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HOKKAIDO UNIVERSITY

No. 176

February, 1996

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A Computer Simulation System for Reconstructing Traffic Accidents

Lang WE, Takashi NAKATSUJI, Toru HAGIWARA,
Takashi FUJIWARA and Yuki ONODERA

(Received October 24, 1995)

Abstract

A computer simulation system was developed to estimate the velocity at the impact and the trajectory of vehicles based on the data of the impact positions and the final rest positions at the accident site. Since this system is coded by the computer language of Visual C++ and working on the Windows systems, it provides not only a good graphical interface but also a good flexibility in the operations.

Containment of loss of coolant accident (LOCA) in fusion reactor — Numerical calculation of the pressure rise due to in-vessel LOCA —

Yuko HIROHATA, Tomoaki HINO, Toshiro YAMASHINA

(Received July 14, 1995)

Abstract

Active cooling components have to be employed in the divertor of a fusion reactor to handle the large power flow from the core plasma. The extremely large thermal stress and electromagnetic forces acting on these components may cause cracking of cooling pipe. Since the inner wall and the vacuum vessel are significantly damaged by this loss of coolant accident, LOCA, the control scheme have to be considered. The process of in-vessel LOCA was investigated, and then several control schemes such as the use of expansion volume, the use of shielding shutter and the use of heat sink were suggested. In addition, the pressure rise of the vacuum chamber due to water leak was calculated for the scheme to uses of the expansion volume and roughing pump systems by using the parameters of ITER/CDA. The pressure rise in the vacuum chamber can be controlled within designed pressure of chamber, e.g., 2 atm, when the pinhole diameter is less than 1 mm. When the expansion volume is assumed to be the same size as the chamber, the time period until the pressure increases up to 2 atm becomes 3 hr when the pinhole diameter is 10 mm. The pressure can be decreased to 0.2 atm by using a roughing pump system.

Analysis for halo current induced during plasma quench

Tomoaki HINO

(Received October 9, 1995)

Abstract

The expression for the halo current induced during the plasma quench phase is analytically obtained. The numerical calculation shows that the highest value of the halo current in the present large tokamaks is approximately 20 % of the plasma current. For the reduction of the halo current, the edge cooling due to the active impurity generation or emission from the wall is adequate, in addition to the enhancement of the wall resistance in the halo current loop by the use of insulators.

Radioactive Analysis of Palladium Used for an Explosive Cold Fusion Experiment

Takaaki MATSUMOTO* and Katsuhei KOBAYASHI**

(Received October 27, 1995)

Abstract

A radioactive analysis of palladium metals that were used for an explosive cold fusion experiment was performed. The samples were irradiated by thermal neutrons at the graphite column of the Kyoto University Reactor (KUR). The production of ^{115}In and ^{104}Ru was clearly observed. The production of the elements is discussed based on The Nattoh Model, in which the nuclear transmutation of the palladium element was proposed.

Electric field effect on emission of 9,9'-bianthryl in polymer films

Yoshinobu NISHIMURA, Shigetoshi OKAZAKI, Nobuhiro OHTA and Iwao YAMAZAKI

(Received November 15, 1995)

Abstract

Electric field effects on the absorption and fluorescence spectra of 9,9'-bianthryl doped in polymer films of polymethylmethacrylate (PMMA) have been examined using electric field modulation spectroscopy. The electroabsorption spectra are very similar to the first derivative of the absorption spectra, indicating that the field-induced change in absorption spectra results from a change in molecular polarizability following photoexcitation, as in the case of anthracene. On the other hand, the electrofluorescence spectra are reproduced by a combination of the fluorescence spectra, its first and second derivative spectra, exhibiting certain changes in both the electric dipole moment and the molecular polarizability following emission. The presence of the electric dipole moment suggests that the fluorescing state of BA films is represented by a mixture of a locally excited state and a charge transfer state in PMMA.

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Evaluation of Plasma Surface Interaction of Boron Film Used as Plasma First Wall

— Oxygen Gettering Properties and Hydrogen Retention Properties —

Takahiro MOCHIZUKI, Yuko HIROHATA, Tomoaki HINO, Toshiro YAMASHINA,
Kazuhiro TSUZUKI, Muhamad NATSIR, Noriyuki INOUE, Akio SAGARA,
Nobuaki NODA, Osamu MOTOJIMA, Toshiaki SOGABE and Koji KURODA

(Received December 22, 1995)

Abstract

Boron films are coated on plasma facing material of nuclear fusion device as the getterings of oxygen. On the other hand, hydrogen will be retained into the boron film during the plasma discharge. If this hydrogen is emitted into the plasma, it shall be a cause of plasma energy loss. In this study, we deposited the boron films on a liner made by stainless steel or graphite by using plasma CVD of the mixture gas of diborane (B_2H_6) and hydrogen (H_2).

