

ABSTRACTS OF PUBLISHED PAPERS

(Accepted January to February, 1998)

CONDENSED MATTER AND MATERIAL

Thin Film Growth and Reflection Hi-Energy Electron Diffraction Intensity Oscillation -Why Does the Oscillation Occur?-

Tsunenori SAKAMOTO
Oyobuturi **66** 12 (1997) 1298-1303

The intensity oscillation of reflection high-energy electron diffraction (RHEED) during molecular beam epitaxial growth has been widely observed in various materials such as semiconductors, metals, oxide superconductors and insulators. This technique has contributed to the discovery of the initial growth mechanism of these thin films and is being used as a tool to control the growth of the thin film at atomic-order precision. The origin of the oscillation has, however, not yet been well clarified. In this paper we describe the relation between the thin film growth and RHEED intensity oscillation, as well as the interpretations of the origin of the oscillation.

Large Excited State Stokes Shift in Crescent- Shaped AlGaAs/GaAs Quantum Wires

Xue-Lun WANG, Mutsuo OGURA,
Hirofumi MATSUHATA, and Ali HAMOUDI
Applied Physics Letters **71** 15 (1997) 2130-2132

The Stokes shifts of the ground and the excited states in a crescent-shaped AlGaAs/GaAs quantum wire (QWR) are investigated using photoluminescence (PL) and PL excitation spectroscopy. The first excited electron to heavy-hole transition showed a Stokes shift (-17 meV) considerably larger than that of ground state-related transitions (-4 meV). This is a quite different phenomenon than that observed in two dimensional quantum well structures, and can be explained by the spatial separation of wave functions with different

confinement energies in crescent-shaped QWRs.

Generation of High-purity Ozone Beam and Its Application to the Formation of Ultra-thin Silicon Dioxide Film

Shingo ICHIMURA, Hidehiko NONAKA,
Akira KUROKAWA and Ken NAKAMURA
J. Surf. Sci. Soc. Japan **18** 12 (1997) 766 - 774

Fabrication of an ozone jet generator system and its application to the formation of ultra-thin silicon dioxide film was discussed. Superior features of using ozone and/or atomic oxygen in an oxidation process is highlighted through the comparison of reactivity among various oxidizing reagents, and also through the survey of their applications to SiO₂ formation. Then the characteristics of the new ozone jet generator, which can supply high purity ozone flux and was specially designed to overcome the current problems in handling high purity ozone, was described in detail. Finally, the oxidation mechanism of Si with ozone, which was investigated by XPS and SHG methods, was discussed focusing on the role of atomic oxygen generated by the dissociation of ozone on silicon surface. (Review paper)

Structural Study of Electrochemically Deposited Copper on p-GaAs(001) by Atomic Force Microscopy and Surface X-ray Absorption Fine Structure Measurement

¹Kohei UOSAKI, ¹Toshihiro KONDO,
¹Michio KOINUMA, ¹Kazuhisa TAMURA
and Hiroyuki OYANAGI
¹Physical Chemistry Laboratory, Division of Chemistry,
Graduate School of Science, Hokkaido University
Applied Surface Science **121/122** (1997) 102-10

The structure of electrochemically deposited Cu on p-GaAs(001) was investigated by means of atomic force microscopy (AFM) and X-ray absorption fine structure (XAFS) measurement. AFM measurement showed that the Cu deposition proceeded strongly depending on the applied potential and the concentration of Cu^{2+} ion in solution. Atomic arrangements corresponding to Cu(111)-(1x1) and GaAs(001)-(1x1) were observed on top of the Cu deposits and at the regions between the Cu deposits, respectively. XAFS data demonstrated that the Cu microclusters were formed on GaAs as initial deposition.

film growth by an atomic layer controlled molecular beam epitaxy. This technology is based on peculiar behavior of the Bi sticking coefficient that depends on the kinds of oxide thin films to be grown. When Bi atoms are supplied in excess with ozone molecular beam, only Bi atoms, being necessary for forming the structural unit (2201 half unit cell), are just incorporated in the film. Surplus Bi is reevaporated from the surface. Using this technique, high quality 2201 thin films are obtained with good reproducibility.

High Spatial Resolution Spectroscopy of a Single V-Shaped Quantum Wire

¹J. BELLESSA, ¹V. VOLIOTIS, ¹R. GROUSSON, X. L. WANG, M. OGURA and H. MATSUHATA
¹*Groupe de Physique des Solides-CNRS-Universite Paris VI*
APPL. PHYS. LETT. **71** 17 (1998) 2481-2483

We report on microscopic photoluminescence of a single V-shaped AlGaAs/GaAs quantum wire. The experiments are performed at low temperature by selectively exciting $1\mu\text{m}^2$ of the sample. The main photoluminescence line is split into sharp peaks of width less than 0.5 meV and separated by a few meV. The energy position and the intensity of the peaks are characteristic of the scanned quantum wire. First micro-photoluminescence results suggest that localization phenomena are predominant in the quantum wire. They are due to the formation of extended monolayer-step islands, larger than the exciton radius, as in the case of high-quality quantum wells.

