decreases as the nickel content of substrate increases, but it is not a linear function of the substrate composition. Films formed on alloys with high nickel content seem to be composed of a single layer, but on low nickel alloys the film may consist of an inner oxide layer which holds the electric field and an outer layer of hydrated oxide. The composition and structures of films are discussed in terms of the substrate composition and the potential.

International Symposium on "Degradation and Stabilization of Polymers."
11–13 September 1974, Brussels

**ERS Studies on Mechanical Degradation of Polymers and Reactivity
of Radicals Produced by the Scission.
(One of the main lectures of the Symposium)**

Junkichi Sohma

It has been proved by analyses of ESR spectra that main-chain scission is induced by mechanical fracture of bulk polymers at low temperatures, such as 77°K. A molecular mechanism for the main-chain scission caused by mechanical fracture of amorphous polymers has been proposed. An anomalous increase of free-radical concentration was observed in the case of mechanical formation of free-radicals (mechano-radicals) in polymers, and the increase is interpreted in terms of excess electric-charges produced by friction, which is accompanied with mechanical fracture. Both the chemical reactivity of the mechano-radicals with oxygen and photo-chemical reaction of the mechano-radicals with oxygen were also discussed and characteristic behaviors in these reactions suggest that the mechano-radicals were formed on the fresh surfaces formed by the fractures.

The Institute of Fuel 1974 Conference
on "The Changing Technology of Fuel"
5th–7th November, 1974
*The Hotel Australia, Brougham Place
North Adelaide, South Australia*

Studies on the structure of coal, high pressure coal hydrogenation process and coke manufacture

Gen Takeya

From 1945–1956 we concentrated our efforts on the elucidation of the chemical and physical properties of Hokkaido caking coal and conducted basic research of indigenous coal toward our ultimate aim of the production of metallurgical coke for modern blast furnaces. By doing so we co-operated in the development and completion of an original technique for blending of raw indigenous coal with foreign caking coal for coke manufacture. From 1956 to the present we have been conducting a multi-angle fundamental research on high pressure hydrogenation of coal.

And in regard to both of the above main problems, we have been working towards the elucidation of coal characteristics, properties and structure using typical coals from our Hokkaido coal fields. At the same time we have been working on various aspects of chemical reactions of coals. The above have been and are our primary objectives. Further, for our studies of high pressure coal hydrogenation, we decided to investigate all representative coals from our island which range in coal rank (C: 70–86% d.a.f.) from brown coal through subbituminous coal to noncaking and caking bituminous coal. In this field one spearhead of our research was aimed at the chemical structure of coal (characteristics) while the other has aimed at chemical reaction (behaviour).

The Japan-U.S. Seminar, March 10–13,
1975, The East-West Center, Honolulu,
Hawaii, U.S.A.

Passivity of Iron, Nickel and Cobalt –General Theory of Passivity–

Norio Sato

Abstract

The anodic current-potential and film thickness-potential curves of iron, nickel and cobalt in acidic and neutral solutions were shown, and the ionic current in and the dissolution current of the passive film were discussed. There is a barrier oxide layer on passivated metals. For iron it is an iron-deficient magnetite layer, for nickel a layer of NiO with an excess oxygen, and for cobalt a bi-layer of CoO/Co₃O₄. The ionic current in the iron-deficient magnetite layer on iron and in the outer Co₃O₄ layer on cobalt obeys a field-assisted ion migration mechanism, which however does not hold for the barrier NiO layer on nickel and the inner CoO layer on cobalt. The dissolution current of the passive film is controlled by the potential difference across the Helmholtz layer separating the film surface from the outer Helmholtz plane in solution, and a Tafel relation is found between the dissolution current and the overpotential at the Helmholtz layer, which leads to the mechanism $\text{Fe}^{3+}(\text{oxide}) \rightarrow \text{Fe}^{3+}(\text{solution})$ for iron and $\text{Co}^{2+}(\text{oxide}) \rightarrow \text{Co}^{2+}(\text{solution})$ for cobalt. A general theory is presented in which the passivity of metals can be explained by the involvement of a barrier layer of some kind in the structure of electrified interface between the metal and the solution.

