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Preparation of sinterable Ca-doped CeO_2 powders prepared by reverse precipitation using tetra-methyl ammonium hydroxide (TMAH) solution

by

Kazuhisa KOBAYASHI, Masashi HIGUCHI, Takashi ASAKA, Yasuo AZUMA and Keiichi KATAYAMA

(Received on Sept. 30, 2006 & accepted on Nov. 22, 2006)

Abstract

In this paper, we report on the preparation of Ca-doped CeO_2 powders by reverse precipitation from nitrate solutions, and the sinterability of the powders. The precipitants were formed by the addition of tetra-methyl ammonium hydroxide (TMAH) aqueous solution to nitrate solutions, or by the addition of nitrate solution to TMAH solution. Precipitates containing the intended amount of Ca were obtained in the latter way (reserve precipitation), while the amount of Ca in the precipitates prepared in the former way (normal precipitation) was far smaller than that contained in the mixed solutions. Fine powders were obtained by the thermal decomposition of the precipitates prepared by reverse precipitation, and the sinterability of the powders was compared with that of powders prepared by a solid-state reaction. Dense Ca-doped CeO_2 ceramics having a theoretical density of 90% or more were easily obtained using powders prepared by heating the precipitates.

Keywords: *Powder preparation, Ca-doped cerium oxide, Reverse precipitation, TMAH*

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Synthesis and biocompatibility of aromatic polyamides containing phosphorylcholine moiety

by

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(Received on September 30, 2006 & accepted on November 22, 2006)

Abstract

2-Methacryloyloxyethyl phosphorylcholine (MPC) polymer has been reported to be an ideal biocompatible material. In this study, to develop the durability of phosphorylcholine (PC)-containing polymer, the synthesis of novel aromatic diamine compounds containing a PC group with different spacer structures was carried out to prepare aromatic polyamides with a PC moiety. The obtained polymers were soluble in specific solvents such as dimethylsulfoxide (DMSO), *N,N*-dimethylformamide (DMF) and 1-methyl-2-pyrrolidinone (NMP) at room temperature. This solubility of polymers is an advantage in the processing of medical devices. From the results of X-ray photoelectron spectroscopy (XPS), the P_{2p} peak was clearly observed for the polymer surface coated under moisturized conditions. In addition, it was confirmed from the results of blood-contacting experiments that the PC-containing polyamide films coated under moisturized conditions exhibited blood compatibility, even though the PC content was about 20 mol% in contrast to polyamide without the PC unit.

Keywords: Biocompatibility, Diamine monomer, Aromatic polyamides, Phosphorylcholine

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Synthesis of Pyroaurites in Mg^{2+}-Fe^{3+}-A (A: Cl^-, NO_3^-, SO_4^{2-}) System and Their Characteristics

by

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(Received on Sept. 29, 2006 & accepted on Dec. 20, 2006)

Abstract

Pyroaurite in an Mg^{2+}-Fe^{3+}-A (A: Cl^-, NO_3^-, SO_4^{2-}) system was synthesized by hydrothermal treatment. Pyroaurites with high crystallinity were obtained at pH=10 from suspensions containing Cl^- or NO_3^-, and those with low crystallinity were obtained from suspensions containing SO_4^{2-}. The morphology, basal spacing and specific surface area for the former powders were almost the same, but those for the latter were slightly different. The anion exchange capacity of pyroaurite synthesized in the Mg^{2+}-Fe^{3+}-Cl^- system from NO_3^- in $NaNO_3$ solution was larger than those of other systems. The pyroaurite after anion exchange was easily returned to the original state by heating at 350℃ and immersion in $NaNO_3$ solution.

Keywords: *Hydrotalcite, Pyroaurite, Hydrothermal treatment, Anion exchange*

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Establishment of optical model of GaN nanotip structure by effective medium approximation

by

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(Received on Sep. 29, 2006 & accepted on Dec. 26, 2006)

Abstract

Nanotips are constructed naturally on a GaN surface by reactive ion etching (RIE) using Cl plasma. The GaN nanotips are distributed uniformly on the surface with a period of less than 100nm. As a result, the reflectance of the incident light decreases and the transmittance increases over a wide wavelength region ranging from ultraviolet to near infrared. The structure of the GaN nanotips can be controlled in the height and density ranges of $0.1 \sim 0.2\,\mu$m and $10^9 \sim 10^{11}$cm^{-2}, respectively. In this research, the reflectance spectra are measured at normal incidence, and an optical model is established by effective medium approximation (EMA), in which the GaN nanotip layer is considered to be a monolayer with an appropriate effective refractive index.

Keywords: GaN nanotips, Effective medium theory, RIE, reflectance spectrum

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Development of multifunctional confocal laser-scanning microscope with UV/VIS laser source

by

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(Received on Sep. 26, 2006 & accepted on Nov. 22, 2006)

Abstract

Many types of confocal laser-scanning microscope (CLSM) have been developed and widely used. Various advanced optical materials such as photonic crystals and nanostructure materials are making the headlines as a result of the rapid growth of nanotechnology research. CLSM is one of the most useful characterization tools for these applications. Although there are several commercial CLSMs at present, they cannot satisfy nanotechnology research requirements, and a new multifunctional CLSM, having flexibility for various applications and higher performances, must be developed. As the first step, a CLSM using UV/VIS light sources was prototyped. The optical system is optimally designed for the two wavelengths of UV 325.0nm and VIS 632.8nm. The transmission and fluorescence characteristics of several lens materials were measured to optimize the lens design. An UV laser is used to achieve higher resolution, and a VIS laser is used for multiple functions. An optical system with an objective lens having NA: 0.95, EFL: 2.5mm, WD: 1.5mm and spatial resolution: 160nm was realizable. Several specimens were characterized to evaluate the performance of the fabricated system, and some optical materials under study were measured for evaluation and interesting results were obtained. Multifunctional measurements are being planned as a next step. This system will help advance the research of nanostructures, photonic crystals and biological systems.