Fabrication of Metal-Oxide-Semiconductor Field-Effect-Transistor-Structured Silicon Field Emitters with a Polysilicon Dual Gate

Seigo KANEMARU, ¹Ken OZAWA, ²Keigo EHARA, ³Takayuki HIRANO, Hisao TANOUE and Junji ITOH
¹*Musashi Inst. of Technical*
²*Toyokohan Co., Ltd.*
³*Kobe Steel Ltd.*
Japanese Journal of Applied Physics
36 12B (1997) 7736 - 7740

We have fabricated a new silicon field emitter that incorporates a metal-oxide-silicon field-effect transistor (MOSFET) structure with a dual gate. One gate is an extraction gate that extracts electrons from the emitter. The other is a control gate that controls the channel conductance in order to regulate the emission current. The fabrication process is simple and compatible with conventional LSI process. The present device exhibits excellent controllability and stability of the emission current. This is because electron emission from the emitter is precisely regulated by the channel current of the built-in MOSFET.

ELECTRONIC DEVICES

Self-limiting Process for the Bismuth Content in Molecular Beam Epitaxial Growth of $\text{Bi}_2\text{Sr}_2\text{CuO}_y$ Thin Films

Shinji MIGITA, Hiroyuki OTA, Yuji KASAI and Shigeki SAKAI
Applied Physics Letters **71** (1997) 3712-37

A new technology utilizing a self-limiting mechanism for the Bi content is demonstrated for $\text{Bi}_2\text{Sr}_2\text{CuO}_y$ (2201) thin

Numerical Analysis of Integrated Thin Crystalline-Silicon Solar Cells Having PN Tunnel Junctions

Hidetaka TAKATO, Toshihiro SEKIGAWA and Ryuichi SHIMOKAWA
Proceedings of the 14th European Photovoltaic Solar Energy Conference (1997) 46 - 49

Integrated thin crystalline-silicon solar cells having pn tunnel junctions were investigated through two-dimensional numerical analysis. The feature of the

integrated cell is that unit cells are connected in series by pn tunnel junctions. First, the unit cell was simulated, and cell parameters on cell performance was investigated. Next, the integrated cell was evaluated and a guideline for the integration of the unit cell was obtained. It was shown that integration of thin crystalline-silicon cells is an important way to realize high-efficiency, high-voltage cells. Therefore, integrated cells are expected to be a promising structure for thin-film poly- and single-crystalline silicon cells.

Numerical Study for Higher-Order Modes in Flux-Flow Oscillators with rf-Terminators

Satoshi KOHJIRO, Masaaki MAEZAWA and Akira SHOJI
*Applied Superconductivity 1997, Institute of Physics
 Conference Series No158, IOP Publishing Ltd*
1 (1997) 615-618

Higher-order modes in flux-flow oscillators (FFOs) have been numerically studied when side-edges of FFOs are terminated by rf-impedances Z_L . It has been found higher-order modes exist, i.e., one-directional flux-flow is not realized even when a conventional criterion is satisfied as $W < 2\lambda_J$, where W is a width of an FFO and λ_J the Josephson penetration depth. A new condition for preventing the higher-order modes is proposed as a function of W/λ_J and $|Z_L|/Z_o$, where Z_o is the characteristic impedance of the FFO. This new criterion is important for the design of FFOs with a radiation frequency above 1THz.

Lateral Tunnel Junction Produced by Electron-Beam-Induced Deposition

Masanori KOMURO and Hiroshi HIROSHIMA
Journal of Vacuum Science and Technology
B15 6 NOV./DEC. (1997) 2809-2815

Electron-beam-induced deposition using a WF_6 precursor molecule was applied to making metal / insulator / metal tunnel junctions for single - electron transport devices. Single wires 8nm high and about 13 nm wide were produced on a SiO_2 substrate with Au/Cr electrode pads and their conductance showed a rapid increase of about five orders of magnitude as electron-beam (EB) dose increased between 5

and 15 pC/shot. To estimate the deposit thickness distribution, spatial thickness distribution in spot exposure was defined and obtained for specified EB doses. From this function, a single - wire resistivity at 230 and 300 K was determined to be $6 \times 10^{-4} \Omega \text{ cm}$ at doses exceeding 15pC/shot. Single-tunnel junctions, where space with a 2.5 nm increment was at the center of single wire, were produced. The electrical characteristics of these single junctions were fitted to a Fowler-Nordheim plot the absolute value of whose gradient gradually increased with increasing space width. The barrier height of this junction was estimated to be 0.17-0.2eV, lower than that for SiO_2/W junctions. This might be caused by the change from the metallic deposit to the insulator for the single wire as a function of the EB dose. This deposition technique enabled us to fabricate a transistor structure where dots were located in space and a side gate electrode was also deposited. The structure showed Coulomb oscillation even at 230 K and Monte Carlo simulation of this device showed reasonable agreement with the experiment, assuming appropriate circuit parameters of gate capacitance and tunnel resistance.

