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A Practical Strategy on the Subject of “Science and Ethics” for Overcoming Engineering Ethics Education and JABEE

by

Yoshiaki YASUI

(Received on Sep. 28, 2007 and accepted on Dec. 25, 2007)

Abstract

The issue of economic globalization and JABEE (Japan Accreditation Board for Engineering Education) mean that education on engineering ethics has now become increasingly important for science-engineering students who will become the next generation of engineers. This is clearly indicated when engineers are made professionally responsible for various unfortunate accidents that happen during daily life in society. Learning engineering ethics is an essential part of the education of the humanities and sciences. This paper treats the contents for the subject of “Science and Ethics” drawing on several years of practice and the fruits of studying science and engineering ethics at the faculty of science-engineering in university. This paper can be considered to be a practical strategy to the formation of morality.

Keywords: Science and Ethics, Engineering Ethics, Education of Humanities and Sciences, JABEE

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Preparation of Mesostructured P₂O₅-SiO₂ Thin Films and Their Electric Conductivity

by

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Yasunobu AKIYAMA, Keiichi KATAYAMA, Yasuo AZUMA

(Received on September 29 2007, accepted on December 25 , 2007)

Abstract

Mesostructured P₂O₅-SiO₂ thin films were prepared using the spin coating method with a precursor solution. The precursor solution was prepared from tetraethyl orthosilicate (TEOS), triethyl phosphate (TEP), and cetyltrimethylammonium bromide (CTAB). The electric conductivity of the prepared thin films was measured using the alternating current impedance method. The following results were obtained.

1. It was easy to prepare the uniform and transport precursor solution using TEP as the phosphorus element. The thin films prepared with this solution were transparent and had mesostructures. Furthermore, the sulfone group could be introduced into the thin film prepared by the surface modification method.

2. Electric conductivity of the mesostructured P₂O₅-SiO₂ thin films increased as the temperature increased. Moreover, the conductivity of the thin films increased under higher humidity. The electric conductivity of the thin films for which surface modification took place was $3.76 \times 10^{-2} \text{ S/cm}$ at 503K.

Keywords: Mesostructure, Thin film, Electric Conductivity

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Pd-catalyzed Coupling with Arylamines and 2-bromo-3,3,3-trifluoropropene

by

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(Received on September 28, 2007 & accepted on December 25, 2007)

Abstract

The palladium-catalyzed coupling of arylamines and 2-bromo-3,3,3-trifluoropropene (BTP) was investigated. When a toluene solution of aniline and BTP was heated to 110 °C in the presence of Pd₂(dba)₃·CHCl₃, 1,1'-diphenylphosphinoferrocene and Cs₂CO₃ in an argon atmosphere, *N*-(1,1,1-trifluoro-2-propylidene)aniline was obtained with an excellent ¹⁹F-NMR yields (99 %) and isolated yield (92 %). Cs₂CO₃ was exclusively effective in the coupling. The coupling using 2-aminobenzonitriles as substrates provided not only 2-*N*-(1,1,1-trifluoro-2-propylidene)aminobenzonitriles but also 4-amino-2-trifluoromethylquinolines and 2-trifluoromethyl-4-*N*-(1,1,1-trifluoro-2-propylidene)aminoquinolines. The strong electron withdrawing character of CF₃ will enhance the acidity of the methyl proton in the *N*-(1,1,1-trifluoromethyl-2-propylidene)amino group, resulting in the addition of the methyl proton to the carbon in the cyano group and cyclization to 4-amino-2-trifluoromethylquinolines. Moreover, the one-pot synthesis of 2-trifluoromethylindoles with 2-bromoanilines and BTP was achieved using Pd(OAc)₂, 2-dicyclohexyl-2',4',6'-triisopropylbipenyl and Cs₂CO₃. The Pd-catalyzed intramolecular Heck coupling of the vinyl group in 2-bromo-*N*-(1-trifluoromethyl)vinylanilines, which is the tautomeric isomer of 2-bromo-*N*-(1,1,1-trifluoro-2-propylidene)anilines, and the C-Br bond presumably furnished indole rings. C-N double bond of the *N*-(1,1,1-trifluoro-2-propylidene)amino group obtained here was smoothly hydrogenated to the *N*-(1-methyl-2,2,2-trifluoro)ethylamino group using LiAlH₄ or H₂ with Pd/C.

Keywords: Palladium, 2-Bromo-3,3,3-trifluoropropene, Amination, 4-Amino-2-trifluoromethylquinoline, 2-Trifluoromethylindole

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Study on Decalcifying and Calcifying Process of Hydroxyapatite HAp Using Structural and Optical Characterizations

by

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(Received on October 10, 2007, and accepted on November 21, 2007)

Abstract

Apatite is expected to be a useful material for artificial bones in surgery and artificial dental roots in dentistry. In particular, studies have recently been conducted into the reconstruction of teeth using Hydroxyapatite (HAp), and several supplements such as gum have become popular for keeping teeth in good condition. However, the decalcifying and calcifying processes are still not well understood. The aim of this research is to study the decalcifying and calcifying mechanisms of HAp. Specifically, the calcifying process was carried out on a sintered pellet of HAp without pores using a Phosphate Acid Maltodextrin (PMD) calcifying promotion agent developed by Oji Paper Co. together with a HEPES (C₈H₁₈N₂O₄S) buffer solution, and a natural calcifying liquid which simulates the situation within a human mouth as a reference. SEM, EDX and X-ray analyses were used for the characterization of the structure, morphology and forming elements. Optical characterizations like IR and Raman spectroscopy were also used for the study of physical properties. As a result, it was found that the rate of decalcification can be monitored from the change of the Raman intensity corresponding to the stretching vibrational mode of PO₄³⁻. It was confirmed that the calcification treatment enabled the growth of a precursor material OCP on the HAp pellet for both agents. The rate of growth was dependent on the agent, and it was found that PMD is more effective to grow OCP faster and with high density.