Keywords: Confocal laser microscope, Nanostructure, Ultraviolet, Optical design

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Dependence of maturity on surface color of pears

by

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(Received on Sep.24,2006 & accepted on Dec.26,2006)

Abstract

The Japanese pear called 'Kosui' does not increase in ripeness after being harvested. Therefore, a harvester must estimate the ripeness of pears on the tree. To estimate the ripeness of a pear, the harvester examines its surface color. However, the surface color estimation of pears is influenced by the harvester's sensory ability. Recently, the sugar content of fruit has been measured by portable noncontact equipment using rays in the infrared region. This equipment has some problems in that it is heavy, bulky and expensive. In this study, the ripeness of pears was estimated from their surface color by a method in which only reflectance in the visible-light region is used. Therefore, the resulting equipment is small, portable and inexpensive. Currently, the surface color of a pear is determined by spectroscopy using an L*a*b* color system. However, this method entails a long measurement time and expensive equipment. The feature of our proposed method is to use only two wavelengths in the visible-light region. In this method, pear ripeness was determined using the reflectance ratio of these two wavelengths. Band-pass filters and LEDs were used for detecting the two characteristic wavelengths. As a result, the degree of pear ripeness was successfully estimated. Miniaturization and a low cost were realized using LEDs. We propose that this method can be applied to many other types of fruit.

Keywords: Pear, Surface color, Spectral reflectivity, LED

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Increase in Maximum Capacity of Distributed Generators Installed in Distribution Systems Using Voltage Control Effect of Sectionalizing Switches

by

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(Received on Sep.28, 2006 & accepted on Nov.22, 2006)

Abstract

Recently, the distributed generators (DGs) introduced in distribution systems have resulted in more complicated electric power systems. Therefore, it is an important problem to know the maximum capacity of the DGs that can be introduced to the systems. The authors propose the use of a sectionalizing switch and analysis based on a genetic algorithm (GA) to solve this problem. The effectiveness of the proposed method is demonstrated in practical distribution systems.

Keywords: Distribution systems, Distributed generator, Reverse flow, Sectionalizing switch, Genetic algorithm

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Basic Research on Cooperation between Step Voltage Regulator and Static Var Compensator in Distribution System

by

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(Received on Sep.28, 2006 & accepted on Nov.22, 2006)

Abstract

In recent years, small-capacity power supplies called "distributed generators (DGs)" have received much attention and have been used in distribution systems. The main driving forces behind this development are the liberalization of electricity and increased concern for the environment. Moreover, increasingly stringent electricity quality control is required with the progress of our information-oriented society. In this study, we propose the cooperation between voltage management machinery. We assess the feasibility of introducing "the cooperative control of" voltage management machinery in practical distribution systems using a step voltage regulator (SVR) and a static var compensator (SVC), and consider "the effects of such control".

Keywords: Static var compensator, Step voltage regulator, Distributed generator, Distribution system, Cooperative work

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Improvement of Heterojunction with Intrinsic Thin Layer (HIT) Solar Cells Studied by Optical Simulation

by

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(Received on September 30 , 2006 & accepted on January 24 , 2007)

Abstract

We have developed an optical simulation method to predict the performance of heterojunction with intrinsic thin layer (HIT) solar cells. In this simulation, the energies of reflected and absorbed light in each layer are calculated using the wave equations of electromagnetic waves. The HIT solar cells have combined structures with thin and thick layers. Therefore, we have developed a simulation technique, in which interference effects occur only in thin layers and average intensity is considered in thick layers. The simulation predicts the amount of absorbed light in each layer of the HIT solar cells. The results show that TiO_2 antireflective (AR) layers enhance the current density by about 1.3 mA/cm^2, and that one of the problems of HIT solar cells is the optical absorption in p, i and n-type amorphous silicon (a-Si) layers. In accordance with the simulation results, we have developed wide-gap hydrogenated a-Si by reactive sputtering using Ar-H_2 mixture gases. The simulation predicted that the current density of HIT solar cells can be improved by 1.5 mA/cm^2 using the developed a-Si, compared with using the conventional wide-gap a-Si.

Keywords: Solar cells, Silicon, Optical simulation, Magnetron sputtering, Absorption coefficient

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Effect of aggregate on workability and durability of high-strength lightweight concrete

by

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(Received on Jul. 25, 2006 & accepted on Nov. 22, 2006)

Abstract

In general, the water-cement ratio of high-strength lightweight concrete (HSLWC) is low compared with that of conventional concrete (CC). HSLWC shows a tendency to have a higher plastic viscosity compared with CC of the same slump value. Therefore, it is difficult to evaluate workability on the basis of the slump value. In this study, new methods of evaluating workability other than that based on the slump value were examined, and the relationship between the material and its mix proportion was evaluated quantitatively using an orthogonalization table. In addition, the resistance of concrete to freezing and thawing, as well as its permeability, were evaluated.

