

ABSTRACTS OF PUBLISHED PAPERS

(Accepted September to October 1998)

CONDENSED MATTER AND MATERIAL

Reexamination of High Drift Mobility a-Si:H

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Journal of Non-Crystalline Solids **227-230** (1998) 229-232

We present the results of reexamination of high drift mobilities observed in hydrogenated amorphous silicon prepared under controlled ion bombardment. It has been clarified that potential minimum in the film under forward bias condition can be a possible source of overestimation of drift mobilities.

Density of Si-H Bonds Responsible for Structural Flexibility in A-Si:H

Hidetoshi OHEDA

Journal of Non-Crystalline Solids **227-230** (1998) 120-123

Modulation of infrared absorption of the Si-H stretching mode following a modulated excitation can be observed at around 2000 cm⁻¹ as a photoinduced bleaching band in a photomodulation spectrum of a-Si:H as reported previously by Vardeny et al. Here we have studied how this modulated vibrational spectrum is affected by photodegradation with assuming that the spectral change comes from breaking of weak Si-Si bonds next to a Si-H bond. By evaluating quantitatively the spectral change induced by photodegradation as well as the simultaneous change of ESR spin density, density of Si-H or weak Si-Si bonds, which are precursor sites for structural flexibility in a-Si:H, can be evaluated to be 1.4 - 2.4 × 10¹⁸ cm⁻³. It is interesting that the evaluated value is only about 0.024 - 0.04 % of the density of

total Si-H bonds contained in the specimen used here.

The Dose Effect of Silicon Implantation on Hydrogen Trapping in Aluminum

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Nuclear Instrument and Method B*

136-138 (1998) 478-482

We have studied the dose effect of silicon as an added element on the trapping of hydrogen in aluminum. For this purpose, we implanted 78 or 150 keV silicon ions into aluminum specimens with doses of 3×10¹⁵ to 3×10¹⁷ Si/cm² and successively 30 keV hydrogen ions with a dose of 3×10¹⁶ H/cm² at 300 K. After the hydrogen implantation, the depth profiles and thermal behaviors of hydrogen in the samples were measured by means of an elastic recoil detection (ERD) method. It was found that the silicon element implanted into aluminum is supersaturated even at 5 at.% and drastically affects the thermal behavior of hydrogen depending on the dose.

Thermal Behavior of Hydrogen in Helium-Implanted High-Purity SUS316L

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Nuclear Instrument and Method B

136-138 (1998) 483-487

We have studied the effects of helium incorporation on

trap-sites of hydrogen in high-purity stainless steel SUS316L. We implanted 10 and 30 keV He ions into high-purity SUS316L samples with several doses ranging from 3×10^{15} to $1 \times 10^{17}/\text{cm}^2$ and successively 30 keV hydrogen ions with a dose of $1 \times 10^{17}/\text{cm}^2$ at a temperature of 300 K, and then observed depth profiles and thermal behavior of hydrogen in the samples by means of the ERD (elastic recoil detection) method. It was found that hydrogen implanted into the high-purity SUS316L is chemically absorbed in helium cavities.

Si Surface Preparation with Si Beam Irradiation on the Growth of III-V on Si

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Isao SAKATA, Toshihiro SEKIGAWA

Material Research Society Symposium Proceedings

485 (1998) 61-66

The preliminary results of the effects of Si beam irradiation for the preparation of Si surface on the growth of GaAs on Si by MBE are reported. The effects are combined with thermal cycle anneal (TCA). A slight improvement in the crystalline quality is observed by photoluminescence measurements on the films grown with Si beam irradiation. On the other hand, no significant changes were observed in the FWHM of X-ray diffraction. Treatments on the initial Si surface affect the quality of thicker films through TCA. Higher substrate temperature during the Si beam irradiation seems preferable to obtain positive effects.

Crystal Growth of Superconductive

$\text{PrBa}_2\text{Cu}_3\text{O}_{7-y}$

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Physica C **300** (1998) 200-206

Superconductive $\text{PrBa}_2\text{Cu}_3\text{O}_{7-y}$ (Pr123) crystals have been grown successfully by the travelling-solvent floating-zone (TSFZ) method using 3.7-5.8% PrO, 27-37% BaO, and 60-69% CuO composition solution with the 0.1-0.4% oxygen mixed argon gas atmosphere. The grown crystals have been identified to be Pr123 by a precession camera, X-ray powder diffractions and scanning electron microscopy-X-ray energy dispersion spectroscopy (SEM-EDS). Some portion of the

grown TSFZ crystal boules show bulk superconductivity below about 80 K after annealing in oxygen.

Solid Phthalocyanine with High Fluorescence Efficiency

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Toshiro TANI

Mol. Cryst. Liq. Cryst. **314** (1998) 71-76

A silicon phthalocyanine (Pc) compound $\text{PcSi}[\text{OSi}(\text{CH}_3)_3]_2$ in solid phase emitted a relatively intense fluorescence as compared with other solid Pc compounds. At room temperature fluorescence spectrum of the solid SiPc had three major bands peaking at 715, 781 and 840 nm, and total fluorescence yield was estimated to be $\sim 10^{-2}$, which was about 1/20 of that of solution. Different time-resolved decay profiles of these bands proved that the fluorescence had at least two emission origins. With decreasing temperature fluorescence intensity and spectrum changed drastically. In particular, below 60 K the 715 nm band became quite sharp and intense. Total intensity at 5 K was about ten times as large as that at 300 K.