Keywords: Hydroxyapatite, Calcification, Decalcification, Ceramics, SEM

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Evaluation Method of Light Scattering in Optical Thin Films

by

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(Received on Sep. 14, 2007 and accepted on Jan. 10, 2008)

Abstract

Higher optical quality is increasingly required for optical thin films in accordance with the advancement of imaging devices. There are few reports on the systematic study of the light scattering characteristics of optical thin films. Currently, it is difficult to control light scattering properties during the deposition process. The wavelength region covered with the optical film becomes wider to the UV region and the light intensity incident upon the film becomes stronger. Light scattering which is the major cause of the decrease in transmission and stray light, is considered an important factor for characterizing the performance of optical thin films. The haze value which is the conventional parameter of light scattering does not possess spectral information. Characterization beyond the visible region is not possible by using the value. In this study, we proposed a spectral haze value which is derived by using a spectrometer and an integral sphere unit. TiO₂ thin films were used as test samples, because the light scattering property of the sample is sensitive to the deposition condition. TiO₂ thin films are deposited on BK7 glass substrates to the thickness of 1 micron by electron beam (EB) deposition and ion assisted deposition (IAD) methods, and the light scattering was characterized by using a spectral haze value for these films.

Keywords : Optical Thin Film, Light Scattering, Haze, TiO₂

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Oxidation of Organic Solutions Using Discharge Plasma

by

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(Received on Aug. 21, 2007 & accepted on Nov. 21, 2007)

Abstract

The vapor of organic solutions is oxidized using a discharge plasma that is applied at a high frequency of 20kHz and high voltage of 30kV. The utilized organic solutions are methanol, ethanol, 1-propanol, 2-butanol, formaldehyde and acetaldehyde. The pH value of all the alcohols decreased from 7 (neutral) to 4 (weak acid) after 20 minutes of oxidation. On the other hand, the pH of formaldehyde solution rapidly decreased from 7 to 3 (hard acid) after 5 minutes. The plasma emission spectrum of organic solution vapor is measured by a multi-channel spectrometer. In the discharge plasma, there are several radicals such as C₂, CH and H. The process of the oxidation mechanism is described along with the radical reaction.

Keywords: organic solution, discharge plasma, oxidation, pH value, emission spectrum, radical

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Research on Service Restoration Problem in Distribution Systems Using Genetic Algorithm

By

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(Received on Sep. 29, 2007 and accepted on Dec. 25, 2007)

Abstract

The problem of recovery from power-system failures is the problem of handling operations that make it possible to supply power from other lines in response to power-system failures or construction by switching between the opened and closed states of sectionalizing switches. Considerable research has already been conducted with regard to this issue. This paper addresses the issue of determining target systems for final recovery in cases when some sections remain subject to power failure (i.e., sound bank capacity < load capacity). For this purpose, intersection is conducted only for parameters within such power-failure sections. In such research, calculations are implemented by setting a value of 2 to the sectionalizing switches of a single parameter. It is clear that the proposed method consisting only of GA is superior in terms of average fitness values.

Keywords: service restoration problem, genetic algorithm, sectionalizing switch

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Voltage and Reactive Power Control Using Multiple Objective Optimization Method with PSO

by

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(Received on Sep. 29, 2007 and accepted on Dec. 25, 2007)

Abstract

This paper presents an application of the multiple objective optimization method for voltage and reactive power control (VQC). In order to obtain the optimal combination of parameters which consists of a large quantity of electric power control machinery precisely and effectively, Meta-heuristics has been used for VQC. However, this method has been used as one objective optimization so that it is impossible to present a relationship between multiple objects. Therefore, a method that allows for consideration of the trade-off among multiple objects should be applied to this problem. Consequently, this paper introduces the concept of Pareto optimal solutions and proposes a method that allows satisfactory solutions to be obtained with PSO (Particle Swarm Optimization). This will allow operators to successfully build a flexible VQC system by finding Pareto optimal solutions.

Keywords: VQC, Multiple objective optimization, Pareto optimal solution, Meta-heuristics, Particle swarm optimization

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Optimal Placement of SVR Considering Multiple Loads

by

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(Received on Sep. 29, 2007 and accepted on Dec. 25, 2007)

Abstract

This paper presents a new approach to optimal placement of a step voltage regulator (SVR) considering the installation of distributed generators (DG) based on a genetic algorithm (GA). In this case, it is necessary to solve problems such as the upper and lower limits of voltage at each node and line capacity. In addition, considering that the load and output of DG changes, it is important to solve more than one of these problems. In order to solve these problems, the conventional GA was improved and the proposed method was applied to a complex operative condition of the distribution power system.

Keywords: Multiple Load, Optimal placement, SVR, Genetic algorithm, Distributed generation

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Fundamental Study on Material Properties of Fiber Reinforced Mortar Using Waste Clay Roof Tile Fine Aggregate.

by

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(Received on Sep. 28, 2007 & accepted on Dec. 25, 2007)

Abstract

There are currently about 800,000 to 900,000 tons of waste clay roof tiles disposed of each year in Japan. It is, however, difficult to dispose of all these tiles at disposal facilities under present conditions. There have been a few studies up until now on using clay roof tile fine aggregate for concrete and mortar. However, in order for the recycling of waste clay roof tiles to be implemented in this way, it is necessary to improve the performance of concrete and mortar that includes clay roof tile fine aggregate. In this study, fiber reinforced mortar specimens that include waste clay roof tile fine aggregate were tested under compressive, split tensile and 3-point flexural loading to investigate the applicability of fiber reinforced mortar. The results suggest it is possible to improve ductility with fiber reinforced mortar specimens that include waste clay roof tile fine aggregate.

Keywords: Waste Clay Roof Tile Fine Aggregate, Fiber Reinforced Mortar, Fiber, Compressive Loading, 3-point flexural loading

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Quality of Recycled Aggregate Concrete Taking into Account the Properties of Residual Mortar of the Original Concrete

by

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(Received on Sep. 27, 2007 and accepted on Dec. 25, 2007)

Abstract

The quality and quantity of the residual mortar greatly influence the quality of the recycled coarse aggregate and change with the mix proportion of the original concrete. In this study, an experimental examination was performed focusing on the water binder ratio and the fine aggregate content of the original concrete that influence the quality of recycled coarse aggregate and recycled aggregate concrete. As a result, it was found that the quality of the recycled coarse aggregate containing the residual mortar of the original concrete is almost equal to that of the original aggregate when the water binder ratio and the fine aggregate content of the original concrete are low.

Keywords: Recycled coarse aggregate, Original concrete, Water binder ratio, Fine aggregate percentage, Drying shrinkage

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Influence of Experimental Conditions on $e \sim \log p$ Relation of Clay and Highly Organic Soil

by

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(Received on September 29, 2007 and accepted on December 25, 2007)

Abstract

As a check on the reliability of one-dimensional consolidation, a review was made of published experimental data concerning the principle settlement computation described by Bjerrum (1967), which showed that the soil model must be clarified by the experimental consolidation behaviors. Standard one-dimensional consolidation tests were performed for undisturbed Hitachi clay and Isehara highly organic soil. In the first series of tests for clay, each load increment was maintained for one or seven days, and in the second series of tests for highly organic soil, two load increment ratios were adopted to check the influence on the $e - \log p$ relation. The $e - \log p$ relation in the majority of the tests is not significantly affected by the load incremental duration and load increment ratio. A technique is suggested for obtaining the compression index of instant compression line from an observed consolidation time curve and the results of the calculation are given to show the adequacy of the proposed soil model, and further proposed analysis shows that the calculated consolidation curves are in closer agreement with those observed behaviors.