Electron Beam Assisted Chemical Etching of Single-Crystal Diamond Substrates with Hydrogen Gas

Jun TANIGUCHI, Iwao MIYAMOTO, Naoto OHNO,
 Kenichi KANTANI, Masanori KOMURO
 and Hiroshi HIROSHIMA
Japanese Journal of Applied Physics
36 12B (1997) 7691-7695

The electron beam assisted chemical etching (EBACE) method with hydrogen gas is applicable to direct fine patterning of single-crystal diamond substrates. A scanning electron microscope (SEM) combined with a gas introduction system was used for EBACE. Hole, line and rectangular patterns were successfully fabricated. In the case of fabrication of the rectangular pattern, the etched depths are proportional to the electron dose. The whether amorphous carbon was formed on the etched areas. The obtained Raman spectra indicate that areas etched using both hydrogen gas and oxygen gas do not form amorphous carbon.

Recognition of Human Genes by Stochastic Parsing

Kiyoshi ASAI, katunobu ITOU, Yutaka UENO
and ¹Tetsushi YADA

¹*Japan Science and Technology Corporation*

PACIFIC SYMPOSIUM ON BIOCOMPUTING '98

3 (1998) 228-239

A gene finding system, GeneDecoder, based on an parsing technique using a stochastic grammar and a dictionary of 'genetic words' is introduced. The structure of human genes are expressed by a stochastic grammar and a dictionary, whose components are the 'genetic words' consisting of 'genetic phonemes', built as hidden markov models (HMMs). The HMMs represent the nucleotide acid bases, the codons, and the amino acids. The 'genetic words' in the dictionary are described by the sequence of these HMMs and represent exons, introns, intergenic regions, tRNA regions and signals in DNA sequences. The statistics between these regions are expressed by the grammar, which is a stochastic network of 'genetic words'. Using the same kind of technique of speech recognition by HMMs with a word dictionary and a grammar, the stochastic network of 'genetic words' enables the motif dictionary to be used during the parsing of the DNA sequences. At the same time, stochastic features of donor / acceptor sites, information of the di-codon statistics, and other important features are integrated into stochastic scores during the parsing. As a result, while the system parses DNA sequences and finds the exon / intron structures, the protein motifs are automatically annotated in the regions. It helps to identify the functions of the genes and reduces the cost of homology search for each hypothetical coding regions. This method is different from simply using the information of homology search. This method uses the information of the motif patterns *during* the parsing process, but searching the motif patterns *after / before* finding the coding regions cannot directly affect the parsing process itself. Experimental results have shown that this method reasonably finds and annotates the motifs in the exons in the DNA sequence of human.

A High-Throughput Graphics Library Designed for a Portable Molecular Structure Viewer

Yutaka UENO and Kiyoshi ASAI

We have equipped our graphics library with efficient functions so that a molecular structure viewer program can provide both portability and high-throughput rendering without hardware acceleration. The library renders graphics primitives into off-screen image memory with novel functions such as a point list for the vertices of three-dimensional graphical primitives, scan conversions of sphere and cylinder primitives, and z-buffered bit-block transfer. A molecular structure viewer program was implemented with the graphics library, giving reasonable rendering performance on conventional UNIX workstations with the X-Window system. The use of dynamic linking also lends a flexible extension facility to this software system. An advanced polygon renderer can be provided as an plug-in style extension module as well as other functional modules that are specific to the application program. The design of our graphics library is not only effective in molecular graphics but is also applicable for general three-dimensional graphics software systems.

Human Interface for Multimedia Database with Visual Interaction Facilities

Toshikazu KATO

Data Science, Classification, and Related Methods

(1997) 632-643

This paper describes visual interaction mechanisms for image database systems. The typical mechanisms for visual interactions are query by visual example (QVE) and query by subjective descriptions (QBD). The former includes a similarity retrieval function by showing a sketch, and the latter includes a sense retrieval function by learning user's personal taste. We modeled user's visual perception process by four levels; a physical level, a physiological level, a visual psychological level, and visual cognition level. These models are automatically created by image analysis and statistical learning, are referred as multimedia indexes to database systems.