Two-Photon Absorption of Biexcitons in ZnS-Based Quantum Wells

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Journal of Crystal Growth **184/185** (1998) 682

Two-photon absorption processes of biexciton in ZnS-based quantum-well structures have been studied by means of photoluminescence excitation spectroscopy. The peak position of two-photon absorption of biexcitons was dependent on the detected energy position in the photoluminescence excitation measurement. The energy difference between the one-photon exciton resonance and the two-photon biexciton resonance increased as the detected energy position was moved towards the lower-energy side of the biexciton luminescence. This result indicated the biexciton localization and the resultant increase in the biexciton binding energy.

Effects of Coulomb Interaction on Nonlinear Optical Response in C₆₀, C₇₀, and Higher Fullerenes

Kikuo HARIGAYA

J. Phys.: Condens. Matter **10** (1998) 6845-6850

Nonlinear optical properties in the fullerene C₆₀ and the extracted higher fullerenes -- C₇₀, C₇₆, C₇₈, and C₈₄ -- are theoretically investigated by using the exciton formalism and the sum-over-states method. We find that off-resonant third order susceptibilities of higher fullerenes are a few times larger than those of C₆₀. The magnitude of nonlinearity increases as the optical gap decreases in higher fullerenes. The nonlinearity is nearly proportional to the fourth power of the carbon number when the on site Coulomb repulsion is 2t or 4t, t being the nearest neighbor hopping integral. This result, indicating important roles of Coulomb interactions, agrees with quantum chemical calculations of higher fullerenes.

Long-Range Excitons in Conjugated Polymers with Ring Torsions: Poly (*para*-phenylene) and Polyaniline

Kikuo HARIGAYA

J. Phys.: Condens. Matter **10** (1998) 7679-7690

Ring torsion effects on optical excitation properties in poly (*para*-phenylene) (PPP) and polyaniline (PAN) are investigated by extending the Shimoi-Abe model [Synth. Met. **78**, 219 (1996)]. The model is solved by the intermediate exciton formalism. Long-range excitons are characterized, and the long-range component of the oscillator strengths is calculated. We find that ring torsions affect the long-range excitons in PAN more easily than in PPP, due to the larger torsion angle of PAN and the large number of bonds whose hopping integrals are modulated by torsions. Next, ring torsional disorder effects simulated by the Gaussian distribution function are analyzed. The long-range component of the total oscillator strengths after sample average is nearly independent of the disorder strength in the PPP case, while that of the PAN decreases easily as the disorder becomes stronger.

Molecular Orientation of Octaalkoxyphthalocyanine Derivatives in Langmuir-Blodgett Films

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Thin Solid Films **327-329** (1998) 87-89

Electron spin resonance and electronic absorption spectra were measured to obtain structural information concerning the out-of-plane anisotropy of Cu(II) 1,4,8,11,15,18,22,25-octaalkoxyphthalocyanine (C_nPcCu: n=6,10,18) molecules in Langmuir-Blodgett (LB) films. It was revealed that the tilt angle with respect to the substrate surface and the aggregation mode of the macrocyclic rings in LB films depend on the length of the alkoxy substituents, being consistent with our previous results from F-A isotherms, UV-visible absorption spectra and Brewster angle microscopy measurements.

In-Plane Orientation of Mesoscopic Domains in Langmuir and Langmuir-Blodgett Films Induced by Rotating Disks

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Thin Solid Films **327-329** (1998) 24-27

The "rotating-disk method" of Mingotaud *et al.* [J. Phys. Chem. **99** (1995) 17068] is a powerful technique for obtaining Langmuir-Blodgett films with controlled in-plane organization. In this report we compare the two versions of this method with respectively one-disk and two-disk systems. The 1-disk version consists of a simpler mechanical system and highly efficient for macroscopically homogeneous monolayers having adequate visco-elastic properties. For some inhomogeneous monolayers, however, the 2-disk version is more effective to induce the in-plane organization.

Possible Low-Temperature Phase Transition of Langmuir-Blodgett Films of a Charge-Transfer Complex Detected by ESR

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Thin Solid Films **327-329** (1998) 391-394

The electron spin resonance (ESR) measurements made on the highly conducting Langmuir-Blodgett films of a charge-transfer complex of bis-(ethylenedioxy)-tetrathiafulvalene (BO) and decyltetra cyanoquinodimethane (C10TCNQ), mixed with icosanoic acid, revealed microscopically the metallic nature of the system in a wide temperature range. Further, an anomalous increase in the ESR linewidth was detected around 140 K. To elucidate the origin of this anomaly, *in-situ* ESR experiments upon annealing at low temperatures have been performed. The temperature dependence of the IR spectrum has been also measured. The obtained results indicate a possible low-temperature phase transition of the present conducting LB system.

Off-Diagonal Wave Functions and Superconductivity in the Variational Monte Carlo Calculations

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Kunihiko YAMAJI

Review of High Pressure Science and Technology

7 (1998) 154-156

We investigate the two-dimensional Hubbard model using off-diagonal wave functions where we improve the Gutzwiller wave function by operating off-diagonal factors. In the 4x4 system, we compare our results with the exact diagonalization. The variational energies are fairly close to the exact values. We show the results for 10x10 Hubbard model.

ELECTRONIC DEVICES

Miniature Tunnel Junction by Electron-Beam-Induced Deposition

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Nanotechnology **9** (1998) 104-107

Electron-beam (EB) induced deposition using a WF6 precursor molecule was applied to making very thin metallic wires and metal/insulator/metal tunnel junctions for single-electron transport devices. Single-wires typically 8 nm thick and 13 nm wide were produced on a SiO₂ substrate, using the primarily EB with 3 nm diameter. It was shown that oxygen plasma treatment of the substrate just before EB induced deposition was effective to avoid hydrocarbon deposits which resulted in high resistance films. A post-annealing procedure in H₂ gas ambient improved also the resistance of the wires up to 3 orders of magnitudes. A tunnel junction where 3 dots structure was connected to the wires was produced. Its electrical characteristics were fitted to a Fowler-Nordheim (FN) plot whose gradient gradually increased with increasing the pitch of the dot array.