Symposium of Unsteady Aerodynamics
Arizona University, Tucson, Arizona,
U.S.A. March 18, 1975

Development of Disturbances in Unsteady Boundary Layers

Y. Kobashi, M. Hayakawa and K. Nakagawa

The Tollmien-Schlichting waves which travel through unsteady boundary layers with or without pressure gradient are studied both theoretically and experimentally.

The Howarth-type boundary layer along a flat plate which is placed in a harmonically oscillating stream and the development of disturbances caused by the instability of the velocity profiles are analysed under the assumptions of the quasi-steady and quasi-parallel flow approximation. The results show that the increase of the unsteadiness of the flow reduces the minimum critical Reynolds number and increases the range and the growth rate of instability. The most characteristic feature of the unstable zone is that it has a tendency to be localized within some phase range of the flow oscillation.

The experiments are carried out in a specially designed wind tunnel in which a flat plate is driven periodically along a steady stream, whose results show good agreement with those of the present analysis.

1975 Joint JSME-ASME Applied Mechanics Western Conference, Honolulu, Hawaii, March 24–27, 1975

Viscous Shear Flow past Small Semicircular and Semielliptical Projections Attached to a Plane Wall

M. Kiya and M. Arie

Numerical solutions of the Navier-Stokes equations are presented for the two-dimensional viscous flow past semicircular and semielliptical projections on a plane wall along which a laminar boundary layer is developing. It is assumed that the height of the obstacle is so small in comparison with the boundary-layer thickness at the location of the obstacle that the oncoming flow can be approximated by a uniform shear flow. Numerical solutions are obtained for the range of the Reynolds number from 0.1 to 100, which is defined in terms of the undisturbed approaching velocity at the top of the obstacle and its height. The geometrical shapes of the front and rear standing vortices, the drag coefficients, the pressure and shear stress distributions are presented as functions of the Reynolds number. The computed results are discussed in connection with the data already obtained in the other theoretical solutions and an experimental observation.

ULTRASONIC INTERNATIONAL
1975, London, 24–26 March 1975

Light-Beat Measurements of Sound Velocity

Yoshihiro Ohtsuka and Issei Sasaki

Department of Engineering Science, Faculty of Engineering

New optical methods to measure the sound velocity are presented; they are

based on optical heterodyne detection techniques. Two successive ultrasonic cells are employed to cause dual diffraction of a laser light beam. The first-order spectrum of the successively diffracted light beam, which has two off-set frequency components overlapped spatially, can be selected to generate a light-beat photocurrent. Since this photocurrent includes two sound velocities in its phase, these velocities can be measured using phase-demodulation techniques. Measurements of the absolute velocity in one of the two ultrasonic waves, the relative velocity between the two ultrasonic waves, and the time-dependent velocity are predicted analytically and verified experimentally using water and NaCl solutions. A change in the time-dependent sound velocity can be observed down to 0.05 ms^{-1} in real-time.

* USA-JAPAN joint seminar, "Passivity and its breakdown on iron and iron base alloys" at East West Center, Honolulu, Hawaii, in March 1975

Temperature Scanning Measurement of the Passivity of Stainless Steel*

Tatsuo Ishikawa

Abstract

A suitable activation energy of a passive current of chromium-bearing steels can be clarified only by a rapid temperature scanning method proposed here because the passive currents deviate from the linear Arrhenius plots at a higher temperature region due to some changes of the passive state during the procedures of temperature change.

The rapid temperature scanning measurements of stainless steel were carried out under various passivation conditions in order to elucidate in what manner changes occur in the surface reactivity of passive state with passivation potentials and passivating temperatures in comparison with that of pure chromium.