We investigated the properties of oxygen gettering and hydrogen retention of the boron films when the oxygen or hydrogen is discharged by using the liner as the cathode. The oxygen gettering amount of the boron film on the graphite liner was two times larger than that of the boron film on stainless steel. The depth of oxygen gettering in boron film was from 50 to 100 nm. The oxygen were chemically bonded to the boron. The oxygen gettering of the boron film was refreshed by helium glow discharge. The amount of retained hydrogen into the boron film was almost the same to that of the graphite. The hydrogen retained into the film and the graphite were nearly desorbed during heating up to 500 °C.

Evaluation of hydrogen absorption and desorption for Ti-6Al-4V alloy with low activation property as a vacuum vessel

Yasuki AIHARA¹⁾, Yuko HIROHATA¹⁾, Tomoaki HINO¹⁾, Toshiro YAMASHINA¹⁾
Nobuharu MIKI²⁾, Satoshi NAKAGAWA²⁾

(Received December 26, 1995)

Abstract

Since the vacuum vessel and components are exposed to fast neutrons with the energy of 14.1 MeV due to D-T reaction in a fusion device, it is advisable to use low activation materials such a components. It is reported that the dose rate of Ti-6Al-4V alloy at 1 year after the shutdown is two orders of magnitude smaller than that of SS316 or Inconel 625. However, it is also reported that the strength of Ti-6Al-4V alloy become small over the hydrogen concentration of 1000 ppm. So, it is worried the embrittlement of the alloy due to the absorption of fuel hydrogen. Although the properties of hydrogen absorption for titanium metal have been evaluated, there are little studies for titanium alloy.

In this study, we investigated the hydrogen absorption properties of the Ti-6Al-4V alloy under the condition of low pressure (0.03-100 Pa) and the temperature ranging from 507 to 819K. The absorption amount was measured by using a technique of Thermal Desorption Spectroscopy (TDS).

The initial concentration (C_0) of Ti-6Al-4V alloy was measured as 90 ± 10 ppm. The temperature dependence to the hydrogen absorption amount was evaluated under the pressure of 0.3 and 10 Pa. In the case of the pressure of 0.3 Pa for 20 hr, no change of the hydrogen concentration (C_{H_2}) was observed, i.e., C_{H_2} is almost same to C_0 . In the case of the pressure of 10 Pa at 819K, the C_{H_2} increase with absorption time. At 20hr, the C_{H_2} become constant, 490 ppm which was smaller than the critical concentration of the embrittlement. The pressure dependence to absorption amount was evaluated at 819K. The C_{H_2} was proportional to the square root of absorption pressure, i.e., $C_{H_2} \propto \sqrt{P}$ for the Sieverts' law.

We also investigated the hydrogen desorption behavior for the samples with various surface treatment by TDS. We prepared three samples, such as as-received, mechanical polished and TiN coated samples. For three samples, the temperature which has a maximum desorption rate was measured as 920K for polished sample, as 1020 K for as-received sample and as over 1053 K for TiN coated sample, respectively. Since as-received or TiN coated samples has the diffusion barriers for the hydrogen, such as surface oxide layer or TiN layer, the desorption peak temperature was higher than that of polished sample. Based on these results, it might be possible to control the absorption rate of hydrogen by using the samples with surface treatment.

A Study of the Influence of a Wake-Field Generated by an Electron Beam Passing Through a Linac Beam Exit Window on Measurement of the Beam II

A. HOMMA, H. TANAKA, M. KITAICHI, T. SAWAMURA, M. NARITA,
S. OKUDA*, T. YAMAMOTO*, S. SUEMINE*

(Received December 27, 1995)

Abstract

The influence of a wake-field on measurements of a beam waveform and a method for suppressing that influence were studied. Beam entrance-holes of various dimensions were inserted in front of a pickup loop, whose function was to suppress the field generated by the beam passing through the entrance-hole end. The suppression was observed in experiments with a single-bunch electron beam at ISIR of Osaka University Linac. Numerical analysis with a beam cavity interaction code (BCI code) was also performed in order to corroborate the suppression in experiments. The main pulse caused by the electron bunch and the oscillating signal following the main pulse due to the residual wake-field was observed. The power-ratio of the former to the latter were compared with the calculation. There was fair agreement in several different hole geometries.