Keywords: clay, standard consolidation test, one-dimensional consolidation, $e - \log p$ relation, secondary compression

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Non-linear Dynamic Response Analysis of Bridge Subjected to Displacement Difference between Support Points

by

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(Received on Sep. 22, 2007 and accepted on Dec. 25, 2007)

Abstract

This paper presents non-linear dynamic analysis of a bridge under earthquake loading subjected to fault induced acceleration and relative displacement. First, an equation of motion with a displacement difference between support points was formulated. After that, the displacements of the fault surface were calculated by the EPS method. Finally, dynamic response analysis of the effect of earthquake fault movement based on special algorithms was carried out. As a result, it was shown that the effect of acceleration is of great importance for evaluating the damage of structures caused by earthquake faults.

Keywords: Equation of Motion, EPS Method, Non-linear Dynamic Response Analysis, Fault Induced Damage

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Teleoperation Experiments Using Force-feedback Micro-manipulation System

by

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(Received on September 29, 2007 & accepted on December 25, 2007)

Abstract

This paper presents recent results of experiments conducted on our micro-manipulation system between Tokai University and Thailand (KMUTT) via the Internet. PHANToM is used as a haptic interface at the master side. The forces observed at the master side (Tokai Univ.) are transmitted to the slave side (KMUTT) while position commands are sent in the opposite direction. The results show that although forces are successfully fed back to the operator at the remote site, a communication time delay causes some problem when there is a sudden change in the force observed, such as an initial contact. It is verified through experiments that an employment of the virtual environment model can circumvent such a problem even if the model is still at a rudimentary level.

Keywords: Micro manipulation, teleoperation, force feedback, haptic interface, force sensing

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Dynamic Behavior of Various Stiffened Cylindrical Shells under Internal and External Pressure

by

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(Received on Sep.28.2007, accepted on Dec.25.2007)

Abstract

Stiffened cylindrical shells are commonly used for aircraft fuselage, missile bodies, and tanks because of their strength, stiffness and good buckling characteristics, as well as their extremely light weight. There have been many reports on the theoretical and experimental investigation with relation to the free vibration characteristics of stiffened shells. The free vibration characteristics are necessary for designing structures while taking into consideration fatigue durability and safety. Some methods of the reinforcement against the natural frequencies of shells have been proposed, but there have not been enough reports on practical use. First, we extensively analyzed the natural frequency characteristics of stiffened cylindrical shells under pressure by FEM analysis. Next, we verified the reinforcement effect of some of the methods by conducting an experiment based on the analysis results, and we ensured that the clamped boundary condition was the same as that of the analysis model. As a result of the investigation, it became clear that there was a natural frequency shift to a lower frequency region and a decrease in the rigidity of shells under external pressure. However, the decrease in rigidity and frequency could be reduced effectively by using ring stiffener. Although oval-type vibration had not been considered as important as beam-type vibration until recently, we were also able to confirm that the control of oval-type vibration is effective in enhancing not only the natural frequency but also the rigidity of the shells. Moreover, the coupling behavior between the beam-type and oval-type vibration influences the vibration characteristics and rigidity of the shells, and the orthogonal stiffener allows for the control of both vibration types. Furthermore, the stringer showed that the effect of reinforcement against external pressure in orthogonally stiffened shells was good. Therefore, these results for the dynamic behavior of stiffened cylindrical shells will help contribute to the design of structures for practical use.

Keywords: Stiffened Cylindrical Shell, Internal Pressure, External Pressure, Free Vibration Characteristics, Dynamic Behavior

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Impact Collapse Characteristics of Thin-Walled Structure Tubes for Automobile under Oblique Impact Loading

by

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(Received on Sep. 29, 2007 and accepted on Dec. 25, 2007)

Abstract

Recently, there are strict requirements for measures against the crushing of automobiles with a lightweight structure. In the frontal collision of an automobile, the energy of the impact of the automobile is absorbed by deformation of mainly thin-walled structural members. In this paper, the impact collapse behavior of hexagonally shaped thin-walled structural tubes under an oblique impact load is numerically analyzed using the finite element method. This paper also shows the energy absorption characteristics for the difference in thickness and rib reinforcements. As a result, the oblique load angle affects the collapse behavior of the member, which leads to collapse by progressive buckling or by bending. Furthermore, the initial compressive load and energy absorption characteristics are influenced. In the case of collapse by progressive buckling, the energy absorbing performance under oblique impact load is effectively improved by rib reinforcement of the member. However, this is not effective in the case of collapse by bending.

Keywords: Impact collapse behavior, Oblique loading, Thin-walled structural tubes, Energy absorption

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Secondary Buckling Characteristics of Angle-Ply Laminated Rectangular Plates under Biaxial Compressive Loads

by

Keiichi NEMOTO, Masayuki TSUJIMOTO and Hirakazu KASUYA

(Received on Sep. 30, 2007, accepted on Des. 25, 2007)

Abstract

Advanced fiber-reinforced laminated plates have been used for structural members in various fields because of their high specific strength and stiffness. This paper examines the secondary buckling stress of angle-ply laminated rectangular plates, which are supported in a simple manner along four edges, under biaxial compression. A method based on the second variation of the total potential energy is proposed for evaluating the stability of the post-buckling equilibrium state and the inevitable secondary buckling is derived analytically. The inevitability of secondary buckling stress is proved analytically and the effects of various factors, such as lamination angle, biaxial compressive load ratio, and plate aspect ratio, are clarified.

