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The 22th International Conference on Phenomena in Ionized Gases, Hoboken, New Jersey, USA, July 31-August 4, 1995

DECOMPOSITION OF NO2 MOLECULES BY UV LIGHT AND GLOW DISCHARGE

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Nitrogen dioxide (NO2) is one of the most difficult air pollutants to remove chemically. Many attempts to decompose NO2 in exhaust gases by corona discharges recently have been carried out. As a basic study, the reaction rates among decomposed components of NO2 have been examined and summarized, and NO2 molecules in a low pressure NO2 glow discharge were observed to be decomposed almost into N2 and O2. In this article, we examine NO2 decomposition by UV irradiation from Xe excimer (172 nm) and Hg (254 & 185 nm) lamps, and compared them with NO2 decomposition results by glow discharges.

The 11th International Conference on Gas Discharge and their Applications, Tokyo, Japan, September 11-15, 1995

Modelling of a self-sustained discharge-excited XeCl excimer laser

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A one-dimensional model including Poisson's equation to consider the space charge for a discharge-excited XeCl excimer laser has been developed. Behavior of the field distortion by the space charge and its effect on discharge evolution in the cathode sheath region have been studied. It was shown that the electric field near the cathode was extremely distorted due to the positive space charge and became up to a few hundreds larger than the applied field at the period of laser oscillation. This high field suggests that a local filamentation starts from the cathode by field emission, if microscopic protuberance is on the cathode surface. The photo-electron emission from the cathode was shown to be essential to moderate the field distortion in the cathode region and to sustain high power large volume discharges. The decrease in the preionization density was shown to cause the increase in the electric field at the cathode at the final stage of the discharge.

The 11th International Conference on Gas Discharge and their Applications, Tokyo, Japan, September 11-15, 1995

BREAKDOWN VOLTAGE MEASUREMENT OF FINE POWDER DIELECTRICS SUSPENDED IN AIR: EFFECT OF KINDS OF POWDER AND APPLIED VOLTAGE WAVE FORMS

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In a previous paper, the authors reported that the breakdown voltage of fine powder dielectrics, with which SiO2 fine powders are suspended in the atmospheric air, is higher than that of the atmospheric air, at the same gap lengths with AC (50 Hz) voltage application. The present paper is a continuation of the previous paper, and reports the effect of the kind of fine powder dielectrics (SiO2, TiO2, Si3N4) and the effects of the applied voltage wave forms (50 Hz AC, DC, impulse). The present result of measurement shows that with SiO2 fine powder dielectrics, the breakdown voltage is higher than that of the atmospheric air not only with AC but also with DC and impulse voltage application. In the case of TiO2 and Si3N4 fine powder dielectrics, however, while the breakdown voltage is higher than that of the atmospheric air with impulse voltage application, the breakdown voltage rise is small with AC and DC voltage application.

The 7th International Symposium on the Science & Technology of Light Sources, Kyoto,Japan, August 27-31, 1995

MODELING OF A BARRIA DISCHARGE EXCIMER LAMP

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Historically, dielectric barrier discharges have been used as ozonizer but are now enjoying renewed interest as UV light source plasmas such as excimer lamps. In this paper, we present a model of the Xenon excimer lamp. It is a cylindrical chamber with an outer radius of 1 cm and an inner radius of 0.9 cm. The high voltage is applied at the center and is shielded from the plasma by a dielectric (quartz) with 0.1 cm thickness. Typical rf voltages are 2-3 kV (peak to peak) at frequencies up to 100 kHz. The fill gas is pure Xe at pressures from 10 to

300 Torr.

In summary, when the step positive voltage is applied, the electrons rapidly charged anode, lowering the gap voltage drop, and preventing the ions from charging the cathode.

48th Annual Gaseous Electronics Conference, October 9-13, 1995, Berkeley, California

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A Computer Simulation of Optogalvanic Signals in Neon Gas Discharges

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When a self-sustained gaseous discharge is illuminated by radiation resonant with an atomic transition of the gas, a change in the electrical conductivity occurs. It is known as "the optogalvanic (OG) effect". We simulate OG signals in steady-state neon discharges for 14 Td<E/N<28 Td and 10e9<ne<10e12 cm-3 using a propagator method. It is shown that the electron energy distributions consistent with the OG signals can be obtained for various discharge conditions and transition wavelength lines. The transient behavior of the discharge after the light illumination is discussed.