Surface Preparation of Si Substrates for Epitaxial Growth

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Surface Science **406** (1998) 312-327

We have improved and evaluated hydrophilic and hydrophobic chemical treatments to prepare Si(001) and Si(111) wafers for epitaxial growth substrates. In the hydrophilic case, we found that a simple chemical treatment in a mixture of H₂SO₄ and H₂O₂ solutions has the same effect as the traditional RCA-based methods. However, the boron contamination of 5×10¹⁸ atoms cm⁻³ on the resultant surface after removal of its oxide layer is difficult to prove in nature and blocks surface diffusion of Si adatom at the initial stage of crystal growth. In the hydrophobic case, improvement of preparation facilities in order to free a sample from oxygen allows a surface to be obtained that is clean enough for crystal growth without the boron problem. In both cases,

there is no difference in the carbon contamination concentration of $2\text{--}4 \times 10^{18}$ atoms cm^{-3} . These results demonstrate that the hydrophobic surface has advantages. We further studied the relationship of surface contamination and surface structures of hydrophobic Si(001) and Si(111). With increasing annealing temperature in UHV, the Si(001) surface exhibited $c(4 \times 4)$ in the narrow range of $580\text{--}750^\circ\text{C}$, and eventually, a very weak SiC transmission pattern appeared above 750°C . The simultaneous disappearance of $c(4 \times 4)$ and appearance of a SiC pattern indicates the association of the $c(4 \times 4)$ reconstruction with carbon. The carbon concentration of $2.5\text{--}4 \times 10^{18}$ atoms cm^{-3} is insufficient for carbon atoms to form a component of the $c(4 \times 4)$ structure, and therefore the carbon must have another effect. A consequence of this conclusion is that carbon is not responsible for C-type defects, and we speculate that boron may be the origin. The Si(111) surface showed $(\sqrt{3} \times \sqrt{3})$ at between 400°C and 600°C , and the reconstruction is independent of the carbon contamination.

Focused-Ion-Beam-Assisted Etching of Diamond in XeF₂

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Journal of Vacuum Science and Technology B
B16 4 (1998) 2506

Ga focused-ion-beam(FIB)-assisted etching of single-crystal diamond and thin film diamond in XeF₂ was studied. The etch yield in FIB-assisted etching of diamond in XeF₂ is enhanced some six times over the physical sputtering yield. In the crystal orientation dependence of the etch yield in FIB-assisted etching, the (100) face produced the highest etch yield of the three faces-(100),(110), and (111). Thin film diamond produces the lowest etch yield. A diamond field emitter with a tip radius of less than 100 nm was obtained using Ga FIB spot exposure.

INFORMATION SCIENCE

From Egocentric to Allocentric Spatial Behavior: A Computational Model of Spatial Development

Kazuo HIRAKI, Akio SASHIMA, Steven PHILLIPS

Adaptive Behavior **6** 3/4 (1998) 371-391

We propose a robot that learns to track a target object mentally as a model for spatial development. Mental Tracking is considered as prediction of an object's position, given the previous environmental state and motor commands and the current environment state resulting from movement. Following Jordan and Rumelhart's forward modeling architecture, the system consists of two components: an inverse model of sensory input to desired motor commands and a forward model of motor commands to desired sensory input.

Dynamic Constraints Relaxation as a Theory of Insight

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Cognitive Studies **5** 2 (1998) 69-79

We propose a general framework that involves three constraints, object-level, relational, and goal. The object-level and relational constraints represent people's natural preferences of how objects and relations in a given problem are represented. The goal constraint evaluates a degree of match of the current state to the goal, and leads problem-solvers to select specific combinations of the representations. In the processes of insight, these constraints operate simultaneously and are gradually relaxed by repeated impasses. Using a geometric puzzle problem, we empirically tested hypotheses derived from the framework.

Experiments of Collecting WWW Information Using Distributed WWW Robots

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Proc. of 21st Ann. Int. ACM SIGIR Conference on Research and Development in Information Retrieval (1998) 379-380

This paper presents the experiments of collecting the documents on the WWW using distributed WWW robots. We propose distributed WWW robots to collect the documents quickly. Our final goal is to collect all of the documents on the WWW in Japan within one day. Currently, eight distributed WWW Robots are running in Japan. The experimental results show that we are able to gain 5.8 to 9.7 times speedup when four distributed WWW robots are placed at different places in comparison with when only one WWW robot is used.

Ocular Following Responses During Vestibular Stimulation

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Aya TAKEMURA, Kazuyo SUEHIRO, Kenji KAWANO
BPES'98 241-244

The effects of the large field visual stimulus and vestibular stimulus on the ocular following responses (OFR) were studied in monkeys. We previously reported that the OFR were enhanced during the smooth pursuit eye movement. The OFR were also enhanced by background motion, which started before the onset of the OF stimulus and moved at a constant velocity. The OFR were also enhanced during vestibular stimulation. But, the pattern of the enhanced OFR was not the same. The OFR enhanced by the background movement were the same pattern as those induced during the smooth pursuit eye movement, but the amplitude was only 65%. The vestibular stimulation enhanced the 2nd and 3rd peak of the OFR. The results suggest that the OFR system can be modulated by both visual and vestibular inputs.