Keywords: High-strength lightweight concrete, Lightweight concrete, Lightweight aggregate, Workability, Durability

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Circulative Use of Lightweight Concrete Using Crushed Waste-Expanded-Polystyrene Melted Ingot

by
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(Received on Sep.30, 2006 & accepted on Dec.20, 2006)

Abstract

It was found that the unit mass of concrete formed using crushed waste-expanded-polystyrene (waste EPS) melted ingot waste as coarse aggregate was approx. 1.7 to 1.8 t/m^3, and that the compressive strength of the concrete was approx. 15 to 33 N/mm^2. In this study, reuse of this concrete was experimentally investigated. The bonding mortar of the recycled coarse aggregate manufactured from this waste EPS original concrete was weaker than that of normal aggregate concrete. Therefore, the quality deterioration of recycled coarse aggregate and concrete in circulative use was small.

Keywords: Waste EPS melted ingot, Crushed waste EPS, Lightweight aggregate, Circulative use

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Flow Characteristics for Structure of Stenosis Tubes with Pulsating Flow

by
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(Received on September 30,2006 & accepted on January 24,2007)

Abstract

In this paper, we describe the flow characteristics for the structure of stenosis tubes under pulsating flow. Stenosis in blood vessels causes the separation and the stagnation of the flow, and occurs in the normal bloodstream. Furthermore, stenosis in blood vessels is determined by a fluid mechanics factor, since it is closely related to the flow via the generation of shapes, such as the divergence points and the curved parts. In the present study, we investigated disorders in the flow by examining the flow characteristics of strictures, which have hardly been examined to date. In this study, the flow was made visible by particle image velocimetry to clarify the formation mechanism of blood vessel stenosis, and a detailed numerical analysis of the relationship between the flow characteristics and the shape changes was carried out.

Keywords: Turbulent kinetic energy, Flow characteristics, Structural stenosis, Percent stenosis, PIV, LES

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Effect of Drag Reduction for the Surface Structure of Circular Cylinder with Longitudinal Grooves

by

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(Received on Sep. 30, 2006 & accepted on Jun. 24, 2007)

Abstract

In this paper, we describe the drag reduction and the characteristic of flow around a circular cylinder with grooves. The surface pressure was measured for circular cylinders with four different numbers of grooves (32, 48, 64 and 96) with Reynolds number Re=0.4×10^5~4.2×10^5. The drag coefficient is calculated from the pressure distribution. The flow around the circular cylinders with grooves is investigated using a hot-wire anemometer and by visualization. From the results, it is clarified that the minimum drag coefficient shifts to the high Reynolds number side as the number of grooves increases. We conclude that the wake area, the position of the separation point change and the drag coefficient are affected by the number of grooves.

Keywords: Circular cylinder, Drag reduction, Surface structure, Grooves, Oil film method

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Effect of Grooves on the Aerodynamics around Corner-cut Square Cylinder

by

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(received on September 30, 2006 & accepted on January 24, 2007)

Abstract

In this paper, we describe the drag reduction of square cylinders with corner cuttings and with grooves, such as riblets, on the surface. We carried out wind-tunnel tests for the measurements of the drag coefficient and the surface pressure acting on a square section of the cylinders with chamfered corners and with grooves. In addition, the flow visualization by spark tracing was carried out. From the results, the drag coefficient decreased as the depth of grooves increased. Compared with the square cylinder without grooves, the drag reduction of the square cylinder with grooves of 10% depth is about 10%, the drag reduction of the square cylinder with chamfered corners is about 30%, and the drag reduction of the square cylinder with chamfered corners and with grooves of 10% depth is about 35%.

Keywords: Square cylinder, Grooves, Corner cuttings, Drag coefficient, Pressure distribution, Spark-tracing method

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Energy Absorption Efficiency of Aluminum Honeycomb Cell Structures under Axial Dynamic Impact Loading

by

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(Received on Sep. 30, 2006 & accepted on Nov. 22, 2006)

Abstract

Honeycomb structures are used as buffers in the field of transportation equipment owing to their excellent impact energy absorption. In this study, the impact absorption characteristics of various aluminum honeycomb cells under axial dynamic impact loading were evaluated by numerical and experimental analysis. Enlarged models of hexagonal unit cells, which determine the impact absorption characteristics of the honeycomb structure, were used. For the purpose of improving the energy absorption ability and reducing the initial peak stress, honeycomb cells having a rib inside the cell, honeycomb cells filled with high-rigidity urethane foam and honeycomb cells with holes at the corner part of the cell were investigated by conducting dropped-hammer impact tests as well as finite-element method (FEM) analysis. As a result of the investigation, it was shown that the energy absorption efficiency of honeycomb cells having the rib inside the cell is higher than those of normal cells and honeycomb cells filled with urethane foam. It was recognized that inserting the rib inside the cell affected the absorption characteristic of the honeycomb cells markedly. Experimental results of the crushing behavior, initial peak stress and energy absorption agree approximately with those of FEM analysis. Furthermore, it was found that the honeycomb cells that had holes and ribs show excellent performance.

Keywords: Aluminum honeycomb cell, Dynamic axial crushing, Urethane foam, Holes, Energy absorption efficiency, Inner rib, FEM

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Analysis of Postbuckling Behavior of Cross-Ply Laminated Plates with Initial Imperfection under Biaxial Compressive Loads

by

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(Received on Sep. 27, 2006, accepted on Des. 20, 2006)

Abstract

Advanced fiber-reinforced laminated plates have been used as structural components in various fields because of their high specific strength and stiffness. In this work, the postbuckling behavior of cross-ply laminated plates with initial imperfection, which are simply supported along four edges, under biaxial compression are examined by Galerkin's methods, as an example. The inevitability of postbuckling behavior is proved analytically, and the effects of various factors, such as initial imperfection, number of layers, biaxial compressive load ratio, and postbuckling deflection pattern, are clarified.