Recognition of 3D Free-Form Objects Using Segment-Based Stereo Vision

Yasushi SUMI, Yoshihiro KAWAI, Takashi YOSHIMI
and Fumiaki TOMITA

*Proceedings of the Sixth International Conference on
Computer Vision (1998) 668 - 674*

We propose a new method to recognize 3D free-form objects from their apparent contours. It is the extension of our established method to recognize objects with fixed edges. Object models are compared with 3D boundaries which are extracted by segment-based stereo vision. Based on the local shapes of the boundaries, candidate transformations are generated. The candidates are verified and adjusted based on the whole shapes of the boundaries. The models are built from all-around range data of the objects. Experimental results show the effectiveness of the method.

3D Object Recognition Using Segment-Based Stereo Vision

Yasushi SUMI and Fumiaki TOMITA

*Proceedings of Third Asian Conference on Computer
Vision II (1998) 249 - 256*

We propose a new method to recognize 3D objects using segment-based stereo vision. Predefined object models are compared with 3D boundaries which are extracted by the stereo vision. Boundaries may be straight lines, circular arcs and free-form curves. The models consist of the local shapes and the whole shapes of the boundaries. The models are constructed from samples of real objects or from CAD models. Based on the local shapes, the candidate transformations are generated. The candidates are verified and adjusted based on the whole shapes. Experimental results show the effectiveness of the method.

Virtual Voyage: Interactive Navigation in the Human Colon

¹Lichan HONG, Shigeru MURAKI, ¹Arie KAUFMAN,
²Dick BARTZ and ³Taosong HE

¹*Department of Computer Science, State University of
New York at Stony Brook*

²*University of Tübingen, WSI/GRIS*

³*Software Production Research Department, Bell
Laboratory, Lucent Technologies
Proceedings of SIGGRAPH97 (1997) 27-34*

Virtual colonoscopy is a non-invasive computerized medical procedure for examining the entire colon to detect polyps. We present an interactive virtual colonoscopy method, which uses a physically-based camera control model and a hardware-assisted visibility algorithm. By employing a potential field and rigid body dynamics, our camera control supplies a convenient and intuitive mechanism for examining the colonic surface while avoiding collisions. Our Zbuffer-assisted visibility algorithm culls invisible regions based on their visibility through a chain of portals, thus providing interactive rendering speed. We demonstrate our method with experimental results on a plastic pipe phantom, the Visible Human, and several patients.

Scale and Rotation Invariant Recognition Method Using Higher-Order Local Autocorrelation Features of Log-Polar Image

Takio KURITA, ¹Kazuhiro HOTTA
and ¹Taketoshi MISHIMA

¹*Saitama Univ.*

*Proceedings of Third Asian Conference on Computer
Vision 2 (1997) 89-96*

This paper proposes a scale and rotation invariant recognition method which uses higher-order local autocorrelation (HLAC) features of log-polar image. Linear scalings and rotations are represented as shifts in the log-polar image which is obtained by re-sampling of the input image. HLAC features of log-polar image become robust to the linear scalings and rotations of a target because HLAC features are shift-invariant. By combining these features with a simple classifier which uses linear discriminant analysis, we can design a scale and rotation invariant recognition system. Robustness to the scalings and rotations are confirmed by experiments on 2D shapes and face recognition. Robustness to the changes of backgrounds is also confirmed by experiments on face recognition.

Fine Motion Strategy for Skill-Based Manipulation

Akira NAKAMURA, Tsukasa OGASAWARA,
Takashi SUEHIRO and Hideo TSUKUNE
Artificial Life and Robotics 1 3 (1997) 147-150

Generally, a manipulator task can be divided into several motion primitives called "skills". Skill-based motion planning is an effective way to execute a complicated task. When planning an assembly process, a technique of fine motion planning such as the backprojection method in configuration space is often used. This paper describes fine motion planning using a skill library, which consists of a pattern of trajectories of skill motions in configuration space. This method gives the initial position and orientation from which the object can reach the goal in skill-based manipulation.

Limits of Generalization: An Error Surface View

Steven PHILLIPS
Japanese Natural Network Conference (1997) 188-189

Feedforward networks with shared weights transfer learning to isomorphic tasks, but the degree of transfer is not the same as humans (3). As an addendum to (3), error surface plots clarify the problem: the global minimum for training cannot be constrained to coincide with the test set minimum, hence generalization cannot be guaranteed. Such networks are rejected as the mechanism for transfer in human cognition.

Systematicity: Psychological Evidence with Connectionist Implications

Steven PHILLIPS
19th Annual Conference of the Cognitive Science Society
614-619

At root, the systematicity debate over classical versus connectionist explanations for cognitive architecture turns on quantifying the degree to which human cognition is systematic. We introduce into the debate recent psychological data that provides strong support for the purely structure-based generalizations claimed by Fodor and Pylyshyn, 1988. We then show, via simulation, that two widely used connectionist models (feedforward and simple recurrent networks) do not

capture the same degree of generalization as human subjects. However, we show that this limitation is overcome by tensor networks that support relational processing.