Estimation of a Degree of Speech Recognition Difficulty for Word Sets --An Application of Between-Word Distance Calculation in a Symbolic Domain--

Kazuyo TANAKA, Hiroaki KOJIMA

*The Journal of the Acoustical Society of Japan(E)***19 5 (1998) 339-347**

This paper presents a between-word distance (BWD) calculation in a symbolic domain and discusses its typical application in estimating the degree of the speech recognition difficulty for given word sets. In the first part of the paper, a method for the distance calculation is described which employs matching by DP (dynamic programming) on subphonemic segment sequences to take phonemic-context-dependent characteristics into account. In order to test the usefulness of the method, two types of word sets are composed using a distance-based clustering technique. Vocabularies of one type have dense sample distributions while the others have sparse sample distributions in a BWD sense. Speaker-independent word recognition is examined for these word sets using a common phone-HMM-based speech recognition technique. We compare the recognition results and the statistical characteristics of individual word sets, and present criteria for relative order of the recognition difficulty of given word sets. One criterion using between-word distance distributions of N-nearest neighbor words provides a reasonable index for the recognition difficulty.

Measurement of Eye Movements at Character Search Task

Takeshi NAGAMI, Keiji MATSUDA
BPES'98 249-252

The Purpose of this study is to investigate a strategy of visual search. We collected tracks of gaze(TG) and reaction time(RT)during character search task, and discussed the strategy of visual search and the validity of the task. The task is composed of 36 sets of a prerequisite character(PC) and an array including a target character(TC). PC is the first KANJI character of a word. Each array is set the second as TC and eight KANJI characters. We made two conditions, the similarity relationship among characters and the position of TC in thearray. TG and RT was collected during a subject search thearray to see if it has TC. ANOVA revealed main effects of each condition. TG suggested that character search task is a valid means of collecting it.

A Synthetic Approach to Spatial Development: Using a Robot for Cognitive Science

Kazuo HIRAKI, Akio SASHIMA
Cognitive Studies **5** 3 (1998) 59-68

This paper overviews current robot research from a cognitive science perspective, and then discuss the possibility of using a mobile robot for a theory construction in spatial cognition. As a concrete case study, the paper presents our recent attempt to model infant's spatial development.

Delivery by Hand between Human and Robot Based on Fingertip Force-Torque Information

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*Proc. of International Conference on Intelligent Robotics
and Systems* (1998) 750-757

This paper presents a delivery by hand between a multifingered hand and a human based on force-torque sensing. Of all cooperated task between humans and robots, the most important and basic factor is delivery of objects by hand. To insure positive delivery, the robot should open its hand only after making sure that the object has been received by the human. The human release the object only after confirming that the robot can actually grasp the object stably. The features of the hand-delivery system introduced in this paper include that (1) the robot recognizes successful transfer of the object to a human when the human changes the grasping condition, (2) the human guides the position and orientation of the grasped object to be stable grasp, and (3) the robot, in response to the above guide, regrasps the object to realize a stable grasping condition.

Emergence of Expert Modules for Mobile Robot Navigation from a Mixture of Elman Networks

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*Proceedings of the Fifth International Conference on
Neural Information Processing* (1998) 256-259

A mixture of Elman network is applied to simultaneous segmentation of an environment and actions of mobile robots. Through a learning process, expert modules for mobile robot navigation are emerged from the mixture of Elman networks. In order to evaluate robustness of the idea, training data sets collected with a real mobile robot are used as well as the data from a simulated robot. A preliminary result of an experiment where the acquired expert modules are used to control a simulated mobile robot is also described.

Realization of Safety in a Coexistent Robotic System by Information Sharing

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Ryo TAKADA, Masayoshi KAKIKURA
*Proceedings of international conference on robotics and
automation* **4** (1998) 3474-3479

Some kinds of service robots will come to work in human coexisting environments. In that case safety is an important issue. To realize the safety, physical and intelligent augmentations should be introduced to the coexistent robot. Few researches on the intelligent augmentation have been found compared to the physical augmentation. The key point of the intelligent augmentation is the information sharing between the robot and the person. There are two aspects in the information sharing. They are (i) information about the place where the robot will perform the task and subtasks and (ii) information about the event what the robot will perform as the task and subtasks. The robot should inform the coexisting person of both of these aspects of the task information. We propose a projection function as a means of the information sharing about the place. A voice message synthesizer is used for the information sharing about the event. The detail of the construction of an experimental system and experiments are described.

Robot Teaching Using Projection Function

Yujin WAKITA, Shigeoki HIRAI, Toshio HORI,
Ryo TAKADA, Masayoshi KAKIKURA

Proceedings of 1998 IEEE/RSJ international conference on intelligent robots and systems **3** 1944-1949

We have proposed a projection function as a method of sharing information between a person and a coexistent robot. The projection function means that an image of the simulated robot motion is projected in the task environment for cooperation between the person and the robot. We apply the projection function to teaching the robot the task coordinates. The simulated image on the task floor moves along with the operator's command. The operator can stay apart from the moving robot with the new teaching method. This method requires only the simulation model of the robot itself, while other methods based on virtual reality require a whole model of the task environment.

BIOSCIENCE

Computational Observation of an Ion Permeation Through a Channel Protein

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Bioscience Reports **18** (1998) 39-48

The ion permeation process, driven by a membrane potential through an outer membrane protein, OmpF porin, was simulated by molecular dynamics. A Na⁺ ion, initially placed in the solvent region at the outer side of the porin channel, moved along the electric field passing through the porin channel in a 1.3 nsec simulation; the permeation rate was consistent with the experimentally estimated channel activity. It was indicated that the ion permeation through the porin channel proceeds by a push-out mechanism, and that Asp 113 is an important residue for the channel activity.