Keywords: *Structural analysis, Composite materials, Secondary buckling, Angle-ply rectangular laminated plates, Biaxial compression*

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Auto-rotation around Short Axis of Rugby Ball

by

Naoko TAKAHASHI, Osamu KOBAYASHI and Kazuya SEO

(Received on Sep. 4, 2007 & accepted on Jan. 10, 2008)

Abstract

It has been observed that a rugby ball, which is set to be able to rotate freely around its short axis in a wind tunnel, starts to rotate automatically when air flows through the wind tunnel. The rotation speed increases to about 600 rpm at airspeed of 25m/s. The purpose of this paper is to clarify the mechanism of auto-rotation of a rugby ball. In order to examine this phenomenon, wind tunnel tests were carried out to measure rotation speeds and static aerodynamic forces, and oil flow test was used to visualize the flow on the surface of a rugby ball. The results of the experiment revealed that the seam lines on a rugby ball are a major factor in inducing the boundary layer transition, and the resulting asymmetrical flow pattern is attributable to the auto-rotation phenomenon. In addition, it is estimated that the distortion of the cross-section shape of rugby ball and another blow-off area on the separation flow region contribute to the complicated aerodynamic characteristics.

Keywords: Rugby ball, Auto-rotation, Wind tunnel test

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Growth of Carbon Nanotube at Large Area and Low Temperature and Application to Electrical Double Layer Capacitor

by

Yoshiyuki SHOW^{*1}

(received & accepted)

Abstract

A carbon nanotube (CNT) was deposited by the triode type plasma chemical vapor deposition method. This CVD equipment achieves growing of the CNT at the low temperature of 550°C and in a large area. Moreover, the CNT was applied as a conductive material in the electrical double layer capacitor (EDLC). The addition of the CNT into the polarized electrodes of the EDLC decreased its series resistance.

Keywords: Carbon nanotube Electrical double layer capacitor, Series resistance

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Environment-Friendly Ductile Fiber Reinforced Cementitious Composite - Fundamental Study on DFRCC Using Recycled Fine Aggregate -

by

Ken WATANABE^{*1}

Abstract

Recently, research and development of ductile fiber reinforced cementitious composites (DFRCC) superior to existing ones are actively conducted. DFRCC is a cementitious composite material reinforced with fibers, and it represents crack dispersing properties under tensile, flexural or compressive stress. In this study, fiber reinforced mortar specimens using recycled fine aggregate were tested under compressive, split tensile, and 3-point flexural loading. To investigate applicability of DFRCC to precast piles, the experiments and finite element analyses of precast piles were also conducted. The 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: Fiber reinforced concrete, Ductile fiber reinforced cementitious composite, Recycled fine aggregate, Precast pile, Finite element method

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Development of Bio-MEMS for Blood Extraction System with Biosensor

by

Kazuyoshi TSUCHIYA¹

Abstract

Medical devices such as a micropump to extract blood through a needle have a structure in which needle and pump are mutually separated, hence, it is not easy to make the micropump including the microneedle smaller. In this study, the tube type micropump installed with set ring type PZT actuator up on a silicone tube was proposed. The flow function demonstrated by the tube type micropump was evaluated and the flow rates were increased 2.78% and decreased 1.79%, thus confirming the control of the flow rate. Furthermore, due to the need for a small blood sugar level monitor for the Bio-MEMS, the two electrodes method based on the effect of hydrogen peroxide caused by the reaction of glucose oxidase was developed, which has 5 % target measuring resolution for the blood sugar level monitor. It was confirmed that the electron flowed from the aluminum electrode to the platinum electrode by the influence of hydrogen peroxide from the red discoloration seen at the platinum electrode side using phenolphthalein solution. Moreover, the system demonstrated less than 5 % measuring resolution.

Keywords: Microneedle, PZT, Piezoelectric Actuator, Micropump, Sputtering

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Shiobara Spa Yuppo No Sato

by

Hirofumi SUGIMOTO*¹ Katsuo NAKATA*² Syunichi MATSUZAKA*³

Abstract

This is a top-class Japanese wooden footbath facility located at the center of the Shiobara Hot Spring Resort, which boasts abundant quantities of hot water. It consists of a gable-roofed administration building and a footbath gallery encircling an oval pond in the center. It is characterized by a structure that assembled from delicate wood elements with no large cross-section members.

Keywords: Wooden Architecture. Footbath. Hot Spring Resort.

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Synthesis and Biocompatibility of Aromatic Polyamides by Using Novel Diamine Monomers Containing Phosphorylcholine Moiety

by

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Yasuhiko IWASAKI*³ and Kazuhiko ISHIHARA*⁴

(Received on March 15, 2008, Accepted on July 9, 2008)

Abstract

The synthesis of novel aromatic diamine compounds containing phosphorylcholine (PC) group with different spacer structures was carried out, which gave the high molecular weight polyamides with PC group by polycondensation. 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 production process for medical devices. From the results of X-ray photoelectron spectroscopy (XPS), the N_{1s} and P_{2p} peaks were clearly observed on the polymer surface, and these polymers exhibited the excellent biocompatibility, which would be due to the surface structure derived from PC side chain. In addition, the obtained polymers showed the high thermal stability up to 250°C, at which the thermal degradation of PC moiety would occur. Therefore, these polyamides are expected as tough biocompatible materials for the use of biomedical devices.

Keywords: Biomaterial, Biocompatibility, Diamine monomer, Aromatic polyamides, Phosphorylcholine

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Synthesis and Properties of Hyperbranched Aromatic Polyamides Containing Phosphorylcholine Moiety at the Branch Ends

by

Azusa YOGO *¹, Yu NAGASE *²,

(Received on March 22, 2008, Accepted on July 9, 2008)

Abstract

Polymeric materials containing a phosphorylcholine (PC) group have been known to show the improved biocompatibility, which can be used for biomedical field. In this study, the synthesis of a novel aromatic carboxyl compound containing PC group, 2-(4-carboxylphenoxy)ethyl phosphorylcholine (CPC), was carried out, in order to prepare hyperbranched polyamides with PC moiety by polymer reaction. The chemical structure of the obtained hyperbranched polyamides was confirmed by ¹H-NMR, and the elements of PC group were observed on the film surface by XPS analysis. Therefore, it was suggested that the film surface was efficiently covered with PC moiety of branch ends.