Measuring Relational Complexity in Oddity Discrimination Tasks

Steven PHILLIPS
Electronic Journal NOETICA 3 1(1997)
<http://www.psy.vq.edu.au/Cogpsych/Noetica>

A relation-based theory of cognition proposes that cognitive capacity is limited, in part, by the maximum arity of a relation that can be processed in working memory Halford, 1993; Halford, Wilson and Phillips, in press. Children below age five are limited to binary relations, hence have great difficulty on transitive inference tasks, which require integration of two binary relations into a ternary relation. This theory attempts to integrate cognitive and developmental data on the basis of a single metric - relational arity (number of related arguments). However, the lack of formal analysis into relational information involved in cognitive tasks threatens to undermine its utility. I propose using Natural language Information Analysis Method} from relational database theory to analyze relational information in cognitive tasks. To demonstrate the utility of this method, I analyze two tasks: (1) simple oddity; and (2) dimension abstracted oddity. The analysis identifies the peak arity of simple oddity as binary and dimension abstracted oddity (like transitive inference) as ternary. Therefore, the relational theory predicts that dimension abstracted oddity cannot be performed until the median age of five years, while simple oddity can be performed earlier. The analysis also suggests variations on these tasks, and the peak arity for each variation is examined.

Abstraction: Nature, Costs and Benefits

Graeme S HALFORD, William H WILSON and
Steven PHILLIPS
International Journal of Educational Research
27 1 (1997) 21-35

It is argued that abstract cognitive processes entail the processing of relations, which differ from more primitive cognitive processes in being more accessible, more flexible,

and less content-specific. A relation is a binding between a relation-symbol or predicate, and one or more arguments. Each argument corresponds to a slot which can be filled in a number of ways, so the relation is independent of specific arguments. The binding of arguments to a relation-symbol means that the relation can be an argument to other relations, and is therefore accessible to other cognitive processes based on relations. It can be shown that the building blocks of cognitive processes, such as propositions, and trees can be expressed as relations. Each argument constitutes a dimension in the space represented by the relation, and the number of arguments provides a metric for conceptual complexity. Neural network modelling shows why relational representations impose a processing load which is a function of the number of dimensions.

Mental Tracking: A Computational Model of Spatial Development

Kazuo HIRAKI, Akio SASHIMA and Steven PHILLIPS
*Proc. of International Joint Conference
of Artificial Intelligence (1997) 301-307*

We propose "mental tracking" as a computational model of spatial development. The model is considered as prediction of an object's position given previous environment and motor commands. The model was tested by using a typical spatial task called "three cups problem". The result suggests the model is consistent with infant spatial development.

Task Allocation mechanism with Case-Based Reasoning to Multiple Autonomous Mobile-Robot

¹Takuya OHKO, Kazuo HIRAKI and Yuichiro ANZAI
¹*Keio University*
Trans. of the institute of electronics, information and communication engineers **J80-D-II** 9 (1997) 2466--2474

The article proposes a multi-robot learning architecture using case-based reasoning. We tested the system in several environments. The results suggest the system can reduce communication cost in multi-robot environments.

Modeling the Mirror Effect in a Continuous Remember/Know Paradigm

Lynne M. REDER, A. NHOUYVANSIVONG,
C.D. SCHUNN, M.S. AYERS, P. ANGSTADT
and Kazuo HIRAKI
*Proc. of THE 19th Annual Conference of the Cognitive
Science Society (1997) 644 - 649*

The paper describes a model for Mirror Effect. The model is based on Fan Effect in activation network theory. The result of simulation of this model was consistent with human data.

BIOSCIENCE

Dopaminergic Modulation of Neuronal Activity in the Monkey Putamen through D1 and D2 Receptors during a Delayed Go/Nogo Task

Masahiko INASE, Bao-Ming LI and ¹Jun TANJI
¹*Tohoku University*
Experimental Brain Research **111** (1997) 207-218