Auditory Evoked off-Response: Its Source Distribution is Different from that of On-Response

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NeuroReport **9** 11 3 (1998) 2621-2625

Offset auditory responses were investigated by electroencephalography mainly in the 1970s, but since then no particular attention has been paid to them. Among the studies using magnetoencephalography (MEG) devices there are, to our knowledge, only three studies of the auditory off-response, and no significant variance has ever been observed between the source locations of on- and off-responses elicited from pure tones. We measured auditory evoked magnetic fields (AEFs) to various frequency pure tone stimulation in 5 healthy subjects with a 122-channel helmet-shaped magnetometer, and compared the distributions of the source locations of auditory N100m-Off (magnetic off-response around 100 ms) with those of N100m-On. Their spatial distributions were quite close to each other, and yet they were significantly different.

Dependence of Short-Latency Ocular Following and Associated Activity in the Medial Superior Temporal Area (MST) on Ocular Vergence

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Motion of a large-field pattern elicits short-latency ocular

following responses (OFR) in the monkey, which are mediated at least in part by the medial superior temporal area of the cortex (MST). The magnitude of the OFR is known to be inversely related to viewing distance, and we investigated the dependence of OFR and the associated neuronal activity in the MST on a major cue to viewing distance, ocular vergence, in alert monkeys (*Macaca fuscata*). The vergence angle, expressed in terms of the apparent viewing distance, ranged from infinity to 16.6 cm ($0-6\text{ m}^{-1}$). The magnitude of the initial OFR increased monotonically with increases in convergence at a mean (\pm SD) rate of $19.6\pm 4.5\%/m^{-1}$ in four monkeys (over the range $0-4\text{ m}^{-1}$). In two monkeys, we recorded the single unit activity of 160 MST neurons that responded to motion of a large-field pattern with directional selectivity. The mean latency (\pm SD) of the MST discharges elicited by large-field motion was $50\pm 7.5\text{ ms}$ ($n=115$), which preceded the onset of OFR by an average of $10\pm 9.9\text{ ms}$. The discharge modulation elicited by large-field motion showed a significant dependence on vergence in 91/160 neurons (57%), 72 of which (79%) increased their firing rate with increasing convergence ("near" neurons), and the remainder increasing their firing rate with decreasing convergence "far" (neurons). However, on average, the sensitivity of these MST neurons to vergence was only about 30% of that shown by the OFR. It could be that only those neurons that are very sensitive to vergence angle contribute to the OFR, but it is also possible that much of the modulation of OFR with vergence occurs downstream from the MST or in alternative pathways (yet to be discovered) that contribute to OFR.

Temporal Firing Patterns of Purkinje Cells in the Cerebellar Ventral Paraflocculus During Ocular Following Responses in Monkeys I. Simple Spikes

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J. Neurophysiology **80** (1998) 818-831

The simple-spike firing frequency of 30 Purkinje cells (P cells) in the ventral paraflocculus (VPFL) of alert monkeys was studied in relation to vertical slow eye movements, termed ocular following response (OFR), induced by large-field

visual motions of different velocities and durations. To quantitatively analyze the relationship between eye movement and firing frequency, an inverse dynamics representation of the eye movement was used for reconstructing the temporal waveform of firing. Coefficients of eye-acceleration, velocity, and position, bias, and time lag between firing and eye movement were estimated by least-square error method. In the regression analyses for each stimulus condition, 86% (146/170) of the well-modulated temporal firing patterns taken from those 30 P cells were reconstructed successfully from eye movement. The model with acceleration, velocity, and position terms, which we used, was shown as the best among several potential models by Cp statistics, consistent with *t*-test of significance of each term. Reliable coefficients were obtained from 75% (109/146) of the well-reconstructed firing patterns of 28 cells among 30. The estimated coefficients were larger (statistically significant) for slow stimuli than for fast stimuli, suggesting changes in sensitivities under different conditions. However, firing patterns of each cell under several different conditions were frequently well reconstructed by an inverse dynamics representation with a single set of coefficients (13 cells among 21). This indicates that the relationships between P cell firing and OFR are roughly linear in those stimulus ranges. The estimated coefficients for acceleration and velocity suggested that the VPFL P cells properly encode the dynamic components of the motor command during vertical OFR. As for the positional component, however, these P cells are correlated with eye movement in the opposite direction. In the regression analysis without positional component, remarkable differences between observed and reconstructed firing patterns were noted especially in the initial phase of the movements, indicating that the negative positional component was not negligible during OFR. Thus we conclude that, during OFR, the VPFL P cells cannot provide the necessary final motor command, and other brain regions, downstream neural structures, or other types of P cells must provide lacking position-dependent motor commands. This finding about the negative correlation with the position is in the opposite sign with previous studies obtained from the fixation and the smooth pursuit movement. From these comparisons, how the VPFL contributes to a part of the final motor command or how other brain regions complement the VPFL is suggested to be different for early and late phases of the movements.

Temporal Firing Patterns of Purkinje Cells in the Cerebellar Ventral Paraflocculus During Ocular Following Responses in Monkeys II. Complex Spikes

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J. Neurophysiology **80** (1998) 832-848