Keywords: *Structural analysis, Composite materials, CFRP, Postbuckling behavior, Cross-ply laminated plates, Biaxial compression, Lamination constitution, Initial imperfection*

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Effect of Structural Damping on Dynamic Stability of Angle-Ply Laminated Cylindrical Shells under Impact Hydrostatic Pressure

by

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(Received on Sep. 27, 2006 , accepted on Nov. 22, 2006)

Abstract

This paper deals with the dynamic stability of composite laminated cylindrical shells under impact hydrostatic pressure. First, the motion of cylindrical shells under impact hydrostatic pressure is defined as axially symmetric motion. Following this definition, certain perturbations are superimposed on this motion, and their effect on the behavior of a shell is investigated. The symmetric state of motion of the shell is stable if the perturbations remain bounded. The solutions for the prebuckling motion and perturbed motion are obtained by Galerkin's method. Stable regions are determined using Mathieu's equation. The inevitability of dynamically unstable behavior is proved analytically, and the effects of various factors, such as structural damping, hydrostatic pressure ratio, lamination angle and the dynamic unstable mode, are clarified.

Keywords: *Structural analysis, Angle-ply laminated cylindrical shells, Impact hydrostatic pressure, Structural damping Dynamic stability, Mathieu's equation*

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Effect of Lamination Constitution on Buckling of Cross-Ply Laminated Cylindrical Shells under Combined Loads

by

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(Received on Sep. 30, 2006 , accepted on Jan. 24, 2006)

Abstract

Advanced fiber-reinforced composite materials have been used for structural members in various fields because of their high specific strength and stiffness. In general, composite laminated cylindrical shells behave differently from homogeneous orthotropic cylindrical shells due to their anisotropy and asymmetric lamination. In the present paper, the buckling problems of carbon fiber/epoxy (CFRP) cross-ply laminated cylindrical shells under combined loads are considered. That is, the effects of the stacking sequence, number of layers, buckling mode and dimensions of cylinders on the buckling stress are analyzed by assuming that the buckling patterns satisfy the equation based on Flügge expressions.

Key words: *Structural analysis, Composite materials, Laminated cylindrical shells, Buckling strength, Lamination constitution, Combined loads, Compression, Torsion, External pressure*

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Effects of Cylinder Length and Phase Difference on Acoustic Characteristics of Sound Field in Cylindrical Enclosure with Excited End Plate

by

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(Received on Sep.30, 2006 & accepted on Des.20, 2006)

Abstract

To study the coupling phenomena between the vibration of a structure and a sound field in contact with the structure, a cavity surrounded by a rigid cylinder having a thin elastic plate at both ends is adopted as an analytical model. When the dimensions of the cylindrical structure are varied, numerous parameters must be treated as influencing factors, because their changes cause the natural frequencies of the systems to shift. In this study, changes in the cylinder length and the phase difference between both plate vibrations, which affect coupling between the vibrations of both end plates and the sound field inside the cavity, are investigated on the basis of the characteristics of each system. A contribution, which is defined as the energy ratio of the sound field including all but a specific acoustic mode to that including all acoustic modes, is used to estimate the degree of influence of each mode on the acoustic characteristics. As a result of this investigation, it is clarified that the average sound pressure level inside the cavity depends on the above length and phase difference. In particular, the sound pressure level varies with the phase, increasing with coupling that is intensified by the wavelength that is close to the cylinder length. When the phase difference, which corresponds to the maximum sound pressure level of each length, varies rapidly and markedly with changes in length, the acoustic mode occupying the sound field is shifted to a neighboring mode, and then the sound pressure level becomes minimum.

Keywords: Coupled vibration, Circular end plate, Cylindrical sound field, Cylinder length, Phase difference

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Flow Characteristics in an Automatic-Transmission Oil Strainer for Automobile

by

Shohei MATSUURA, Hisayuki ENNOJI and Toshio IIJIMA

(Received on Sep. 30, 2006, accepted on Dec., 2006)

Abstract

The flow in an automatic-transmission oil strainer for an automobile was studied experimentally and analytically. Water was used instead of the automatic-transmission fluid (ATF) as the fluid in the oil strainer, and an experiment and a numerical simulation were carried out in the range of practical Reynolds numbers. In the experiment, the velocity distributions in many cross sections of the oil strainer were measured in detail by later Doppler velocimeter (LDV). In the numerical analysis, the computational fluid dynamics (CFD) code was used, and the velocity distribution, velocity vector, streamline, and pressure distribution were obtained. As a result, the validity of the experimental and analytical results was confirmed, and the flow characteristics in the oil strainer were clarified.

Keywords: Oil strainer, Flow characteristics, Automobile, Transmission, LDV, CFD

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Wide-Temperature-Range Test of Fluxgate Magnetometer Sensor for Exploration of Mercury

by

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(Received on Aug. 25, 2006 & accepted on Nov. 22, 2006)

Abstract

The Mercury spacecraft mission, Bepi-Colombo Mercury Magnetospheric Orbiter (MMO), is one of the cooperative projects between Japan and Europe. A ring-core-type fluxgate magnetometer made in Japan will be installed on the MMO for observing the magnetic field of Mercury and Mercury's magnetosphere. Interplanetary magnetic-field observation is very important for clarifying the interaction between solar wind and planetary magnetosphere structures. Although the fluxgate magnetometer has been used for many magnetic-field observations, there is a problem of temperature dependence. The temperature change of the sensor is assumed to range from -100 to +175°C during the research mission. However, no existing nonmagnetic temperature test apparatus can cover this wide temperature range. Thus, we have developed a wide-temperature-range testing system and tested two kinds of sensor, one with a bobbin made of INCONEL and the other with a bobbin made of ceramic. We obtained data on sensor sensitivity, offset drift, and noise level in the range from -160 to +200°C using this testing system. As a result, the ceramic sensor showed poorer performance than the INCONEL sensor for temperatures below -100°C, and no marked difference in the temperature characteristics was observed for temperatures over -100°C.