Using multibarreled glass micropipettes, we recorded single-unit activity in the putamen, and iontophoretically applied D1 and D2 dopamine receptor agonists (SKF38393, quinpirole) and antagonists (SCH23390, sulpiride) while two monkeys were performing a delayed Go/Nogo task. The putaminal neurons exhibited changes in activity during various task periods (hold, cue, delay, response, and reward periods) in both Go and Nogo trials. Out of 296 task-related putaminal neurons, 87 neurons showed activity changes in Go trials only (Go type), 74 did in Nogo trials only (Nogo type), 99 did in both trials during same task periods (Both type), and 36 did in both trials but during different task periods (Different type). These 296 neurons were examined in effects of both D1 and D2 agonists and/or antagonists, and 234 neurons responded to either D1- or D2-related substances or both. Among them 41% of neurons responded to the D1 substances only (D1 group), 36% responded to the D2 only (D2 group), and 23% responded to both the D1 and D2 (D1D2 group). During the iontophoretic application of the D1 and D2 substances, most of the responded neurons changed the task-related activity but not the baseline firing rates. The D1 agonist increased the activity in 19 neurons and decreased it in 105 neurons. On

the other hand, the D2 agonist increased the activity in 54 neurons and decreased it in 50 neurons. The D1 and D2 substances modulated the activity in both Go and Nogo trials. Each of the three D1/D2 groups (D1, D2, and D1/D2 groups) contained all four Go/Nogo types (GO, Nogo, Both, and Different types) of neurons. Percentages of each Go/Nogo type of neurons were comparable among the three D1/D2 groups. The D1 and D2 substances modulated the activity related to various task periods. Each of the three D1/D2 groups included neurons activated during the cue, delay, response, or reward period in Go and Nogo trials. Distributions of the neurons related to each task period were similar among the D1/D2 groups. These results suggest that dopamine can modulate activity of single putaminal neurons through both D1 and D2 receptors and that the dopaminergic modulation through the two receptors in the putamen affects similar types of signals in behavioral control.

Reevaluation of Ipsilateral Corticocortical Inputs to the Orofacial Region of the Primary Motor Cortex in the Macaque Monkey.

¹Hironobu TOKUNO, ²Masahiko TAKADA,

¹Atsushi NAMBU and Masahiko INASE

¹*Tokyo Metropolitan Institute for Neuroscience*

²*Kyoto University*

Journal of Comparative Neurology **389** (1997) 34-48

An anatomical approach to possible areas in the cerebral cortex that are involved in somatic motor behavior is to analyze the cortical areas containing neurons that connect directly to the primary motor cortex (MI). To define the cortical areas related to orofacial movements, we made an attempt to examine the distribution of cortical neurons sending their axons to the orofacial region of the MI in the macaque monkey. Injections of retrograde tracers into the orofacial region of the MI, which had been identified electrophysiologically using intracortical microstimulation, revealed that the retrogradely labeled neurons were distributed abundantly in the orbital cortex (areas 12 and 13), insular cortex and frontoparietal operculum, including the deep part of the cortical masticatory area and the secondary somatosensory cortex, and ventral division of the premotor cortex (PMv), especially in its lateral part, and, to a lesser extent, in the orofacial region of the supplementary motor area (SMA) and the rostral and caudal divisions of the

cingulate motor area (CMA). In addition, a number of labeled neurons were seen in the MI around the injection sites and parietal cortex, including the primary somatosensory cortex and area 7b. No labeled neurons were found in the dorsal division of the premotor cortex (PMd). Employing fluorescent retrograde double labeling, we further examined the difference in the distribution pattern between cortical neurons projecting to the orofacial region of the MI and those projecting to the forelimb region of the MI. The cortical neurons projecting to the orofacial region of the MI were located mainly in the lateral aspects of the hemisphere, i.e., the lateral part of the PMv and orbital, insular, and opercular cortices—except that a number of them were distributed in the SMA and CMA, whereas those projecting to the forelimb region of the MI were located mainly in the medial aspects of the hemisphere, i.e., the SMA, CMA, PMd, and medial part of the PMv. Virtually no overlap of distribution was observed between cortical neurons projecting to these two distinct regions of the MI. Based on the present results, we discuss the functional diversity of the cortical areas related to orofacial motor behavior, the somatotopic organization in the premotor areas of the frontal cortex, and the evolutionary aspect of the somatotopy in the primate SMA.

Kinetics of Protein-Induced Flocculation of Phosphatidylcholine Liposomes

M. DIMITROVA, H. MATSUMURA and V. NEITCHEV
LANGMUIR **13** (1997) 6516 - 6523

The influence of protein adsorption on membrane-membrane interactions was studied regarding the kinetic stability of phosphatidylcholine liposome dispersions. The rate of flocculation were measured by the decrease in the transmitted light intensity in time. To elucidate the experimental data, we proposed an analytical method relating light transmittance to the average size of liposome flocs.

OPTICS AND RADIATION

Observation of Exciton States in GaAs Coupled Quantum Wires on a V-Grooved Substrate

Kazuhiro KOMORI, Xun Lun WANG, Mutsuo OGURA,
and Hirofumi MATSUHATA

The exciton states of GaAs coupled quantum wires are investigated by the measurement of photoluminescence excitation (PLE) in comparison with those of single quantum wires. In the PLE spectra of single quantum wires (wire thickness = 4.5nm), sharp exciton peaks of the first two heavy hole-like transitions are observed with large energy difference of 47meV. While, two adjacent exciton peaks with the small energy splitting of 24meV are observed in the coupled quantum wires (wire thickness = 5nm, barrier thickness= 3 nm). From the measurements of the barrier thickness dependence, these exciton states agree well with the coupled states of the quantum wires calculated by the finite element method.