Many theories of cerebellar motor learning propose that complex spikes (CS) provide essential error signals for learning and modulate parallel fiber inputs that generate simple spikes (SS). These theories, however, do not satisfactorily specify what modality is represented by CS or how information is conveyed by the ultra-low CS firing rate (1 Hz). To further examine the function of CS and the relationship between CS and SS in the cerebellum, CS and SS were recorded in the ventral paraflocculus (VPFL) of awake monkeys during ocular following responses (OFR). In addition, a new statistical method using a generalized linear model of firing probability based on a binomial distribution of the spike count was developed for analysis of the ultra-low CS firing rate. The results of the present study showed that the spatial coordinates of CS were aligned with those of SS and the speed-tuning properties of CS and SS were more linear for eye movement than retinal slip velocity, indicating that CS contain a motor component in addition to the sensory component identified in previous studies. The generalized linear model to reproduce firing probability confirmed these results, demonstrating that CS conveyed high-frequency information with its ultra-low firing frequency and conveyed both sensory and motor information. Although the temporal patterns of the CS were similar to those of the SS when the sign was reversed and magnitude was amplified ~50 times, the velocity/acceleration coefficient ratio of the eye movement model, an aspect of the CS temporal firing profile, was less than that of the SS, suggesting that CS were more sensory in nature than SS. A cross-correlation analysis of SS that are triggered by CS revealed that short-term modulation, that is, the brief pause in SS caused by CS, does not account for the reciprocal modulation of SS and CS. The results also showed

that three major aspects of the CS and SS individual cell firing characteristics were negatively correlated on a cell-to-cell basis: the preferred direction of stimulus motion, the mean percent change in firing rate induced by upward stimulus motion, and patterns of temporal firing probability. These results suggest that CS may contribute to long-term interactions between parallel and climbing fiber inputs, such as long-term depression and/or potentiation.

Temperature Dependence of Protein-Induced Flocculation of Phosphatidylcholine Liposomes

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Langmuir **14** 19 (1998) 5438-5445

We studied the influence of the ambient temperature on the lysozyme- and cytochrome c-induced flocculation of phosphatidylcholine liposomes and its relation to the adsorption of the proteins at phospholipid membrane surfaces. The temperature dependence of two kinetic parameters, flocculation rate and activation energy, was experimentally determined.

OPTICS AND RADIATION

Fragment Ion Yields from CFCl_3 Photoexcited in Regions of the $\text{Cl}2p$, the $\text{C}1s$, and the $\text{F}1s$ Electron Transitions

Isao H. SUZUKI and Norio SAITO
Chemical Physics **234** (1998) 255-264

Fragment ions from CFCl_3 have been measured in the soft X-ray region using monochromatized synchrotron radiation and a time-of-flight mass spectrometer. The atomic chlorine ion shows the highest yield ratio, about half of the total ion yield in all the photon energies studied. At the $\text{Cl}2p$ photoionization, C-Cl bonds are broken frequently, yielding an intensity increase in CFCl^+ and CF^+ , but the process where only the C-F bond is cleaved does not take place, including no production of CCl_3^+ .

0.1%, respectively.

MEASUREMENT AND STANDARD

Aging Characteristics of Deuterium Lamp

Tatsuya ZAMA and Hideo ONUKI

Journal of the spectroscopical society of Japan

47 3 (1998) 129

Aging characteristics of deuterium lamps were studied. From the measurements of spectra in the UV and VUV regions and the degradation of window glasses of deuterium lamps, it was found that the degradation of window glass in the degradation of deuterium lamp was more than 50%. The aging characteristic of deuterium lamp and the degradation of window glass could be improved by exchanging window glass material (exchanging non-doped silica glass for fluorine-doped silica glass). But on the deuterium lamp which has long nose (the distance between the window glass and the light source is about twice longer than that of regular deuterium lamp and the radiant flux at the window glass was about quarter of regular deuterium lamp), the aging characteristic of lamp and the degradation of window glass were not improved. In order to suppress the degradation of deuterium lamp, it appeared that exchange of window glass material is effective.

Beamline for Calibration of Transfer Standard Light Sources in the UV and VUV Regions

Tatsuya ZAMA, Terubumi SAITO and Hideo ONUKI

Journal of synchrotron radiation **5** (1998) 759-761

We are constructing a beamline which serves for calibrating transfer standard light sources (deuterium lamps, excimer lamps, Xe lamp, etc.) in the UV and VUV regions. The synchrotron radiation (SR) from the electron storage ring TERAS (750 MeV) is used as a primary standard of spectral radiant-intensity for calibrations of spectral radiance and irradiance of transfer standard light sources. In order to use SR as a primary standard, the electron beam and SR beam parameters are needed to be evaluated. Uncertainties of SR flux evaluated by measurements of the magnetic flux density, the position of the electron orbital plane, the electron beam size and the distance from the SR tangent point to the detector system are expected to be about 0.003%, 0.01%, 0.05% and

Absolute Soft X-Ray Measurements Using An Ion Chamber

Norio SAITO and Isao H. SUZUKI

J. Synchrotron Rad. **5** (1998) 869-871

Measurements of soft X-ray absolute intensities have been carried out using a double ion chamber and monochromatized synchrotron radiation. The chamber is cylindrical and 1.3m long. The soft X-ray beam enters the chamber at a position off the central axis, and the produced ions are collected with electrodes on the opposite side to the photon entrance. An index constant for rare gas, the γ -value, which is the average number of electrons emitted from an atom having absorbed a photon, was used for obtaining the absolute photon intensity. The obtained intensity ranges from 1 G photons/s to 25 G photons/s in the energy range 72-800 eV. The estimated uncertainty is about 5-20% depending on the intensity and the spectral purity of the soft X-rays.

Characterization of Superconducting Tunnel Junction X-Ray Detectors by Low Temperature Scanning Electron Microscopy

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Nobuyuki HAYASHI, Jens MARTIN,

Friedhelm PANTELEIT and Rudolf HUEBENER

Jpn. J. Appl. Phys. **37** 37-2 (1998) 36-39

In order to study the double peak phenomenon, Low Temperature Scanning Electron Microscope (LTSEM) is a versatile tool, since it is possible to analyze two electrodes separately. From the LTSEM analyses in combination with x-ray detection experiments, it has been revealed that the intrinsic charge output of the base electrode is higher than that of the counter electrode over a wide range of bias voltages in our Nb/Al polycrystalline junctions.