Keywords: *Biocompatibility, Phosphorylcholine, Polymer reaction, Hyperbranched polyamide.*

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Study on Calcifying Processes of Hydroxyapatite (HAp) using xylitol calcification promotion solution

by

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(Received on Mar. 31, 2008 and accepted on Jul. 9, 2008)

Abstract

Apatite is expected to be a useful material for artificial bones in surgery and artificial dental roots in dentistry. In particular, studies have recently been conducted on the reconstruction of teeth using Hydroxyapatite (HAp), and several supplements such as gum have become popular for keeping teeth in good condition. However, the decalcifying and calcifying processes are still not well understood. The aim of this research is to study the calcifying mechanisms of HAp. Specifically, a calcifying process was carried out on a sintered pellet of HAp without pore using a Xylitol calcifying promotion agent, and a natural calcifying liquid which simulates the situation within a human mouth as a reference. SEM, EDX and X-ray analyses were used for the characterization of the structure, morphology and forming elements. Optical characterizations like IR, UV and Raman spectroscopy were also used for the study of physical properties. It was confirmed that the calcification treatment enabled the growth of a precursor material OCP on the HAp pellet for both agents. The rate of growth was dependent on the agent, and it was found that PMD is more effective to grow OCP faster and with high density. These results were compared with another promotion agent PMD and discussed the utility of these agents.

Keywords: *Hydroxyapatite, Calcification, Decalcification, Ceramics, SEM, Xylitol*

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Research of Ag Photodoping phenomenon in GeS₂ chalcogenide glass film

by

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(Received on Mar. 31. 2008 & accepted on Jun. 5. 2008)

Abstract

Photodarkening, photobleaching, photostopping and photodoping are well-known light-induced phenomena in chalcogenide glasses. Photodoping phenomenon is observed when a double layer consisting of chalcogenide glass (As₂S₃, GeS₂, GeSe₂ etc.) and metal (Ag, Cu etc.) film is exposed to the light. Chalcogenide glass remarkably changes its optical, electrical, chemical and mechanical properties by the diffusion of metal. The kinetics of photodoping phenomenon of Ag/a-GeS₂ double-layer film was studied under the irradiation of several lasers with different wavelengths. The quantum efficiency was estimated using laser beam as the light for photodoping.

In this measurement, the process of diffusion was observed with an atomic force microscope. The doped layer diffused in the vertical direction, and then in the lateral direction. The progress of the doping is assumed to be related with dangling bond stats. In the photodoping phenomena the doping rate seems to depend on the number of dangling bond of the chalcogenide glass.

Keywords: Photodoping, chalcogenide glass, GeS₂

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Photocatalytic activity of TiO₂ thin films with Au nanoparticles under ultraviolet and visible light irradiation

by

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(Received on Mar. 31, 2008 and accepted on Jul. 9, 2008)

Abstract

Titanium dioxide (TiO₂) is one of the most promising photocatalysts, and is now used in various practical applications. However, TiO₂ converts only a small ultraviolet band of solar light, about 3-4%. Therefore, the development of a more efficient TiO₂ photocatalyst with a higher photoelectric conversion of visible light is needed. Plasmon-induced photocatalytic activity in the ultraviolet and visible light region has been studied for the TiO₂ thin film dispersed with gold nanoparticles. However, the detailed mechanism of photocatalytic process of TiO₂ dispersed with Au nanoparticles has not been clarified. The factors to optimize the effect are also not obtained enough. In this paper, TiO₂ thin films containing gold nanoparticles were prepared using sol-gel and dip coating methods with Au to Ti molar ratios 0:100, 5:95, 10:90 and 20:80. After dip coating on HAp substrates, coated films were sintered at 500°C in air. The TiO₂ thin films with gold nanoparticles were investigated through ultraviolet-visible-near-infrared spectroscopy and X-ray diffraction. X-ray diffraction peaks corresponding to crystalline gold and anatase titanium dioxide were observed. The size of the gold nanoparticles was determined around 14 nm calculated by Scherrer's equation. Optical spectra showed absorption band centered at 600 nm due to the surface plasmon resonance of gold nanoparticles. Photocatalytic activity was analyzed for degradation of stearic acid using FT-IR measurement. Under ultraviolet light irradiation, photocatalytic activity of Au-TiO₂ thin film compositions Au:Ti = 10:90 was promoted about five times compared with non-doped TiO₂ thin film. And under visible light irradiation, that was promoted about two times. These results showed the gold nanoparticles can increase photocatalytic activity of TiO₂ under both ultraviolet and visible light irradiation.

Keywords: Photocatalytic activity, Visible light irradiation, Titanium dioxide, Gold nanoparticles

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Optimum Structures of 90-degree Optical Path Change for Opto-Electronic Printed Wiring Boards

by

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(Received on Mar. 31, 2008 and accepted on Jun. 5, 2008)

Abstract

We analyzed optimum structures of 90-degree optical path change for opto-electronic printed wiring boards (OE-PWBs) by using a ray tracing method. We obtained following results to get high coupling efficiencies. A combination of an optical connection rod and an optical waveguide with a 42-degree mirror can give the highest efficiency in a case of transmission. On the other hand, a combination of an optical funnel and an optical waveguide with a 50-degree mirror is effective for the reception. It is also a key for achievement of the high coupling efficiency to choose a light emitting device with a smaller divergence angle.

Keywords: Optical waveguide, Optical pin, Optical funnel, Optical path, OE-PWB

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Growth of Tungsten Oxide Whisker and its Characterization

by

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(Received on March 6 , 2008 & accepted on June 5 , 2008)

Abstract

Tungsten oxide whiskers have been prepared by HF-CVD (Hot Filament Chemical Vapor Deposition). The tungsten filament (W) is the starting materials of the tungsten oxide whiskers. When tungsten filament is heated at 1400—2400°C in a mild oxidation atmosphere, the heated tungsten filament is oxidized, and then WO₂, WO_{2.72} and WO_{2.9} whiskers are grown on the substrate. For making a mild oxidation atmosphere, water vapor is used as oxidizer, and alcohol vapor or hydrogen are used as reducer, respectively. The obtained whiskers have been characterized by XRD (X-ray Diffraction), SEM (Scanning Electron Microscopy) and TEM (Transmission Electron Microscopy). The growth mechanism of WO₂ whisker is proposed.

Keywords : Tungsten Oxide, Whisker, Hot Filament CVD, Oxidation, SEM, XRD, Characterization

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Experimental Study on Formation of Amino Acids Using Discharge Plasma and its Characterization

by

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(Received on March 13, 2008 & accepted on June 5, 2008)

Abstract

In this article, we suggest a possibility of amino acids formation under primitive earth conditions. The starting materials of amino acids are ethanol (C₂H₅OH) and ammonia water (NH₄OH). The amino acids are produced using discharge plasma that is applied at a high frequency of 20kHz and high voltage of 30kV. In the discharge plasma, there are several radicals such as CN, C₂, CH, H, OH and N. The obtained samples are characterized by paper chromatography and high-performance liquid chromatography (HPLC) that identified glycine, alanine and tyrosine. The mechanism of amino acids formation in the discharge plasma is described along with the radical reaction.