Photon-Stimulated Ion Desorption from DCOO/ Si(100) near the O K-Edge

Hiromi Ikeura SEKIGUCHI and ¹Tetsuhiro SEKIGUCHI
¹*Japan Atomic Energy Research Institute*
Surface Science **390** (1997) 214-218

Photon-stimulated ion desorption from deuterated formic acid chemisorbed on Si(100) has been studied using pulsed synchrotron radiation by the carbon and oxygen 1s electron excitation region. The system contains only one carbon atom involved in a number of different bondings such as C-D, C-O, and C=O which can be selectively excited at $\sigma^*(\text{C-D})$, $\sigma^*(\text{C-O})$ and $\sigma^*(\text{C=O})$ resonances in the C K-edge. On the other hand, the system contains two type of oxygen atoms which are hydroxyl oxygen (C-O) and carbonyl oxygen (C=O), then it is possible to selectively excite the 1s electrons of two oxygen atoms in the O K-edge. The results indicate that the ion desorption is related both to the antibonding character of excited molecular orbitals and the local character of excited core orbitals.

Dispersions for a Femtosecond Cr:LiSAF Laser

Sadao UEMURA
5th International Workshop on Femtosecond Technology
Abstract FST'98 (1998) 94

Based on the measurement of Cr:LiSAF dispersion and

the calculation of prism-pair dispersion, the dispersion of femtosecond Cr:LiSAF laser is estimated. It is possible to obtain 10-fs pulses from the laser.

Dispersion Compensation for a Femtosecond Cr:LiSAF Laser

Sadao UEMURA
Jpn. J. Appl. Phys. **37** (1998) 133-134

First, the dispersion of a Cr:LiSAF crystal has been measured. The dispersion of Cr:LiSAF calculated from the refractive index is largely different from the measured value. This fact indicates that the refractive index of Cr:LiSAF has a large error. Next, the dispersion of a prism pair has directly been calculated from phase difference without approximations to be estimated in a large wavelength range. The results calculated from the approximation are largely deviated from those directly calculated from the phase difference. Finally, we consider an example of a z-fold laser cavity composed of 5-mm-long Cr:LiSAF crystal and a 500-mm-separated fused-silica (FS) Brewster prism pair. Using the results of the dispersions of Cr:LiSAF crystal and a Brewster prism pair mentioned above, we can choose the center wavelength and intraprism path length which simultaneously make the 2nd and 3rd dispersions of the laser cavity zero. It is possible to obtain nearly 10 fs pulses from the mode-locked Cr:LiSAF laser.

MEASUREMENT TECHNOLOGY

Calibration of a 10 : 1 Ratio Transformer Using Thompson's Method

Yasuhiro NAKAMURA, Akio FUKUSHIMA
and Yasuhiko SAKAMOTO
METROLOGIA **34** 4(1997) 353-355

The results of the calibration of a 10 : 1 ratio transformer which will be used for setting up scales of capacitance at ETL, by using Thompson's method are reported. The deviation of the ratio from the nominal value of the 10 : 1 was measured as -1.37×10^{-7} for the in-phase component and -7.22×10^{-7} for the quadrature, with the transformer operated at a frequency of 1592 Hz with an applied voltage of 100 Vrms. The uncertainties of

the measurement were estimated to be 5×10^{-9} for the in-phase and 1.2×10^{-8} for the quadrature.

ENERGY TECHNOLOGY

Simulation of Temperature Modulated DSC of Temperature Dependent Heat Capacity

Katsuhiko KANARI and ¹Takeo OZAWA

¹Chiba Institute of Technology

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Mathematical analysis can be applied to elucidated dynamic steady state in temperature modulated DSC, because it is a linear process, and its results were reported previously, but it was done on assumption of constant heat capacity. In real measurement of the heat capacity is not constant instead it is dependent on the temperature. To elucidate thermal response during heat capacity change, computer simulation has been applied. Two cases have been simulated: heat capacity with linear temperature dependence and ramp change of heat capacity like a glass transition. The results are reported in this paper in relation to additional errors due to this temperature dependence.

Thermal Studies of a Lithium-Ion Battery

Yoshiyasu SAITO, Katsuhiko KANARI
and Kiyonami TAKANO

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In order to characterize the heat generation behavior of a lithium-ion secondary battery during discharge, calorimetry of the battery was carried out. The temperature dependency of the heat generation was studied between 283 and 333 K. An exothermic peak and an endothermic peak were observed around 4 V except at 333 K. These peaks are caused by a phase transition of the positive electrode material, Li_xCoO_2 , between hexagonal and monoclinic structures, which is observed at around $x = 0.5$. The heat of discharge consists of mainly two factors, the battery reaction and the electrochemical polarization. In the temperature range between 283 to 333 K, if the battery is discharged at 50 mA, the least heat generation is observed at about 300 K owing to the temperature dependence of both factors.