Absolute Measurement of Monochromatized SR Soft X-Rays

Norio SAITO and Isao H. SUZUKI

*Proc.12th Workshop on Radiation Detectors and
Their Uses* **4** (1998) 1

Synchrotron radiation has a capability of the standard light source in the region of ultraviolet radiation to X-rays, because the intensity and characteristics of the radiation can be calculated. However, this radiation is usually necessary to employ some focusing and monochromatizing optical elements. Since these elements have uncountable efficiencies on photon transfer, it is necessary to develop a technique for measuring the absolute intensity of the soft X-ray beam. In the present study, a double ion chamber has been developed, with which the absolute intensity of the soft X-ray beam is obtained in aid of an index constant (γ) of rare gases on multiple photoionization. The values of γ have been measured with a time-of-flight mass spectrometer.

ENERGY TECHNOLOGY

Voltage Hysteresis and Heat Generation Behavior in Lithium-Ion Batteries

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Katsuhiko KANARI, Ken NOZAKI

Material Research Society Symposium Proceedings
496 (1998) 551-556

In order to characterize the heat generation behavior of a lithium-ion cell during charge and discharge, calorimetry has been carried out. The influence of past treatments applied to the cell is examined based on heat generation. The test cell shows a voltage hysteresis during charge and discharge, and the heat generation behavior is related to this hysteresis. A hard carbon is used in the cell as the negative electrode material, and the hysteresis mechanism and heat generation are discussed based on the reactions in the hard carbon electrode.

Solid Oxide Fuel Cell Using Ceria Electrolyte for Transportation

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Susumu NAGATA, Ken NOZAKI

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1998 Fuel Cell Seminar Abstracts 56-59

Considering SOFC as a alternative power generator for transportation use, required performance for the SOFC system is estimated. Furthermore, for the thin tubular cell with ceria based electrolyte, a numerical model is made and the efficiency and output power are calculated. In order to clarify the key points for improving cell performance and to design cell structure to optimize the cell performance, the dependence of the electrical property of the tubular cell on the cell parameters is discussed.

Properties of Fiber-Reinforced Superconductors Adopting Tantalum Fibers

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*Proceedings of Fifteenth International Conference on
Magnet Technology* **2** (1998) 1032-1035

We have been developing fiber-reinforced superconductors (FRS) for high-field and large-scale magnets. This paper describes FRS using tantalum fibers. Tantalum has high elastic modulus and can be processed mechanically, i.e. in a drawing process, more easily than tungsten. FRS using tantalum fibers are described with making comparison with FRS of tungsten to clarify the basic properties of FRS using tantalum fibers. The depth profile in Nb₃Sn layer in FRS is measured to examine the reaction between the superconducting layer and reinforcement fibers. Superconducting properties including strain and stress characteristics are shown.

Fundamental Analysis of Thermally Regenerative Fuel Cell Utilizing Solar Thermal Energy

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Takumi TAKASHIMA

Proceedings of the 33rd Intersociety Energy Conversion Engineering Conference

We propose thermally regenerative fuel cell operated by solar thermal energy. It consists of 2-propanol dehydrogenation at negative electrode and acetone hydrogenation at positive electrode by using the principle of fuel cell. By means of combination with chemical reaction and fuel cell, it can convert low temperature heat energy like solar thermal energy into electrical energy directly. The activity of 2-propanol dehydrogenation catalyst is not sufficient for the cell. So, in order to make clear characteristics of our proposed cell, we use molecular hydrogen as proton source instead of 2-propanol in this experiment. The activity of carbon-supported ruthenium and platinum composite catalyst (designated hereafter as Ru-Pt/carbon) for acetone hydrogenation at 90 °C is much higher than those of carbon-supported ruthenium catalyst and carbon supported platinum catalyst. We adopted Ru-Pt/carbon as electrodes of the cell and examined its characteristics. Open-circuit voltage of the cell is 127 mV and 142 mV at 90 and 25 °C, respectively. This result agrees with the theoretical value. Short-circuit current is 2.2 and 2.9 mA/cm² when loading of the catalyst is 3 and 5 wt%, respectively.

Transient Heat Transfer of Liquid Helium in Rotating Machines

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Proc. 15th Int. Conf. on Magnet Technology

Part 1 (1998) 526-529

Transient heat transfer characteristics of liquid helium under centrifugal acceleration fields have been investigated using a Platinum-0.5 at% Cobalt (Pt-Co) thin wire. Step heat inputs ranging from 1 to 5 W/cm² are applied to the 20μm diameter wire in a rotating cryostat containing liquid helium. The maximum centrifugal acceleration is around 1300 times larger than gravitational acceleration at 3600 rpm. The temperature rise is measured by the resistivity of the Pt-Co wire. As the result, the take-off time (onset of film boiling)

can be described by a power fit of the heat flux. The cyclic temperature fluctuations have been observed, the times of which can be also described by a power fit of the centrifugal acceleration. These results are discussed on the basis of the bubble departure time.

Study on Optimum Conditions for Maximizing Power Generation Obtained from PV Array

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Trans. IEE of Japan **118-B** 11 (1998) 1329-1333

Global environmental problem induced by vast amount of consumption of fossil fuels is one of the most important subjects in the world. To solve this problem, utilization of solar energy is one of the most useful methods. Above all, PV system is one of the power generation systems expected to attain this purpose, which is composed of PV modules connecting many solar cells. Power generation of solar cell is affected by the fluctuation of solar radiation and temperature, and actual output is less than of standard condition. In this paper, analytical consideration is done to obtain the maximum output of PV array under some solar conditions and we obtain maximum conditions from simplified V-I characteristics equations. From the analysis, the output increases by the method we introduced and we defined characteristics of solar cell for this realization.