Keywords: amino acids, primitive earth conditions, discharge plasma, mechanism of amino acids formation, radical reaction

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A Nitric Oxide Removal Process by Xe Excimer Light Irradiation

by

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(Received on Mar. 31, 2008 and accepted on June 5, 2008)

Abstract

For air pollution control to the global environment and for health, effective NO_x treatment processes are required. In this work, a photochemical effect of vacuum ultra-violet (VUV) light on NO removal was experimentally investigated. The experiment was conducted by using a Xe excimer lamp as the VUV light source. The quantitative measurement of NO concentration was conducted by a NO_x analyzer with electrochemical sensors and the supplementary qualitative measurement was conducted by analyzing FT-IR spectra. The photon energy radiated from the Xe excimer lamp can easily dissociate the NO molecule's bond. For NO/N₂ or NO/N₂/O₂ mixture gas at the atmospheric pressure, the NO concentration was decreased with increasing the VUV radiation time. On the other hands, the NO₂ concentration was slightly increased due to the O₃ molecule generated from the O₂ molecule by the photochemical effect and the NO oxidation by the dissociated O atoms from the NO molecules. In this paper, the experimental process and the results are presented in the photochemical effect on NO removal.

Keywords: Nitrogen oxide, Xe excimer light, Vacuum ultra-violet, Photochemical process

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Simple design evaluation method of the inductor for EV/HEVs

by

Kazuaki YOSHIKURA^{*1}, Masayuki MORIMOTO^{*2}

(Received on March. 28, 2008 and accepted on June. 5, 2008)

Abstract

This paper describes simple design evaluation method of the inductor for EV/HEVs. The method is used for the estimation of design parameters by measuring only voltage, amperage and wattage of the inductor, with the condition that the inductor is a black box. Using measured V, A, and W, an internal design parameter of the inductor can be estimated. As a result, two inductors whose size is a nearly equal have different design parameters.

Keywords: Choke Coil, Equivalent Circuit, Iron Loss, DCDC Converter, Back Boost Converter

Voltage and Reactive Power Control Considering Operation Room

by

Satosi KISHI^{*1}, Ikuo MICHIBATA^{*1} and Hidenori AOKI^{*2}

(Received on March 27, 2008 and accepted on July 9, 2008)

Abstract

Due to deregulation of the electric power market, the incidence of several power transactions and distributed generators will increase greatly. Because of this the power flow will increasingly vary, becoming more complex and uncertain. So it is difficult for voltage and reactive power control (VQC) to sustain adequate voltages in the power system. On the other hand, room is demanded from operation and control under a competitive environment in the power system. In order to obtain the optimal combination of parameters, namely, a large quantity of electric power control machinery controlled precisely and effectively, Meta-heuristic methods has been used for VQC. These methods, which allow for consideration of the trade-off among objects, should be applied to the problem.

In this paper, we propose the optimization of VQC with a genetic algorithm (GA), taking into account the operation room. The operation room is considered as a minimization of generator reactive outputs and tap positions difference from the neutral. The effectiveness of the proposed method is demonstrated by a practical 15-bus system.

Keywords: Voltage and reactive power control, Meta-heuristic, Trade-off, Tap position, Genetic algorithm

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Cooperative Work of Step Voltage Regulator and Static Var Compensator by

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(Received on March 31, 2008 and accepted on July 9, 2008)

Abstract

In recent years, a power supply with small capacity that is called "Distributed Generators (DGs)" has got much attention, and is being used to a distribution network system. The main backgrounds of this are liberalization of electricity market and the growing concern with the environment. Besides, more and more powerful electricity quality control is requested as progress of an information-oriented society.

In this paper, the authors propose a cooperated work of voltage management machinery. The paper concerns with an introduction of the cooperation control by Step Voltage Regulator (SVR) and Static Var Compensator (SVC) that is used for voltage management machinery in practical distribution network system, and their control effects.

Keywords: Cooperation work, Step Voltage Regulator, Static Var Compensator, Distribution systems, Distributed generator

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Strength of Retrofitted Carbon Fiber Chip Reinforced Concrete Cylindrical Shells

by

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(Received on March. 19, 2008 and accepted on July. 9, 2008)

Abstract

The strength and cracking patterns of retrofitted carbon-fiber-chip-reinforced concrete cylindrical shells were investigated, both experimentally and numerically. Three kinds of retrofits to the damaged shells were adopted in this paper. These are precut retrofit, filler retrofit and sheeting retrofit. The precut retrofit was defined as the method worked to cut the region adjacent to the damaged boundary to be smoothed in order to avoid the stress concentration. The filler retrofit was defined as the method made by filling the region with the non-contracted mortar after applying by the precut retrofit. The sheeting retrofit was defined as the method worked on the surface of the region covered with the carbon fiber sheets after applying by the filler retrofit. The concrete was artificially damaged before it was evaluated by a loading experiment using a one-point concentrated load, and the retrofit applied to the damaged shells was realized by the three kinds of retrofitting methods described above. In the experimental study, a static point load was applied perpendicularly onto the retrofitted cylindrical shell specimens until the cracking pattern was obtained by applying the maximum force. In the numerical analysis, nonlinear finite element analysis to model the effects of concrete cracking and tension stiffening was applied. The strength and cracking patterns of the retrofitted carbon-fiber-chip-reinforced concrete shells are discussed on the basis of the results of the numerical analysis and the experiment

Keywords: Retrofit, Carbon-Fiber Chip, Concrete Shell

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Interrelations between Vibratory Characteristics and Both Strength and Cracking Pattern of Retrofitted Concrete Cylindrical Shells

by

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(Received on March. 19, 2008 and accepted on July. 9, 2008)

Abstract

The main purpose of this study is to investigate, mainly experimentally, the interrelations between the vibratory characteristics and both strength and cracking pattern of retrofitted concrete cylindrical shells, three kinds of reinforcement of which were steel wires, mixed-in carbon fiber chips and mixed-in vinylon fiber chips. Three kinds of retrofits to the damaged shells were adopted in this paper. These are precut retrofit, filler retrofit and sheeting retrofit. The precut retrofit was defined as the method worked to cut the region adjacent to the damaged boundary to be smoothed in order to avoid the stress concentration. The filler retrofit was defined as the method made by filling the region with the non-contracted mortar after applying by the precut retrofit. The sheeting retrofit was defined as the method worked on the surface of the region covered with the carbon fiber sheets after applying by the filler retrofit. Before and after the loading experiment by one-point concentrated load, vibratory tests by an impact hammer and an oscillatory machine were conducted. Vibratory tests were applied on two kinds of boundaries, which were free body and pin-support. The concrete was artificially damaged before it was evaluated by a loading experiment and the retrofit applied to the damaged shells was realized by the three kinds of retrofitting methods described above. In the loading experimental study, a static point load was applied perpendicularly onto the retrofitted cylindrical shell specimens until the cracking pattern was obtained by applying the maximum force. The interrelations between vibratory characteristics distilled from retrofitted model before and after the loading experiment were derived. The strength and vibratory characteristics of the retrofitted concrete shells are discussed on the basis of the results of the experiment with the before and after vibratory tests.