Keywords: Fluxgate magnetometer, Temperature test, Bepi-Colombo MMO, Planetary exploration, Mercury magnetosphere

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Comprehensive Analysis of Human Mannosyltransferase Complex

by

Tetsuo TAKAHASHI*

Abstract

The biosynthesis of the eukaryotic N-glycan precursor, lipid-linked oligosaccharide (LLO), is carried out by a series of glycosyltransferases localized on the rough endoplasmic reticulum (rER) membrane. In the early assembly process, five mannosyltransferase activities are required, which are carried out by three mannosyltransferases. To analyze the physical interaction among them in human, the yeast split-ubiquitin system was applied, which can detect protein-protein interaction on the rER membrane *in vivo*. Three human mannosyltransferase genes (*Hmat-1*, *Hmat-3* and *Hmat-5*) were subcloned into a bait or prey vector, and introduced into the yeast *NMY51* strain (host cell). Cotransformants with bait and prey constructs were assayed for reporter expression indicating physical interaction. In this assay, three types of interaction were revealed.

Keywords: Mannosyltransferase, Lipid-linked oligosaccharide, Split-ubiquitin system

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Proteomic Analysis of Digestive Cancer-Related Glycoproteins

by

Munehiro NAKATA

Abstract

Cell surface glycosylation changes dramatically during oncogenesis. Among the many types of carbohydrates, sialic acid is extremely important in the development of cancer, because enhanced sialylation is thought to play an important role in tumor progression and metastasis. To investigate the clinicopathological significance of sialoglycoconjugates in various gastrointestinal cancers, we performed histochemical analysis using sialic acid-binding lectins. Primary and metastatic cancer tissues were subjected to histochemical staining using *Maackia amurensis* leukoagglutinin (MAL). In gastric cancers, a high level of MAL staining was significantly related to unfavorable pathological features. Next, two-dimensional polyacrylamide gel electrophoresis followed by blotting MAL-positive glycoproteins onto a PVDF membrane was performed to characterize the cancer-related sialoglycoproteins in gastric cancer. MAL-positive glycoproteins were found in samples from the cancerous region but not in those from non-cancerous region. These glycoproteins have molecular weights of approximately 200 kDa or higher, and have diverse pI values probably due to the degree of sialylation. Thus, the aberrant expression of sialoglycoconjugates might play an important role in tumor progression and may be useful as one of the clinicopathological factors in various gastrointestinal cancers.

Keywords: Glycoprotein, Sialic acid, Lectin, Cancer, Metastasis

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Preparation of Nanosize Powder and Its Sheet Forming for Multilayer Capacitors

—Preparation of $Ba_{0.5}Sr_{0.5}TiO_3$ Fine Powder by KCl Molten Salt Method—

by

Keiichi KATAYAMA

Abstract

Single-phase $Ba_{0.5}Sr_{0.5}TiO_3$ (BST) fine powder was successfully prepared at 800-1000°C by the KCl molten salt method. The particle size and shape of the powder largely depended on the preparation temperature, and fine spherical powder having a particle size of 0.3 μm was obtained. BST ceramics of 90 % density or higher were easily fabricated from the powder by firing at 1300-1500°C. **The dielectric properties of these ceramics were measured from –60 to 50°C at 1kHz, and the maximum dielectric constant was obtained near the Curie temperature. These results indicate that the powder prepared using** this method is suitable for producing a thick film of BST. The preparation of nanosized BST powder and a thick film using the powder will be carried out next.

Keywords: **Molten salt method, Barium strontium titanate, Powder preparation, Dielectric property**

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Improving Performance of Micromanipulation System with Multilink Mechanism

by

Yoshio YAMAMOTO*

(received & accepted)

Abstract

Micromanipulation and nanomanipulation techniques have attracted much attention because of their potential utility not only in manufacturing fields but also in medical and bioengineering domains. Many prior systems have been developed to accommodate accurate positioning capability. However, changing the orientation of a manipulation probe is considered far more difficult in such systems than changing the translational position alone. The installation of a posture-changing mechanism, in general, requires a large complex apparatus or a highly expensive system. In this study, the author provides the posture-changing mechanism for micromanipulation at a reasonable cost using an offset planar hinge mechanism. In this report, the author presents a prototype system that has recently been developed.

Keywords: Micromanipulator, Posture control, Offset planar hinge mechanism

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Noncontact High Speed Conveyance Control for Electromagnetically Levitated Thin Steel Plate based on High-Precision Magnetic Field Analysis

by

Yasuo OSHINOYA

Abstract

For thin steel plates, which are used in many industrial products including those in the automobile industry, we have proposed a magnetic levitation control system and confirmed its realization by means a digital control experiment. However, when only levitation control is applied to the steel plate, there is no horizontal restraining force in the direction of travel. Therefore, electromagnetic actuators are installed to control the horizontal movement of the levitated sheet steel. The electromagnetic attractive control forces of the actuators are applied to the two facing edges of the levitated sheet steel, from the horizontal direction. In this study, the suppression of the bending the plate during the horizontal noncontact positioning control is reported.

