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Appendix
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No. 168

February 1994

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Relationship between Combustibility and Torque Harmonics in Internal Combustion Engines

Wen-Zhe LI and Noboru MIYAMOTO
(Received October 4, 1993)

Abstract

This paper investigates characteristics of torque harmonics related to combustibility and in-cylinder pressure variations in internal combustion engines.

The result of the investigation indicated that lower frequency torque harmonics, below 2-orders of the engine revolution were governed mainly by the indicated mean effective pressure rather than by combustibility or the behavior of the combustion rates. Higher frequency torque harmonics, above 2.0 or 2.5-orders, were somewhat affected by combustibility and showed a stronger positive correlation to maximum cylinder pressures.

However, the retardation of ignition timings and increases in combustion duration resulted in a slight increase in the lower frequency harmonics in spite of the small increased indicated mean effective pressures, and the decrease in the higher frequency harmonics.

Effect of Aperture Size on Image Reconstruction Characteristics of Phase Conjugator via Nearly Degenerate Four-Wave Mixing

Atsushi OKAMOTO, Teruhito MISHIMA
(Received September 29, 1993)

Abstract

Image reconstruction with phase conjugation via nearly degenerate four-wave mixing is studied. An equation describing the dependence of the conjugate image location on the wavelength detuning is derived. The reconstructed images of distorted probe object are calculated. The result shows that the quality of the reconstructed images is limited by the aperture size, as well as, by the detuning.

Properties of reflectivities in self-pumped phase conjugators by photorefractive crystal

Yoshihisa TAKAYAMA, Atsushi OKAMOTO, Teruhito MISHIMA

(Received September 29, 1993)

Abstract

Properties of reflectivities in self-pumped phase conjugators are analyzed. Both the transmission and reflection gratings are treated individually. At first, the equations required for the analysis are given, where the absorption in the crystal is neglected and the depletions of pump beams are considered. Secondly, the equations are applied to self-pumped phase conjugators. Then the phase conjugate reflectivities of self-pumped conjugators are calculated. At last, the difference and similarity between transmission grating and reflection grating are described clearly.

Two Dimensional Quasi-Phase-Matching for Optical Second Harmonic Generation

Kojiro KOYANAGI and Teruhito MISHIMA

(Received October 12, 1993)

Abstract

A new technique is proposed for quasi-phase-matched (QPM) second harmonic generation (SHG) in a nonlinear bulk crystal with domain inverted structures, where two fundamental waves propagate in different directions. The residual mismatch caused by fabrication errors or by the shift of the wavelength is easily compensated by readjusting the incident directions.

An adaptive ARMA-D modeling using an analytic signal

Eisuke HORITA, Yoshikazu MIYANAGA and Koji TOCHINAI
(Received October 21, 1993)

Abstract

In this paper, a complex adaptive spectral estimation method of speech signals is proposed. Speech signals are transformed in this method to analytic signals. A pre-processing is applied to compensate the discontinuity of a spectrum in decimated analytic signals. Furthermore, tracking ability of the complex adaptive method is discussed. It is shown from the results of experiments that the proposed method has better tracking ability than conventional adaptive methods and estimates higher accurate power spectra of speech signals than conventional real adaptive methods.

Simple Model for Selective Helium Pumping of Nickel

— Temperature Dependence of Helium Retention —

Tomoaki HINO, Hideto YANAGIHARA and Toshiro YAMASHINA
(Received October 20, 1993)

Abstract

A simple model for He selective pumping of Ni, which may be applied for ash removal in a fusion reactor, is proposed to explain the temperature dependence of He retention. The He retention is determined by the balance of trapped He ions in the surface, the diffusion from the surface to bulk and the loss from the bulk due to the Ni self diffusion. In this model, explained is the appearance of maximum He retention in the domain of the irradiation temperature.

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June 1994

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Studies on the Elasto-plastic Analysis of Reinforced Concrete Walls Subjected to Cyclic Temperature Changes

Tetsuhiro ASARI¹⁾, Mamoru OBATA¹⁾, and Shigeru KUSHIYAMA²⁾

(Received December 24, 1993)

Abstract

This paper describes an analytical method which is applicable to two dimensional stress fields. The method is applied to cyclic thermal stress analysis of reinforced concrete walls. Effects of reinforcement ratio and boundary condition of the wall to the analytical results are discussed. The conclusion are as follows.

- 1) The wall in an outer span has higher probability of cracking caused by temperature change than the wall in inner spans. At the cracked portion of the wall, some of steel reinforcing bars yielded regardless of the amount of reinforcement ratio.
- 2) The wall in the center span has many cracks when the temperature decreases, but has no cracks when the temperature increases. When the wall reinforcement ratio is 0.5 % or more, the cracks are minute and not visible, because the stress of the reinforcement is below yield level.