Cryogenic Stabilization of AC Superconducting Magnet

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Takashi SAITOU, Nobuyuki SADAKATA, Hiroshi FUJI,
Mitsugi YAMAGUCHI

Proceedings of fifteenth international conference on magnet technology **Part I** (1998) 579-582

Recently, many application studies on AC superconducting conductor are extensively progressing targeting

superconducting AC power machines and apparatuses. However, as for AC superconductors, there are still stability problems to be solved. In this paper, cryogenic stabilization for AC superconducting conductor is discussed. The equal-area theorem is applied for a one-dimensional heat flow. The comparison of experimental results with a theoretically calculated result and the equation of minimum AC propagating current is presented.

SPACE AND OCEAN TECHNOLOGY

Precise Telerobotic System for Space Experiment on ETS-VII

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Proc. of 49th Int. Astronautical Congress

IAF-98-U.5.05 (1998) 1-10

In this paper we present the design, development and space test of the world's first precise telerobotic system boarded on an unmanned space vehicle, ETS-VII (Engineering Test Satellite VII). The robotic system has features of skill and autonomy using a three-finger multisensory hand at a work site in space and computer graphics-based desktop telerobotics at a control site on the ground. We developed a compact robotic system with space environment adaptability and satellite system compatibility as well as dexterity and flexible operability. The robotic system was launched into low-earth orbit in November, 1997. The objectives of the space test are to demonstrate the potential of the multidegree-of-freedom and multisensory hand for use in high-precision in-orbit servicing and to establish telerobotic technology that enables the space robot operation from the ground via a space communications network, overcoming the limitations of communication capacity and time delay. The space test reveals that the system works well in orbit.

ENVIRONMENT TECHNOLOGY

Experiments on Space Robot Path Planning Using the Sensors Database, Part II

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AIAA Guidance, Navigation, and Control Conference
(1998) 252-260

We proposed a sensor-based method to simultaneously control the orientation and the arm position of a space robot via only arm motion, using a database of the relationships among the current sensor outputs, the robot action, and the change of sensor outputs. We use a genetic algorithm (GA) and optimal control techniques to determine the arm path. A "gene" in the GA represents one motion, and the "chromosome" expresses the total motion. The GA yielded the shortest path after 2,436 generations. Since the GA planned a temporary path in the early stage, we consider that GA is better than breadth-first search or A-search. In order to deal with continuous values of joint angles, we used optimal control techniques with approximation of the database. The optimal control calculation was based on the Sequential Conjugate Gradient-Restoration Algorithm (SCGRA) and the Modified Quasi-linearization Algorithm (MQA). When the joint angle was beyond the movable range, we used a penalty function. We confirmed the validity of our method in experiments using a drop shaft which provides ten seconds of microgravity during free fall.

Evaluation of the Amount of N atoms Generated by N₂ Corona Discharges

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Trans. IEE of Japan **118-A** 9 (1998) 930-935

A pulsed corona discharge at the atmospheric pressure can be used for combustion gas treatment. It is expected to remove NO_x and SO₂ with low energy consumption. The main process is estimated to be radical reactions such as N and OH with NO_x. These radicals are produced by the collisions between fast electrons and major species of combustion gas. This paper presents a new method for the evaluation of the total amount of N atoms produced by corona discharges. The experiment of N₂+NO gas treatment was conducted changing the initial NO concentration and keeping the discharge input power constant. Analyzing the data at the high NO concentration region, it was shown that the total amount of N atom production was approximately equal to the reduction quantity of NO_x. The energy efficiency of N atom production

was roughly evaluated as 70eV/N-atom and the utilization rate of the effective energy used for N atom production was about 8%.

carried out, with precise adjustment of the optical system and improvement of measurement and control system. As a result the operation of the system has been clarified to be in accordance with our expectation.

OTHERS

Experimental Studies on Cloud Physical and Radiative Properties -Experiments on Optical Properties of Cloud Particles-

Hideyuki MINATO, Akio NISHIMOTO,
Yoshinari ISHIDO

Japanese Cloud and Climate Study Annual Report,
September 1998 9 87-94

The purpose of this study is the development of precision calibration technologies of infrared radiation and high accurate measurement technologies in atmospheric IR transmission windows for experimental research on optical property of cloud. The result of this study in 1997 is summarized as follows. (1)The experimental examination for the spectral radiance distribution measurement of the sky from the window of the laboratory is advanced. In this fiscal year, the optical measurement system was improved for the radiometry with the regulation of the polarization of the light. In the preliminary experiment, the polarization of the infrared radiation from the cloud at 8 μm ~12 μm has been found to be small most can. (2)On the estimation of the luminance temperature of the cloud based on the spectral radiance distribution measurement, it was found to be effective method that the calculation of the comparison between the area of the curve of the radiance distribution within 8 μm ~12 μm and that of the curve of the radiance from an ideal black body. (3)On the development of the portable infrared radiometer, design and trial manufacture of body and optical system of the radiometer were carried out. This radiometer is used in order to observe radiation and luminance temperature of the cloud from the ground. The optical system of this radiometer consists of scanning reflecting mirror, narrow band interference filter within 8 μm ~12 μm , mirror chopper, low-temperature light source, and HgCdTe semiconductor detector. In this radiometer we use the liquid nitrogen surface with the mirror chopper as a low temperature light source, then we expect that the radiation and luminance temperature more than -70°C can be estimated. (4)And, the experimental examination of output characteristics for the black body type radiation source was