Keywords: Concrete Shell, Carbon Fiber Sheet, Strength, Vibratory Characteristics

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Judgment Method on Liquefaction of Residential Areas by Cone Penetration Test — The Damage Investigation and The Analysis of Niigata Chuetsu and Chuetsu-oki Earthquakes —

by

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(Received on Mar.31,2008 and accepted on Jun.5,2008)

Abstract

The earthquakes of Chuetsu (2004) and Chuetsu offshore (2007) in Niigata Prefecture, caused land slides, slope failures, and liquefaction at many locations, also damaged the residences and the residential areas due to ground failure. The damage by the phenomena of liquefaction occurred not only in reclaimed site of coastal area, but also mainly in residential areas which buries the river channels. As for damage at slope area, landslide occurred on earth fill area which was filled up in a valley, and the embankment move down which caused the great damage to the houses and residential areas. Traverse cracking, generated by the movement of ground, caused a large amount of damage to the buildings. Landslide by liquefaction occurred at the residential area which was filled up by the banking material with dune sand. As the results of residences damage due to liquefaction, were observed ground settlement with displacement and inclination, movement and the deformation which accompany lateral flow. In Japan, the method of Swedish weight sounding test is widely used for ground investigation, due to the houses are mainly wooden buildings, and, generally, the foundations are constructed by continuous footing or mat foundation. Based on the investigation and results of this method, the allowable stress of ground can be obtained and then the type of foundation can be decided. This paper reports the tendency and characteristic of ground investigation on residential areas where liquefaction occurred. In regard to the analysis of the damage cases, as feature of liquefaction is rearranged with various types of sounding test, also briefly reports the current status and future issues concerning about seismic performance evaluation of residential areas in Japan.

Keywords: Earthquake; Damage; Wooden building; Foundation; Ground; Liquefaction; Landslide

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Compression Index in One-dimensional Consolidation Analysis Taking Account of Secondary Compression

by

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(Received on March 31, 2008 and accepted on July 9, 2008)

Abstract

To describe the delayed compression behavior, a system of approximately parallel e - $\log p$ relations is introduced in one-dimensional consolidation analysis. In this widely used diagram, compression index λ is commonly adopted to calculate the instant compression component of the settlement which occurs on increase of effective stress. To check the effect of secondary compression on the compression index, this paper is concerned with the relationship between the void ratio and the effective stress for the component of primary consolidation, namely the instant compression index showing the tangent of the slope angle of e - $\log p$ line. Consolidation time curves obtained from oedometer test have been compared with the result of one-dimensional consolidation analysis incorporated with two types of the compression index that include or does not include secondary compression. It is shown that the change in void ratio estimated by the traditional compression index λ includes the component of secondary consolidation and also leads to the overestimation of consolidation settlement.

Keywords: One-dimensional consolidation, Secondary compression, Compression index, Clay, Peat

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A Method for Estimating Consolidation Parameters from Primary Consolidation

by

Motohiro SUGIYAMA, Shinpei OHGANE, Hiroaki SHIRAKO, and Masaru AKAISHI

(Received on , 2008 and accepted on , 2008)

Abstract

We have already proposed the constitutive equation for one-dimensional consolidation analysis that accounts for secondary compression. To calculate the secondary consolidation from the primary consolidation, the proposed model requires the compression index C_c^* and the coefficient of consolidation c_v^* , defined by the primary consolidation, which are not available from consolidation test results. Therefore, these constants are determined by trial and error until a match is obtained with the consolidation-time curve from the consolidation test. This study investigated an easier method for estimating C_c^* and c_v^* , by first attempting to use the primary consolidation ratio r , calculated by the standard consolidation test, because the ratio of C_c^* to C_c indicates the ratio of primary consolidation to the total settlement. The method of square root of time was then devised, using t_{50} instead of t_{90} . By applying these methods to undisturbed and reconstituted clays with different properties, it was found that both methods are capable of reproducing consolidation-time curves without significant differences from the conventional trial and error method.

Keywords: primary consolidation, square root of time, numerical analysis, compression index, secondary compression

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Effects of Shapes of Dimple on Flow Characteristics around a Golf Ball

by

Koji MUTO^{*1}, Hiroo OKANAGA^{*2} and Katsumi AOKI^{*3}

(Received on March 31, 2008 and accepted on July 9, 2008)

Abstract

It is known that the aerodynamic characteristics of the three dimensional bluff body such as a sphere depends on the surface structure. The purpose of this study is to clarify the mechanism of the drag reduction to the surface structural change. In this study, Reynolds number is changed from 4.23×10^4 to 1.69×10^5 . The diameter of the test sphere is 42.6 mm. The number of dimples is 328. The shapes of dimple are arc, cone and trapezoid. The state of the test sphere is stationary. The drag acting of the test sphere is measured using a three components loadcell. The pressure acting around the test sphere is measured using a pressure transducer. And more, the flow visualization around the test sphere is performed applying the spark tracing method. In addition, a detailed flow around the test sphere is clarified by the turbulent flow model LES. As a result of these experiments and numerical analysis, the drag coefficient for the shape of dimple, pressure coefficient, skin friction coefficient, separation point and the flow pattern around the test sphere became clear.