Korea-Japan Symposium on Electrical Discharge and High Voltage Engineering, Kumi, Korea, May 31-June 1, 1996

Motion of liquid nitrogen by Maxwell stress in a microgravity environment

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The motion of liquid nitrogen (LN2) at the boiling point between electrodes and its surface profile in a microgravity environment just after release from the terrestrial gravity are observed. The dynamic behavior is analyzed considering the following forces: Maxwell stress, capillary effect (surface tension) and viscosity of LN2, and is explained consistently by theory including these forces. The velocity of the liquid driven by Maxwell stress and capillary force is compared with that driven by capillary force only. The growth dynamics of bubbles produced on the surface of electrodes is discussed.

A Workshop in Honor of Prof. Robert W. Crompton, Canberra, Australia, June 14, 1996

MODELING OF A MICRO-ARC FORMATION IN A DISCHARGE-EXCITED ArF EXCIMER LASER

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A three-dimensional fluid model considering local distortion of the electric field and the gas temperature to simulate time-spatial evolution of thermally constricted micro-arc discharges in a discharge-excited ArF excimer laser medium has been developed. An entire process from initiation and development to extinction of the micro-arc is studied in connection with the electron swarm properties and chemical reaction processes.

Results show that the micro-arc is triggered at a sharp point on the cathode surface and develops in the direction of the anode in a cathode sheath region. The developing process is explained on the basis of a theory of the thermal constriction induced by electric field distortion. The results are consistent with experimental observations.

The 8th International Micro-Process Conference, July 17-20, 1995, Sendai, Japan

Transport Characterization of Schottky In-Plane Gate $Al_{0.3}Ga_{0.7}As/GaAs$ Quantum Wire Transistors Realized by In-Situ Electrochemical Process

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The low-temperature transport properties of the novel $Al_{0.3}Ga_{0.7}As/GaAs$ Schottky in-plane gate (IPG) quantum wire transistor realized by the in-situ electrochemical process were studied. The device showed good field-effect transistor (FET) characteristics with excellent gate control and complete pinch-off. Quantized conductance in the units of $2e^2/h$ was clearly seen at 4K. The first plateau persisted up to 40K. Shubnikov-de Haas oscillation measurements showed an extremely weak dependence of the carrier density on the gate bias, indicating that the Schottky IPG controls the wire width without changing the sheet carrier density. Application of a magnetic field widened the conductance plateaus. Under harmonic approxi-

mation for the electrostatic confinement potentials, a subband spacing of $h\omega_0 = 4\text{-}5$ meV was obtained.

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the 1995 International Conference on Solid State Devices and Materials, August 21-24, 1995, International Hause, Osaka, Japan

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Scanning Tunneling Microscope Study of (001) InP Surface Prepared by Gas Source Molecular Beam Epitaxy

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(001) InP surface prepared by gas source molecular beam epitaxy (GSMBE) using tertiarybutylphosphine (TBP) as P source was studied by ultrahigh-vacuum scanning tunneling microscope (UHV-STM), reflection high-energy electron diffraction (RHEED) and X-ray photoelectron spectroscopy (XPS). It was found that the P-stabilized (2×4) reconstructed (001) InP surfaces can be obtained by annealing the (2×1) reconstructed surface which contains excess phosphorus. (2×4) reconstructed surfaces were found to possess the missing-dimer arrangements with at least two microscopic structures, α phase with two missing-dimer rows and β phase with one missing-dimer row, depending on the annealing temperature of the (2×1) surface. The (2×4) α phase is more stable with a wider range of annealing temperature, whereas the (2×4) β phase was obtained by annealing only near 330°C. The (2×4) α phase was observed even on a partially oxidized surface having many oxide patches, showing its remarkable stability.

the 1995 International Conference on Solid state Devices and Materials, August 21-24, 1995, International House, Osaka, Japan

Photoluminescence and Cathodoluminescence Investigation of Optical Properties of InP-Based InGaAs Ridge Quantum Wires Formed by Selective Molecular Beam Epitaxy

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Optical properties of InP-based InGaAs ridge quantum wires formed by selective molecular beam epitaxy (MBE) growth were characterized in detail by using cathodoluminescence (CL) and photoluminescence (PL). Both the CL and PL spectra had strong emission peaks with narrow widths. Spot-excited CL images confirmed that these peaks originated from ridge quantum wires. Depending on the excitation power, emission peaks showed energy shift and half-width change due to band filling. Temperature dependence of the PL emission peak followed that of the energy gap. The PL intensity decreased with increasing temperature, but was still fairly intense at room temperature. The behavior of PL intensity change with temperature was found to be the same for wires and reference wells, indicating the presence of a common nonradiative recombination mechanism.

the 1995 International Conference on Solid State Devices and Materials, August 21-24, 1995, Internatioal House, Osaka, Japan

Fabrication and Characterization of A Novel Lateral Surface Superlattice Structure Utilizing Schottky Barrier Height Control by Doped Silicon Interface Control Layers

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A novel lateral surface superlattice (LSSL) device structure based on Schottky barrier height (SBH) difference produced by periodic insertion of Si interface control layer (Si ICL) stripes is proposed, fabricated and characterized.