Keywords : Electromagnetic levitation control, Steel plate, Vibration control, Elastic vibration, Electromagnetic field analysis, FEM, FDM

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Development and Operation of Direct Dimethyl Ether Fuel Cell (DDFC) Stack

by

Zhili Chen

Abstract

In this report, the author presents the concepts and results of a study aimed at developing and demonstrating a direct solid polymer electrolyte (SPE) fuel cell stack that operates using dimethyl ether (DME). As a preliminary study, a test stack (three -cell stack) was developed for determining the requirements for the auxiliary operation systems including those of fuel supply and gas humidification.

Keywords: Fuel cell, Dimethyl ether, DME, Stack, Auxiliary system

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Microfabrication of DC Microarcjet Nozzles by Fifth-Harmonic Generation of Nd:YAG Lasers

by

Hideyuki Horisawa*

Abstract

The microfabrication of a microarcjet by the fifth-harmonic generation of Nd:YAG pulses (wavelength 213 nm) was performed and its plasma acceleration characteristics were investigated. The microarcjet, with a rectangular exit of 0.5 mm in height, was machined in a 1.0-mm-thick quartz plate. For the electrodes, Au films were coated on a divergent part of the nozzle for the anode and on an inner wall surface for the cathode. In addition, the microfabrication of 3 x 3 rectangular micro nozzle arrays, each with an exit height of 0.5 mm, using an ultraviolet laser was conducted. Relatively fine structures and smooth surfaces were obtained with a surface roughness of about 200 nm.

Keywords: Laser machining, Microfabrication, Surface machining, Fifth-harmonic generation of Nd:YAG lasers, Microthruster, Microarcjet.

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Oxidation of various Alcohols Using Heated Metal Filament

by

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(Received on March 31, 2007 & accepted on June 12, 2007)

Abstract

Various alcohol solutions are oxidized using a heated metal filament. The oxidation occurs at more than 1000℃. The utilized alcohols are methanol, ethanol, 1-propanol and 2-butanol. The color of the alcohol solutions varied from clear to yellow after 20 minutes of oxidation except for methanol. The pH value of all the alcohols decreased from 7 to 4 after oxidation. The alcohols were decomposed and oxidized by thermoelectrons from the heated filament, and an oxidation mechanism is proposed.

Keywords : alcohol solution, ethanol, oxidation, pH value, thermoelectron, heated filament, oxidation mechanism

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Synthesis and Herbicidal Activity of Novel Imidazol-4-carboxamide Derivatives

by

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(Received on March 31, 2007 & accepted on May 24, 2007)

Abstract

A series of novel 1-(substituted phenyl)imidazol-4-carboxamides substituted with cyano and trifluoromethyl groups at the 5 position of the imidazole ring were synthesized, and their herbicidal activities were evaluated against various weeds under paddy and upland field conditions. 5-Cyanoimidazol-4-carboxamides were synthesized by regioselective hydrolysis of the 4-cyano group of 4,5-dicyanoimidazole followed by amidation of the carboxylic acids obtained. On the other hand, 5-(trifluoromethyl)imidazol-4-carboxamides were easily obtained by amidation of the corresponding imidazol-4-carboxylic acids, which were prepared by cyclic condensation of *N*-(substituted phenyl)imidoyl chlorides with ethyl isocyanoacetate followed by hydrolysis of the ester moiety. The herbicidal activity of these derivatives was primarily influenced by the substituent at the 5 position of the imidazole ring, and the trifluoromethyl group was much more efficient in enhancing the activity than the cyano group. The level of activity also varied with the *N*-substituent of the 4-carbamoyl group; a bulky alkyl group provided the best combination of herbicidal activity against annual lowland weeds and excellent safety for transplanting rice. Introduction of a pair of electron-withdrawing groups at both *ortho* positions of the benzene ring at the 1 position of the imidazole ring enhanced the herbicidal activity significantly. Among the compounds synthesized, *N*-*t*-butyl-1-(2,6-dichlorophenyl)-5-(trifluoromethyl)imidazol-4-carboxamide, which showed good herbicidal activity against various annual lowland weeds and excellent safety for rice at a low dosage, is considered to be the most promising rice herbicide.

Keywords: *Synthesis, Herbicidal Activity, Imidazole, Carboxamide*

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Development of Lighting System for Color Hologram Using High Power LEDs

by

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(Received on Mar. 31, 2007 & accepted on May 24, 2007)

Abstract

A halogen lamp is a popular light source for the reconstruction of holograms and has the merits of a wide-range spectrum covering the whole visible region, which makes it easy to obtain the image of the hologram. However, there are several problems of lighting systems using the halogen lamp. The reconstructed image of a blue hologram has a low intensity compared with that of a red one. Light-emitting diodes (LEDs) have rapidly become popular since the appearance of the blue LED. Three-color (R, G, B) LEDs are utilized for image display systems because of the development of multicolor LEDs. White LEDs have become used commercially, in which fluorescent materials are excited with blue or UV light sources. White LEDs are prevailing in general lighting applications. As a result, LEDs are replacing conventional incandescent lighting and are even used in automobile headlights. The aim of this research is to evaluate the feasibility of applying LEDs for the reconstruction of hologram images by comparing the efficiency of different light sources including a halogen lamp and LEDs. The characterization was performed by illuminating red, green and blue test holograms using a halogen lamp and various colored LEDs. We also aim to design and fabricate a high-efficiency lighting system for holograms using white LEDs.