Keywords: Golf ball, Shape of dimple, Drag coefficient, Pressure coefficient, CFD

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Improvement of Adhesive Strength for Ti-doped DLC Films by Heat Treatment in Vacuum

by

Masao KOHZAKI*

(Received on March 31, 2008 and accepted on July 9, 2008)

Abstract

Ti-doped DLC films have been prepared on silicon substrates by DC magnetron sputtering with C and Ti targets in Ar plasma. The amount of Ti in the film has been controlled with the input electric power to the Ti target from 0 to 200 W. The Ti concentration measured by X-ray photoelectron spectroscopy, increased up to 15 at.% at a Ti target power of 200 W. After the deposition, the DLC and the Ti-doped DLC films were heated at 500 °C for 10 minutes in a vacuum of 1×10^{-4} Pa. The frictional characteristics of the films were evaluated by using a ball on disk friction tester in an ambient atmosphere. Even after the heating, the DLC and the Ti-doped DLC films showed the good tribological performance with a low friction coefficient below 0.3 against a steel ball. The adhesive strength of the DLC film and the Ti-doped DLC films were measured by scratch tests with a loaded diamond stylus. The Ti-doped DLC films prepared at 250 °C had almost constant values of the critical loads in the scratch tests irrespective of the Ti concentration. By the heat treatment in the vacuum, the adhesion of the Ti-doped DLC film with high Ti concentration was improved effectively and the critical loads of the films containing 15 at.% Ti increased from 180 mN to 400 mN. Furthermore, the critical loads of the Ti-doped DLC films increased with increasing the deposition temperature. The heat treated Ti-doped DLC films deposited at 350 °C had the maximum critical load of 500 mN. The apparent increase in the critical loads will be caused by the chemical interaction between Ti and the substrate material.

Keywords: DLC film, DC magnetron sputtering, Adhesion, Heat treatment

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Development of Ti-B-C Coated Tool for Cutting of Titanium Alloy

by

Jiro MORITA*¹ and Masao KOHZAKI*²

(Received on March 31, 2008 and accepted on July 9, 2008)

Abstract

We attempt to improve the performance of cutting tools against titanium alloys by coating of titanium -boron-carbon (Ti-B-C) thin films. We have prepared the Ti-B-C thin films by DC magnetron sputtering using boron carbide (B₄C) target and Ti target. At first, the deposition experiments were performed with silicon and tungsten carbide substrates for optimizing the coating conditions. The target power for Ti was varied from 0 to 200 W and CH₄ gas flow rate from 0 to 80 sccm in the deposition process to understand the influences of titanium and carbon contents on nano-indentation hardness, frictional properties and adhesive strength of coatings. Then, at the optimized coating conditions, the Ti-B-C films were produced on tungsten carbide inserts and turning tests were carried out against titanium alloy with the coated tools. Chip produced became smooth by Ti-B-C coating, although obvious tool wear was not observed on rake face of the coated and the uncoated tool. As the coated tool, cutting force was lower than that in using the uncoated tool. Moreover, the surface roughness of the titanium alloy was improved by Ti-B-C coating on the tool. As a result, the coating provided improvements in cutting performance against titanium alloys.

Keywords: Ti-B-C thin film, DC magnetron sputtering, Titanium alloy, Cutting property

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Secondary Buckling Analysis of Angle-Ply Laminated Plates with Initial Imperfections under Biaxial Compressive Loads

by

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(Received on March 31, 2008, accepted on on June 5, 2008)

Abstract

Advanced fiber-reinforced laminated plates have been used for structural members in various fields, by virtue of their high specific strength and stiffness. This paper considers, by use of the second variation of the total potential energy, secondary buckling of angle-ply laminated plates with initial deflection under biaxial compression that is simply supported along four edges. The occurrence of secondary buckling is proven analytically, and the effects of various factors, such as initial imperfection, lamination angle, biaxial compressive load ratio, and postbuckling deflection pattern, are discussed.

Keywords: *Structural Analysis, Composite Materials, CFRP, Secondary Buckling, Angle-Ply Laminated Plates, Biaxial Compression, Initial Imperfection*

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Buckling Analysis of Composite Laminated Cylindrical Shells with a Circular Cut-out under Axial Compression

by

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(Received on March 31, 2008 and accepted on June 5, 2008)

Abstract

Advanced fiber-reinforced laminated 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 this paper, we describe the buckling strength of cross-ply laminated cylindrical shells with a circular cut-out under axial compression by the finite element method. Consequently, we analytically clarified the effects of various factors such as hole-radius, stress concentration, stacking sequence, number of layers, and buckling mode of cylinder on the buckling strength.

Keywords: *Composite materials, Laminated cylindrical shells, Axial compressive buckling hole, Stress concentration, Finite element method*

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Effect of Vibro-Acoustic Coupling on Acoustic Characteristics in Cylindrical Enclosure with an Excited End Plate

by

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(Received on Mar. 31, 2008 and accepted on Jul. 9, 2008)

Abstract

This paper describes vibro-acoustic coupling between structural vibrations and internal sound fields of thin structures that are used for an aircraft, a chemical plant and others. We treat a cylindrical enclosure placing thin elastic plates at both ends and take notice of the coupling phenomena between the plate vibration and internal sound field, when an external force is applied to an only end plate. The coupling phenomena are theoretically and experimentally estimated based on behavior of both plates and acoustic characteristics of the internal sound field with changing vibration characteristics of end plates. Consequently, in the same conditions at both end plates, when the natural frequency of the plates exists in the vicinity of the resonance frequency of the acoustic mode whose modal shape is conformable to the vibrational modal shape, the sound pressure level inside the cavity depends strongly on the phase difference between both plate vibrations and is maximized in the middle phase difference of the same and opposite phases. In case the natural frequency isn't in the vicinity of the above resonance frequency, coupling is weakened and the increases in the sound pressure level are restrained. On the other hand, when unilateral end plate doesn't vibrate with the natural frequency, the sound pressure level isn't promoted because the contribution of other acoustic modes to coupling is intensified. The result suggests that the existence of nonexcited side is important factor for coupling between the three systems even if the plate is not excited by a point force.

Keywords: Vibro-acoustic coupling, Eigenfrequency, Plate vibration, Internal sound field, Phase difference

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Active Feedback Modal Control of Sound Field in Enclosure Surrounded by Rigid Walls

by

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(Received on March 31, 2008 and accepted on June 5, 2008)

Abstract

The present paper describes the investigation of an active feedback noise control system in an enclosure surrounded by rigid walls. A higher-order model is required for identification in a rigid-walled sound field because several sound pressure peaks can exist. Since the rigid-walled sound field can be expressed by the superposition of a large number of orthogonal acoustic modes, it is expected that identification can be achieved using a lower-order model for each mode independently based on the modal decomposition technique. Therefore, we propose an active control system with feedback controllers to suppress multiple mode amplitudes independently based on the modal decomposition technique. In the present paper, we verify the characteristics of the proposed system to control four modes numerically and experimentally. The obtained results show that reduction of mode amplitudes can be achieved independently without any mode couplings.

Keywords: Active Control, Feedback Control, Acoustic Mode, Enclosure

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