Effect of Impact Velocity in Erosive Wear of Austempered Ductile Iron

Kazumichi SHIMIZU, Noboru SHIRAMINE*,
Minoru FUJITA* and Toru NŌGUCHI*

(Received December 24, 1993)

Abstract

Erosive wear tests were performed on austempered ductile iron (ADI) and mild steel (SS400) using a shot blast machine. Erosion damage was measured by the removed material volume at various impact angles between 10° and 90° and impact velocities of 100 and 145m/s. The mechanism of erosive wear, the effect of impact angles (α) and impact velocity (V), and the differences in wear features of the specimens were discussed.

After an initial stage, the eroded volume increases almost linearly with blasting time both in ADI and SS400, and the erosion rate in ADI is about 20% at 145m/s, 23% at 100m/s of SS400, showing that ADI has superior erosion resistance.

The surface hardness of eroded ADI specimens increased up to HV 700 from the initial HV 350 after 600s of blasting. The amount of retained austenite was measured to be about 40% of the matrix before the test, but it decreased to less than 5% by transforming to martensite, hardening the surface and practically eliminating the erosion rate markedly, and so reduces the effect of impact velocity.

Development of a BBS Host Program

Osamu ISHIKAWA

(Received December 24, 1993)

Abstract

According to the presumption that personal computer communications would grow up remarkably as electronic social field, we have opened a BBS host system experimentally and examined the possibilities in collaboration with citizen.

One of our themes was development of a multi-channel BBS host program. This report describes the three fundamental gists of our program, that is to say,

- 1) Corresponding with multi-channel.
- 2) High-speed processing of transmission and reception.
- 3) Efficiency utilization of limited memories.

Our program is up-loaded to NIFTY-Serve, therefore anybody can down-load it and open a high-function BBS host easily.

Effect of incident beam power on response time of transmission grating in photorefractive crystal

YOSHIHISA TAKAYAMA, ATSUSHI OKAMOTO and TERUHITO MISHIMA

(Received December 21, 1993)

Abstract

Effect of incident beam power on response time of transmission grating in photorefractive crystal is analyzed. Temporal variation of coupling strength of four-wave mixing by a photorefractive crystal is derived with physical parameters of the crystal. The time dependent coupling strength is applied to the phase conjugate reflectivity in the case of transmission grating. The calculation of the reflectivities is made and the reflection properties are shown as a function of time.

Experiment on generating the phase conjugate beam via four-wave mixing by a BaTiO₃ crystal is performed. The response time of the phase conjugate beam is measured and shown at several beam intensities. The results fit an approximate function and are compared with theoretical ones.

Model for Hydrogen Retention and Chemical Sputtering of Boron-Carbon Plasma Facing Material

Tomoaki HINO, Yuji YAMAUCHI and Toshiro YAMASHINA

(Received December 21, 1993)

Abstract

The model for hydrogen retention of boron carbide material used as the plasma facing wall in fusion devices is described. In this model, the hydrogen detrappings of C-H and B-H bondings are assumed as the rate determining step of the desorption. The hydrogen retention is observed to more rapidly decrease with the temperature, compared with a case of graphite. This tendency is similar to the experimental observation. Several parameters of thermal desorption and ion impact desorption are discussed based on the model.

For the chemical sputtering, the model is suggested to explain the yield and the peak temperature of boron carbide material. The comparison between the model and the experimental shows that the reduction of the yield in the boron carbide is due to one order of magnitude smaller reactivity of methane formation, compared with that of graphite.

Conditionings for Boron-Carbon Plasma Facing Wall

Tomoaki HINO, Yuji YAMAUCHI and Toshiro YAMASHINA

(Received December 21, 1993)

Abstract

For plasma facing material with components of boron and carbon, the method of conditionings due to He discharge cleaning and baking is considered. The conditioning time required to suppress the hydrogen recycling is discussed. It is shown that the hydrogen trapped by the boron can be relatively easily removed only by the baking at 300°C or only by He discharge cleaning with current density of 0.1 mA/cm². It is not easy to remove the hydrogen trapped by the carbon by the baking since the temperature required becomes 500°C. The current density required also becomes high, 1 mA/cm², for the reduction of the hydrogen trapped by the carbon.

Reduction of Helium Ash in Fusion Plasma by Selective Helium Pumping

Tomoaki HINO, Hideto YANAGIHARA and Toshiro YAMASHINA

(Received December 21, 1993)

Abstract

The concept for reduction of helium ash concentration in a fusion plasma, based on the selective pumping for helium ions, is described. In a case that this scheme is employed together with the pumping of divertor, the helium ash concentration can be considerably reduced. Thus, this method is helpful to sustain the burning plasma state or the ignition condition. The pumping condition required for the selective helium pumping metal is also discussed.