Keywords: *Hologram, Light-Emitting Diode, Efficiency of Reconstruction, Tristimulus Value*

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Dynamic-Behavior Analysis of Breakup Process of Fine Particle Composed of Quasi-Particles

by

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(Received on March 31, 2007, Accepted on May 24, 2007)

Abstract

Assuming the existence of quasi-particles, which is proposed as an idea of simplification technique, we can reduce the number of particles to be treated in a given system. This simplification can enable us to perform computer simulations more easily when we analyze the behavior of many particles by the molecular dynamics method. After an appropriate potential function to be applied to the quasi-particle was formulated successfully, we were able to develop a computer code QPC (quasi-particle collision simulation) based on the quasi-particles. Dynamic-behavior analysis of the breakup process of a model particle composed of quasi-particles was performed using the QPC code from a microscopic point of view. The findings are summarized in a two-dimensional map of three regions representing an agglomeration process of collided particles, a particle growth process, and also a particle breakup process after a head-on collision took place between the model particles.

Keywords: Breakup Process, Particle Collision, Computer Simulation, Coalescence, Molecular Dynamics Method

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Effect of Sulfur on Carbon Nanofiber Growth

by

Kohei HOSONO*1 and Yoichi HIROSE*2

(Received on March 6, 2007 & accepted on May 24, 2007)

Abstract

Carbon nanofibers (CNFs) are grown by hot-filament chemical vapor deposition (hot-filament CVD) using CH_3OH-doped CS_2 (0.01~0.1vol%). The utilized substrates are Ni, Mo, Ta, W, Ti, Zr, Ag and Cu. CNF growth can occur on the substrates of metals that can form carbides and sulfides such as Mo. Metals and vaporized sulfur react to form metal sulfides, which activate the CNF growth. The growth mechanism of CNFs on Mo sulfide is proposed. The obtained samples are characterized by scanning electron microscopy (SEM), transmission electron microscopy (TEM) and electron spectroscopy for chemical analysis (ESCA).

Keywords: Carbon nanofiber, CVD, Sulfurized metal catalyst, Solid solution, Carbon, Growth model

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Examination of Locational and Hourly Maximum Capacity of a Distributed Generator Connected to a Distribution Power System Using Sectionalizing Switch

by

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(Received on March 31,2007 & accepted on May 24,2007)

Abstract

Recently, the distributed generators (DGs) that have been connected to distribution systems have increased the complexity of electric power systems. If DGs are installed in distribution systems appropriately, the reduction of distribution loss and the substitution of petroleum resources can be expected. To ensure that the deployment of DGs is effective, it is necessary to know how many DGs can be introduced in systems and to increase their capacity. In this paper, we use sectionalizing switches and propose an algorithm that calculates the hourly maximum capacity of DGs at each location. We conclude by producing an optimal distribution scheme.

Keywords: locational and hourly capacity of DGs, distribution systems, distributed generator, sectionalizing switch, reverse flow

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Strength and Postdamage Pattern of Predamaged and Retrofitted Carbon-Fiber-Chip-Reinforced Concrete Cylindrical Shells

by

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(Received on March 16, 2007 & Accepted on July 4, 2007)

Abstract

The strength and postdamage patterns of predamaged and retrofitted carbon-fiber-chip-reinforced concrete cylindrical shells were investigated, both experimentally and numerically, in this study. The concrete was artificially predamaged before it was evaluated by a loading experiment using a one-point concentrated load, and the retrofit applied to the predamaged shells was realized using noncontracted mortar and carbon-fiber sheets. In the experimental study, a static point load was applied perpendicularly onto the predamaged and retrofitted cylindrical shell specimens until the postdamage was obtained by applying the maximum strength. In the numerical analysis, nonlinear finite element analysis to model the effects of concrete cracking and tension stiffening was applied. The strength and postdamage patterns of the predamaged and retrofitted carbon-fiber-chip-reinforced concrete shells are discussed on the basis of the results of the numerical analysis and the experiment.

Keywords: Concrete Shell, Predamage, Carbon-Fiber Chip

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Strength and Postdamage Pattern of Predamaged and Retrofitted Reinforced Concrete Cylindrical Shells

by

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(Received on March 16, 2007& Accepted on July 4, 2007)

Abstract

The main purpose of this study is to investigate, both experimentally and numerically, the strength of predamaged and retrofitted reinforced concrete cylindrical shells. The strength of reinforced concrete cylindrical shells, predamaged by natural disasters, such as earthquakes, impact loads, wind and explosions, is difficult to estimate, and the strength of reinforced concrete cylindrical shells that were retrofitted on the basis of predamage to the shells has never been previously evaluated. In this study, the shells were artificially predamaged before evaluation by a loading experiment using a one-point concentrated load. The predamaged shells were retrofitted using noncontracted mortar and carbon-fiber sheets. A static point load was applied perpendicularly onto the predamaged and retrofitted cylindrical shell specimens. A numerical study by nonlinear FEM analysis including analysis of the fluctuations of the shell thickness was also conducted. The strength of the predamaged and retrofitted concrete shells in consideration of the reinforcement of the carbon-fiber sheets was discussed on the basis of the results of the nonlinear FEM analysis and the loading experiment.

Keywords: Concrete Shell, Predamage, Carbon-Fiber Sheet

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Experimental Study on Pulling-out Resistance of the Tip of a Nodular Pile in a Foot of Protective Concrete

by

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(Received on March 30, 2007 & accepted on May 24, 2007)

Abstract

According to the recommendations on the design of building foundations, the pulling-out resistance power of a pile is evaluated by summing the frictional resistance power and its weight. In this evaluation, the pulling-out resistance power in the tip of the pile is not known. When the tip of the pile is solidified in a foot of protective concrete, we can consider the pulling-out resistance power of the expanded foot body. Two problems in the testing is the lack of existing data for the pulling-out test, and the fact that the resistance power is thought to depend on the construction method used. We consider the bond strength, shear strength and bearing strength of a model nodular pile in a solidified foot body based on the bond characteristic of the concrete and steel bar. We used three piles with different heights of the nodular part, and three burial lengths of the foot body. As a result of the pulling-out test, we found that the destruction shape was conical. Also, the size of the cone tended to be larger as the burial length increased. Moreover, it was demonstrated that the shearing point is generated when the pulling-out load reaches the maximum, and the sliding line moves outwards and upwards. We also found that the bond strength tended to increase as the burial length and height of the nodular part increased. Using the result, we can predict the bearing strength and the bond strength based on the strength of the foot of the protective concrete and the size of the nodular part with very high accuracy.