A Study of an Electron Gun Controlled with a Meshless Grid for a Linear Accelerator

A. Homma, K. Nakata, T. Sawamura, M. Narita

(Received December 27, 1995)

Abstract

An electron gun for a linear accelerator with a control grid of meshless electrode (meshless grid) is expected to overcome some disadvantages of beam quality using an ordinary mesh grid. A gun of this type was designed and its characteristics were numerically analyzed. The simulation program code Egn2 with a boundary setting routine POLYGON was used. The result indicated that the grid can control the beam launched from the cathode to the anode electrode. It also indicated the $I_p - V_p$ and $I_p - V_p$ characteristics which are different from an ordinary triode gun with a mesh-grid. The mutual conductance g_m of $0.4[mS]$, the maximum average current of $1.6[A]$ and cut-off voltage $-200[V]$ were obtained under a condition of $200[kV]$ acceleration voltage.

Beam Scanning Bulk Quasi-Phase-Matching Second-Harmonic-Generation Modulators Using Pockels Effect

Kojiro KOYANAGI

(Received January 25, 1996)

Abstract

Three basic modulators of bulk LiNbO_3 quasi-phase-matching second-harmonic-generation (QPM-SHG) using Pockels effect are analyzed theoretically. Beam scanning QPM-SHG modulators with asymmetric distribution of refractive index which can be obtained by introducing asymmetry in the spatial distribution of applied electric field are proposed. It is shown that the deflection angle of the second harmonic beam increases as the gradient of applied electric field increases. The results derived in this paper are useful for many applications in optical information processing.

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Retrieval of Chemical Literature by UnCover

Tsukasa IWADARE, Masahisa KOZENI, Kazuhiko ORITO and Michiko NOGUCHI
(Received June 28, 1996)

Abstract

This paper discusses retrieval of chemical information from a database system, UnCover. The features of access to and information retrieval from UnCover, as well as the method of searching by journal title, author's name and key word using the commands //T, //N and //W, respectively, are described.

This system is suitable for chemists who are not familiar with the operation of a database terminal because of its simple command system and operation.

Information from current issues of journals can easily be acquired using this database. Searching by author's name is not recommended for this system. Searching by subject key words produced good results, although there were some difficulties when using chemical compounds.

**Gas desorption property of carbon fiber composite/oxygen-free
high conductivity copper brazed material
as a divertor plate for a nuclear fusion device**

Takashi ROKUTANDA, Yuko HIROHATA, Tomoaki HINO, Toshiro YAMASHINA

(Received December 22, 1995)

Abstract

In a fusion device since, the divertor plate is irradiated with high heat flux, the temperature of the divertor component shall become very high. In order to reduce the heat load, a carbon fiber composite (CFC)/oxygen-free, high conductivity copper (OFHC-Cu) brazed material with a pipe for water cooling was developed as a divertor component. However, gas desorption from the divertor component occurs during the plasma discharge. In this study, we investigated the gas desorption property of this brazed material following electron beam irradiation by thermal desorption spectroscopy (TDS). Two CFCs (CX-2002U and MFC-1) were used as the plasma facing material (PFM). The results were compared with the case before electron beam irradiation.

For TDS measurement, the brazed material was cut into small pieces of five different positions (two pieces from the CFC part, two pieces from the part containing a brazed layer, and the OFHC-Cu part). The desorbed gases from the material following irradiation were very similar to those from the material before irradiation at every sampling position. The main desorbed gases were H_2 , H_2O , CO, and CO_2 .

For the surface of CFC, the total amount of desorbed gases from the material following an irradiation was about four times larger than that before irradiation. For the OFHC-Cu, a large desorption peak was observed in the TDS spectrum of CO_2 . The total amount of desorbed gases from the material following irradiation was 0.6-1.5 times that before irradiation. For the sample containing a brazed layer of an MFC-1 series brazed component, the total amount of gases desorbed from the material following irradiation was 7 times larger than that before irradiation. However, in the case of CX-2002U series brazed component, there was little difference in between the total amount of desorbed gases from the materials before and after irradiation.

Based on the desorption amounts of the three samples, i.e., the CFC, the OFHC-Cu and the sample containing a brazed layer, we estimated the gas desorption amount from a brazed layer with a thickness of $50\mu m$. In the case of an MFC-1 series brazed component, the gas desorption amount from the brazed layer of the material after irradiation was estimated to be 20 times larger than that before irradiation. The contribution of the brazed layer to the total desorption of the entire brazed material greatly increased by electron irradiation.