Experimental Results with Tubular Heat Exchanger Type Exothermic Reactor on a Solar Chemical Heat Pump

Takumi TAKASHIMA, Takuya DOI, Yuji ANDO,
Tadayoshi TANAKA, ¹Ryosuke MIYAHARA
and ¹Junji KAMOSHIDA

¹Shibaura Institute of Technology

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Upgrading low temperature solar thermal energy to higher temperature makes the wide utilization of solar energy. A solar chemical heat pump system, which is composed of the reversible chemical reactions of 2-propanol / acetone / hydrogen, can upgrade low temperature heat about 80°C to higher one about 150 - 200°C. Therefore, these chemical reactions are suitable for upgrading low temperature solar heat to industrial process heat. In the exothermic process of above reaction, i.e. acetone hydrogenation reaction, a temperature peak occurs near the inlet of reaction zone in the case of arranging catalyst uniformly. Such a temperature distribution is not suitable for heat exchange. Therefore, we arrange the concentration of catalyst gradationally so as not to occur the temperature peak. In this paper, experimental results of exothermic reaction with concentration gradient catalyst layer in a tubular heat exchanger type exothermic reactor are presented. These results show that the arrangement of concentration gradient catalyst has the possibility about the temperature control in the catalytic reactor and about the improvement of the thermal effectiveness.

Study on the Thermal Efficiency of Solar Chemical Heat Pump System

Takuya DOI, Tadayoshi TANAKA, Takumi TAKASHIMA
and Yuji ANDO

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It is not easy to use solar energy because it has low energy density and is interrupted by passing clouds. Furthermore it is difficult to continuously get high-temperature thermal energy from the sun under a poor solar condition such as in Japan. However it is easy to get low-temperature thermal energy. Therefore, we are investigating a solar chemical heat

pump, which uses endothermic and exothermic reactions in order to upgrade low-temperature thermal energy obtained from the sun. We adopted 2-propanol / acetone / hydrogen system as the chemical reaction. It is very important to clarify what is the dominating factor of the system efficiency and how to improve the efficiency. To attain this purpose, we analyzed the thermal efficiency under the consideration of the reaction temperatures, the reflux ratio and the heat utilization factor in the endothermic reaction as the major factors in this system. In this paper, we report the effects of these factors from calculations with an analytical model.

SPACE AND OCEAN TECHNOLOGY

Investigation of Electrochemical Hydrogen Evolution under Microgravity Condition

Akira IWASAKI, Hiroko KANEKO, Yoshiyuki ABE
and Masayuki KAMIMOTO

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We investigated the electrochemical evolution of hydrogen gas under microgravity conditions in a dropshaft over a potential range of 2 to 5 V vs. a silver electrode using a three electrode system. The formation of hydrogen gas bubbles on a platinum electrode in an aqueous solution of sulfuric acid was observed under high magnification. Under microgravity conditions, bubbles remained on the electrode, covering the electrode surface, and their diameter increased tenfold. The current density became lower than that under terrestrial conditions. The use of an acceleration level of good quality eliminated the bubble motion caused by residual acceleration and allowed precise measurement of bubble behavior. The bubbles did not coalesce to form a single large bubble but detached from the surface of the electrode due to the inertia of coalescence. The effect of microgravity on the current density became appreciable when the potential exceeded about 2.5 V.

Experimental Study on Space Structure Assembly by Far-Distant Robot

Kazuo MACHIDA, Shigeoki HIRAI, Yujin WAKITA
Toshiaki IWATA, ¹Kenji OGIMOTO, ¹Masahiro KITAMI
and ¹Hiroaki UJIIE

¹*Kawasaki Heavy Industries LTD*
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This paper describes the results of the Japan-USA international joint research on "Super-long-distance space telerobotics". An experimental study of space structure assembly by a far-distant robot was conducted. Handling a deployable truss with flexible structure and measures to cope with a low communication rate and long time delay are dealt with for space structure assembly by the telerobot. Furthermore, the technology of interoperation of space robots by internationally distributed users through a communication network of public phonelines and the Internet are studied. An intelligent telerobotic system integrated by a man-robot cooperative function with an object-handling knowledge base and an intelligent monitoring function was developed. A Trans-Pacific experiment between Electrotechnical Laboratory in Japan and Jet Propulsion Laboratory in US was achieved to demonstrate the effectiveness of the telerobotic system using a ground testbed.