Keywords: Nodular pile, Pulling-out resistance, Bond stress, Shear stress, Bearing stress

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Mechanical Property of the Pile-Tip Protection Using the Ductile-Fiber-Reinforced Cementitious Composite

by

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(Received on Mar. 31, 2007, accepted on July 4, 2007)

Abstract

Recently, the research and development of ductile-fiber-reinforced cementitious composites (DFRCC) superior to existing composites has been actively conducted. DFRCC is a cementitious composite material reinforced with fibers, and it exhibits crack-dispersing properties under tensile, flexural or compressive stress. The use of DFRCC as an energy absorption device will reduce the seismic response of structures. Using DFRCC instead of concrete will also enhance the durability of reinforced concrete structures. In this study, to investigate the applicability of DFRCC to the pile-tip protection of precast piles, experiments and the finite element analysis of precast piles were conducted. Results suggest that the use of DFRCC for the pile-tip protection of precast piles improves the bearing ductility of the tip of precast piles. The present finite element analysis was able to simulate the effect of the use of DFRCC for the pile-tip protection of precast piles.

Keywords: Bearing Strength, Ductile-Fiber-Reinforced Cementitious Composite, Recycled Fine Aggregate, Precast Pile, Finite Element Method

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Method of Predicting Horizontal Girder Response Induced by Pedestrians

by

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(Received on March 31, 2007 & accepted on July 4, 2007)

Abstract

Equations of motion have been proposed to predict the horizontal girder response of footbridges induced by pedestrians. The equations take into consideration the ratio of the pedestrians' horizontal force to their weight, the pedestrian density, the proportion of synchronized pedestrians, and the pedestrians' response to large-amplitude vibrations. The equations are then applied to two cable-supported bridges that have suffered from horizontal vibration. The predicted horizontal girder response agreed well with the measured girder response of these bridges, which verifies the validity of the prediction method.

Keywords: lateral vibration, footbridges, cable-supported bridges, synchronization

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Structural and Aesthetic Studies on Cable-Supported Bridges Using Steel Pipe Girders

by

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(Received on March 31, 2007 & accepted on May 24, 2007)

Abstract

Two new types of cable-supported bridges using steel pipe girders and steel orthotropic decks are proposed: two-pipe-girder bridges with two cable planes and three-pipe-girder bridges with one cable plane. Each cable-supported bridge with a main span of 500m was designed and verified to be feasible. Wind-tunnel tests were then conducted for these bridges. Torsional flutter occurred at a nondimensional wind speed of about 4.5 for the two-pipe-girder bridge. However, the three-pipe-girder bridge showed superb aerodynamic properties. The aesthetics of these new bridges were studied using computer graphics and models, which show that the proposed bridges are not only structurally sound but also attractive, impressive and harmonious with their surrounding environments.

Keywords: cable-supported bridge, pipe girder, computer graphics, aesthetics

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Formulation of Equation of Motion for Displacement Difference between Support Points of Bridge to Analyze Dynamic Response

by

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(Received on March 31, 2007 & Accepted on July 4, 2007)

Abstract

Bridge damage due to surface earthquake faults has been observed after earthquakes but is not considered in the current seismic design of bridges. In this research, an equation of motion for the displacement difference between support points of a bridge due to a surface earthquake fault is formulated using a beam element model with 3 degrees of freedom. Furthermore, the dynamic behavior of bridges is analyzed on the basis of observed data. As a result, inertial forces caused by ground acceleration are shown to be of great importance in evaluating the dynamic response of structures.

Keywords: Equation of Motion, EPS Method, Surface Earthquake Fault

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Theoretical Study on the Postbuckling Behavior of Cross-Ply Laminated Curved Plates with Initial Imperfections under Biaxial Compressive Loads

by

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(Received on March 31, 2007, accepted on July 4, 2007)

Abstract

Because of their high specific strength and stiffness, fiber-reinforced plastics have been used as structures in various fields, and hence the analysis of thin laminated structures is of importance. In this work, the postbuckling behavior of cross-ply laminated curved plates with initial imperfections, which are simply supported along four edges, under biaxial compression are examined by various methods including Galerkin's method. The inevitability of postbuckling behavior is proved analytically, and the effects of various factors, such as the type of initial imperfection, number of layers, biaxial compressive load ratio, and the postbuckling deflection pattern, are clarified.

Key Words : *Structural analysis, Cross-ply laminated curved plates, Postbuckling behavior, Biaxial compressive loads, Initial imperfections*

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Development of hydrogen generator for fuel cell operation

by

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(received on Mar. 21, 2007 & accepted on July 4, 2007)

Abstract

A hydrogen generator was developed for fuel cell operation. This generator produces hydrogen gas by using the electrolysis of deionized water. A Pt catalyst was used to generate the protons from water and reduce the operation voltage without using an electrolyte. The operation voltage required to produce hydrogen gas was 3V.

Keywords: hydrogen generator, electrolysis, fuel cell

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