According to our experimental results, the different behaviors of passive current at various potentials to the temperature scanning, the enrichment of chromium component in the passive film of stainless steel and the aging process of the amorphous film formed at an early stage to a rigid oxide layer were discussed.

(The 4th Research Conference on High
Polymers, Ohtsu, Japan, May 5 to 9,
1975)

Texture and Melting Behavior of Polytrioxane and Polytetraoxane, and their Changes during Annealing

Akira Odajima and Teruo Ishibashi

Department of Applied Physics, Faculty of Engineering

Yoshiaki Nakase and Isamu Kuriyama

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Japan Atomic Energy Research Institute*

This paper is concerned with the studies on fine structure and its changes during annealing of polytrioxane and polytetraoxane crystals obtained by radiation-induced post-polymerization in a solid state, in terms of X-ray small angle and wide angle measurements and differential scanning calorimetry.

The main results are summarized as follows:

- i) The ratio of the sub- to the main-crystal in polytrioxane decreases with the increasing polymer yield.
- ii) Polytetraoxane polymerized over 90°C shows no sub-crystal, and consists of extended- and folded-type crystals, the structure of which may be something in the nature of "Shish-Kebab" form.
- iii) Both the annealing effects of polytrioxane and polytetraoxane upon the structural changes are similarly correlated to their starting temperature T_S on the endotherm. The reorganization of the sub-crystal taking place during annealing in polytrioxane is quite similar to that of the fold-type in polytetraoxane, accompanying the long period increasing.
- iv) Therefore, the texture of the sub-crystal in polytrioxane is suspected to be also of fold type, although its folding period must be much longer than that of the folded type crystal in polytetraoxane.

Display Generated by a Generalized Cone Representation

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We describe the generalized cone representation and its data structure for a class of three-dimensional curved objects, and describe an algorithm for hidden line elimination for displaying objects. In the generalized cone representation, an object is represented by a sequence of disjoint slices called cross sections, normal to a space curve called the spine. Accordingly, an object is displayed with cross section edges and longitudinal edges which connect corresponding points of two adjacent cross sections. Modelling by generalized cones simplifies input for curved objects.

The program first suppresses hidden lines within a segment of a part, between two adjacent cross sections. Lines hidden by other segments of parts are eliminated by a brute force comparison of one segment versus every other segment. Bounding rectangles aligned with the coordinate axes of the screen, however, are calculated, and those pieces whose bounding rectangles are disjoint are immediately ignored.

EIGHTH CELLULOSE CONFERENCE
Wood Chemicals - A Future Challenge
Jointly Sponsored by The Cellulose Research Institute State University of New York College of Environmental Science and Forestry and The Wood Chemistry Committee Technical Association of the Pulp and Paper Industry, Syracuse, New York, USA, May 19-23, 1975

The Change of Chain Conformation of Cellulose From I to II Type.

Jisuke Hayashi and Takuji Yamada

It seems that there is some difference in the relative intensity ratio of (040) to (080) between Na-celluloses prepared from cellulose I and II family under a fixed length. The ratios were about 0.5 for the former and about 0.05 for the later. They were classified as Na-cell I_I and I_{II}.

When the Na-cell I_I prepared under the fixed length was regenerated in boiling water, it provided the mixed X-ray diffraction pattern of cellulose I(50%) and II(50%). The X-ray pattern of Na-cell I freely mercerized from ramie fiber was a mixture of Na-cell I_I(30%) and I_{II}(70%). It was further regenerated into a mixture of cellulose I(15%) and II(85%) in boiling water. However, when ramie fiber was freely mercerized at 100°C, it resulted only in the Na-cell I_I pattern. The regenerated product also gave a complete pattern of cellulose I. On the other hand, Na-cell I_{II} from all sources was completely regenerated into cellulose II under all conditions studied. It was considered that the conformational change of cellulose chain was advanced as a result of the hydration of Na⁺ ion to -OH group of cellulose. This change might proceed the crystallization or the regeneration of Na-cell I.