Gas Desorption Property of Carbon Based Material Used for Cathode-Ray Tube

Masao HASHIBA, Yuko HIROHATA, Tomoaki HINO, Toshiro YAMASHINA
Akira MISUMI¹ and Shigemi HIRASAWA¹

(Received December 24, 1993)

Abstract

The gas desorption properties of several carbon based materials used for cathode-ray tube (CRT) were investigated by using a thermal desorption spectroscopy (TDS). The samples for the TDS measurement were prepared with baking for 1 hr at 450 °C under atmosphere. The gas desorption measurements were carried out by heating the samples from 23 °C up to 500 °C in vacuum. The major gas species were CO₂ and H₂O. The desorption peaks of these species were observed at about 120–150°C. The desorption amount of CO₂ was approximately twice larger than that of H₂O for every sample. The desorption quantity of the sample with a high content of TiO₂ was low. The sample with a high content of water-glass had a large desorption quantity.

The activation energy, E_d , were obtained for desorptions of CO₂ and H₂O. The values of E_d were 1.2 eV and 0.66 eV for CO₂ and H₂O, respectively. These results suggest that CO₂ and H₂O are due to chemically and physically absorbed states, respectively.

The surface morphology of the samples were observed, and the relation between the surface roughness and the gas desorption was examined.

Desorption behavior of H₂O from isotropic graphites dipped in water

Masao OKITA, Yuko HIROHATA, Tomoaki HINO and Toshiro YAMASHINA

(Received December 24, 1993)¹

Abstract

H₂O desorption behavior of isotropic graphites dipped in water was investigated by a technique of thermal desorption spectroscopy (TDS). Gas species, H₂, H₂O, CO, CO₂ and numerous hydrocarbons, were found to be desorbed from the graphite. The temperature with the maximum desorption rate of H₂O was around 873 K, for the ramp rate ranging from 0.083 to 0.83 K/s. The peak temperature of H₂O became again around 873 K, even after the heat treatment for the graphite sample at 625 K for 7 hrs prior to the TDS measurement. Apparent activation energy of the desorption for H₂O was obtained as 252 ± 24 kJ/mole. From the evaluation for value of the activation energy, it is presumed that the H₂O desorb due to the recombination between -H and -OH groups adsorbed on edge surfaces of the graphite.

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Effect of the Gullet Shape on Cutting Resistance of the Saw

Masahiro OHSHIMA, Tadahiko KANAUCHI

(Received March 28, 1994)

Abstract

Blades with several forms of gullet tested to examine the effect of gullet shape on cutting resistance. The variable K was defined as the of the chip volume to gullet volume in order to assess the volume of accumulated chips in the gullet for each case.

The results are summarized as follows :

- (1) The friction force between the wall of a flute and the amount of accumulated chips in the gullet increases in proportion with driving force on the blade and with wall area.
- (2) The amount of accumulated chips in the gullet prominently the cutting thrust force.
- (3) Once K has begun to influence the cutting resistance, it increases with traverse feed rate.
- (4) K decreases with increase in area of the gullet for all shapes tested.
- (5) The increment rate of cutting thrust force for the ratio K was the smallest in the case of gullet type E.
- (6) Through out the range of gullet shapes tested, the ratio K began to influence the cutting resistance at 30% to 45%.

Several Considerations Based on the Access Data of Experimental BBS Host

Osamu ISHIKAWA

(Received March 18, 1994)

Abstract

It has been five years and a half since we built an experimental BBS host system in order to investigate how data communications spread through civil society. In this report we have considered the situation of personal computer communications from several angles on the basis of our access data.

The compositions of participants in our system has changed little ; the ratios of female and of elderly people have increased little.

We have also shown variations in access frequency and hourly distribution of access. Signal speed has risen drastically.

These results are a great help to management and technical development of personal computer communications as electronic social fields.

Characterization of InGaAs Wires by photoluminescence

Tadayoshi IWA-ANA, Hajime FUJIKURA and Hideki HASEGAWA

(Received March 31, 1994)

Abstract

InGaAs wire structures fabricated by preferential molecular beam epitaxy (MBE) growth on corrugated InP substrates were characterized by photoluminescence (PL) to optimize the growth conditions and assess the quality of wires. The growth conditions of the lower InAlAs barrier were also optimized by PL and scanning electron microscopy (SEM). Wire structures were grown on the InP substrates having V-grooves with (211)A or (111)A facets. In the case of growth on (211)A facets, a phase separation in the InGaAs wire was observed both by SEM and PL. No such separation was observed on (111)A facets. The quality of the InGaAs wires was found to be improved by using a double-layer structure for the lower InAlAs barrier where low temperature and high temperature growth were done successively. The temperature dependence of PL intensity indicated presence of the levels having the activation energy of 6meV and 20meV. Inducing of the low-temperature InGaAs buffer layer underneath the InAlAs barrier was found to greatly improve the band-edge PL intensity.