Surface Nitritization of Si by Plasma Processing

Makoto HARADA, Yuko HIROHATA, Ichiro FUJITA, Tomoaki HINO, Toshiro YAMASHINA

(Received March 31, 1996)

Abstract

Nitritization of Si was carried out using ECR nitrogen plasma. Optical emission spectroscopy was used to observe the state of plasma. The intensity of N_2^+ or N_2^* particles increases with pressure. The amounts and average depth of implanted nitrogen were evaluated by AES-analysis with Ar^+ ion etching. Chemical bindings of Si and N were observed by XPS analysis. The amount and average depth of implanted nitrogen increased exponentially with increase in substrate temperature and substrate bias voltage. The maximum concentration of nitrogen was around 40 at.%, in every sample. The amount of implanted nitrogen at 800°C was saturated at $1.1 \times 10^{16}/cm^2$, when the nitrogen ion fluence was $1 \times 10^{18}N/cm^2$. When the substrate bias changed from +200 to -1000V, the amount of implanted nitrogen increased with minus bias voltage. Si-N binding was observed in every sample.

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Formation and the Electrical Conductivity of (La, M^{II})(Cr, Mn)O_{3-δ} Thin Films [M^{II}=Ca, Sr]

Atsushi FURUSAKI¹⁾, Koji KURIBAYASHI, Isao SAEKI,
Hidetaka KONNO and Ryusaburo FURUICHI

(Received November 15, 1996)

Abstract

Perovskite-type (La, MII)(Cr, Mn)O_{3-δ} thin films [M^{II}=Ca, Sr] were formed on different substrates successfully by ultrasonic spray pyrolysis. The partial substitution of alkaline earths for lanthanum in LaCrO₃ caused a marked increase in electrical conductivity of the oxide films. Changes in the conductivity of (La_{0.8}Ca_{0.2})CrO_{3-δ} films with temperature could be explained on the basis of the small polaron mechanism, and the activation energy for conduction was calculated to be 0.15 eV. The partial substitution of manganese for chromium in (La_{0.8}M^{II}_{0.2})CrO_{3-δ} resulted in a small increase in conductivity due to improvement of the contacts between oxide particles. (La_{0.8}Ca_{0.2})(Cr_{0.5}Mn_{0.5})O_{3-δ} films sintered at 1200 °C for 10 hours in air showed a higher conductivity, while in the case of sintered (La_{0.8}Sr_{0.2})(Cr_{0.5}Mn_{0.5})O_{3-δ} films, the conductivity fell drastically due to the preferential oxide particle growth.

Direction Detection Errors due to Displacement of the Pilot Signal Receiving Antenna Elements in the Spacetenna of the Solar Power Satellite SPS2000

Manabu OMIYA, Yasuhiro KAWATA, Yasutaka OGAWA and Kiyohiko ITOH

(Received November 8, 1996)

Abstract

This paper describes the configuration of a pilot signal receiving antenna array and a direction detection system for the solar power satellite, SPS2000. This configuration simplifies the conventional system which requires a standard signal generator with the same frequency as the pilot signal. First, we show from the results of theoretical analysis that the direction detection system accurately estimates the pilot signal direction under an ideal condition. Next, we clarify the performance degradation of the pilot signal detection when the pilot signal receiving antenna elements are randomly displaced. Computer simulations were carried out to investigate effects of the direction detection errors due to displacement of antenna elements. Numerical results show that estimation errors of the pilot signal direction increase with increases in the degree of the antenna element displacement. The results indicate the necessity to prevent displacement of the pilot signal antenna elements by mechanical and electronic means or by digital signal processing.

Vibration control of a rigid-flexible two-link arm

Yukinori KOBAYASHI, Teruyuki OOTSU and Gen YAMADA

(Received November, 14, 1996)

Abstract

Vibration control of a rigid-flexible two-link arm that is operated horizontally by two DC-servo motors is investigated. Two piezoelectric actuators are attached to both sides of the flexible arm to improve the vibration control. The equation of motion of the system is derived by Hamilton's principle and the state equation is obtained by means of the constrained modal method. The digital optimal regulator theory is applied to control the arm positioning and the vibration of the flexible arm, and minimal order observer is also introduced. The performance of the controller is investigated by experiments and simulation.

Identification of crack location and depth in beam structures

Masaki NAGAMINE and Hiroshi UCHIDA

(Received November 15, 1996)

Abstract

This paper deals with the dynamics of cracked beam structures for bending vibrations. Cracks reduce the natural frequencies of structures, because they have the equivalent effect of "softening" the structures. This property can be used to detect the existence of a crack and its location in the structure. Recently, Narkis proposed algebraic equations for identification of crack location from frequency measurements. The validity of this method is confirmed here by the Finite Element Method (FEM) using a simple model of cracks, and it is shown that identification of both crack location and depth is possible from data of the variation of the first two natural frequencies.