Fabrication and Characterization of GaAs and AlGaAs Micro-Pyramids by Selective MOCVD

Motoya KISHIDA, Kazuhide KUMAKURA, Kazuaki NAKAKOSHI, Takahiro YAMAZAKI,
Junichi MOTOHISA, Takasi FUKUI and Hideki HASEGAWA

(Received March 31, 1994)

Abstract

Selective epitaxial growth on masked substrates by metalorganic chemical vapor deposition (MOCVD) has attracted much attention for the fabrication of quantum wires and dots.

It has the advantage of producing damage-free and contamination-free structures. GaAs and AlGaAs micro-pyramidal structures with $\{011\}$ sidewall facets on SiO_2 masked GaAs (001) substrates were fabricated here, and the growth process was assessed by observation of the cross section which includes markers; AlGaAs thin layers to GaAs growth. It was revealed that the growth rate increases during crystal growth due to lateral diffusion of group III atoms from the masked area. Based on these characteristics, GaAs/AlGaAs Quantum Plates were fabricated near the top of the pyramidal structures and photoluminescence (PL) measurement was made. The growth rate enhancement was also observed in Quantum Plate structures and they showed excellent agreement with the growth rate data estimated from the cross sectional view.

Electrical conduction near surface of semi-insulating substrate and its surface passivation

Keiji SASAKI, Masamichi AKAZAWA, Syunsuke SHIOBARA and Hideki HASEGAWA

(Received March 31, 1994)

Abstract

Electrical conduction near the surface of the semi-insulating GaAs and InP substrates was studied. We measuring I-V characteristics for planar structures before and after surface treatments and surface passivation. Based on the experimental results, the relationship between surface states and the breakdown voltage V_B are discussed.

It was found that the breakdown voltage V_B is proportional to electrode distance. For the same distance, the breakdown voltage of the InP substrate was bound to be about one order of magnitude higher than that of the typical GaAs LEC (Liquid Encapsulated Czochralski) substrate. A new surface passivation scheme including MBE growth of Si on GaAs followed by deposition of silicon dioxide by photo-CVD process, was found to be very effective to reduce leakage current and increase the breakdown voltage. Electrical conduction near surface of semi-insulating substrate was concluded to be closely related to surface states.

Efficient Optical Second-Harmonic-Generation Using External Resonant Cavity with Periodic Nonlinear Medium inside

Kojiro KOYANAGI*, Teruhito MISHIMA* and Ichiro SAKURABA**

(Received March 23, 1994)

Abstract

We propose an efficient external cavity resonant second-harmonic-generation using quasi-phase-matching in a nonlinear medium with periodic structures. A theory of external frequency doubling with a resonant fundamental is presented for efficiently induced nonlinear-optical polarization by both forward and backward propagating fundamental beams.

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Shear Resisting Model of Reinforced and Prestressed Concrete Beams Based on Finite Element Analysis

Yasuhiko SATO, Tamon UEDA and Yoshio KAKUTA

(Received June 30, 1994)

Abstract

In this study a shear resisting model was developed by non-linear finite element analysis. Concrete strength, the shear span to effective depth ratio, stiffness of main and web reinforcement, yielding of web reinforcement and prestressing force were chosen as parameters. The shear resisting model was defined as summation of shear resisting forces by concrete in a compression zone, by web reinforcement and others in a shear cracking zone, and by concrete in a horizontal zone linking the compressive and shear cracking zones. This model can be applied to reinforced and prestressed concrete beams reinforced with steel bars and/or FRP (Fiber Reinforced Plastic) rods.

**Improvement of relevance in on-line database retrieval
by discrimination of keywords
and selection of relevant data using keywords accompanied by role indicators**

Tsukasa IWADARE, Keishi MIKUNI, Masahisa KOZENI, Takeo SAEGUSA and Kazuhiko ORITO

(Received June 17, 1994)

Abstract

A procedure to discriminate keywords in on-line database retrieval was proposed. The discrimination was carried out by seeking major and minor (less essential) keywords in the article title and Basic Index respectively. This procedure afforded significant improvement in the relevance of output data. Roles of keywords appearing in article titles were analysed. There the keywords were classified into five categories, and the relationship between the roles of keywords and accompanying role indicators were investigated. Use of the keywords accompanied by proper role indicators gave better results in selection of relevant data than those by the conventional procedure.