Two-dimensional computer simulation was performed first to gain information on basic design considerations. An electron beam induced current (EBIC) study on the fabricated device directly confirmed SBH modulation by Si ICL stripes. The devices showed periodic oscillations of drainconductance and transconductance at low temperatures up to 10K whose behavior was distinctly different from that of previous split-gate devices. The mechanism of these oscillations was explained by a sequential resonant tunneling model. According to a quantitative analysis of the data, SBH difference of 70-150 meV was produced at the metal-semiconductor interface and it produced quantized levels with the separation of 2-3 meV at heterointerface.

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the 1995 International Conference on Solid State Devices and Materials, August 21-24, 1995, Internatioal House, Osaka, Japan

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Novel GaAs-Based Single-Electron Transistors with Schottky In-Plane Gates Operating up to 20K

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In an attempt to enhance the operation temperature of GaAs-based single-electron transistors (SETs), a novel Schottky in-plane gate (IPG) SET based on voltage-controlled depletion of two-dimensional electron gas (2DEG) was proposed, fabricated and characterized. For device fabrication, EB lithography and the in-situ electrochemical process were applied to a MBE-grown AlGaAs/GaAs 2DEG wafer, and narrow Pt IPGs with 200 nm length were realized on the side walls of 2DEG. The fabricated SETs clearly showed Coulomb oscillations with a Coulomb gap and Coulomb staircase at low temperatures. Coulomb oscillation was observed up to 20K which is much higher than the operation temperature of split-gate devices having similar dimensions of several hundred nm. The small capacitance values as well as the observed strong bias dependences of device characteristics are explained in terms of the depletion characteristics of 2DEG with the Schottky IPG. The current leakage within the Coulomb gap is compatible with the cotunneling theory.

the 1995 international Conference on Solid State Devices and Materials, August 21-24, 1995, International House, Osaka, Japan

Deep Levels and Conduction Mechanism in Low-Temperature GaAs Grown by Molecular Beam Epitaxy

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Deep levels in low-temperature (LT) GaAs layer grown by molecular beam epitaxy were investigated by deep level transient spectroscopy (DLTS), photocapacitance and photoluminescence (PL) techniques. For the LT-GaAs layers grown at 350C, five electron traps were detected, and the trap concentration of the dominant deep level (S1) was found to be 1.8× 1016 cm-3 with an activation energy of 0.64 eV. The S1 level showed remarkable photoquenching behavior. The electrical conduction in LT-GaAs seems to be governed by these traps with high density.

the 1995 International Conference on Solid State Devices and Materials, August 21-24, 1995, Internatioal House, Osaka, Japan

0.86 eV Platinum Schottky Barrier on Indium Phosphide by In Situ Electrochemical Process and Its Application to MESFETs

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Pt Schottky barrier diodes (SBDs) with a high Schottky barrier height of 0.86eV and an ideality factor of near unity were successfully realized by a novel in situ electrochemical process. Applying this novel technique to InP metal semiconductor field effect transistors (MESFETs), good gate control of drain current with pinch-off, an effective channel mobility of 1,840 $cm^2V^{-1}s^{-1}$ and no drain current drift behavior were achieved. The InP MESFET operates even under a positive gate bias, showing feasibility of enhancement-mode operation as well as depletion-mode operation.

the 1995 International Conference on Solid State Devices and Materials, August 21-24, 1995, International House, Osaka, Japan

Contactless Characterization of Thermally Oxidized, Air Exposed and Hydrogen-Terminated Silicon Surfaces by Capacitance-Voltage and Photoluminescence Methods

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Contactless and nondestructive characterization of the electrical properties of the free surfaces of single-crystalline silicon wafers is accomplished for the first time by combined use of the contactless metal-insulator-semiconductor (MIS) capacitance-voltage (C-V) technique and the photoluminescence surface state spectroscopy (PLS^3) technique. The thermally oxidized, air-exposed and hydrogen-terminated silicon (111) surfaces were investigated. Thick thermally oxidized surfaces showed well-behaved characteristics with a minimum of a broad U-shaped interface state density (Nss) distributions in a range of $10^{10}cm^{-2}eV^{-1}$. On the other hand, the air-exposed Si surface exhibited a GaAs MIS-like behavior with strong Fermi level pinning near the charge neutrality level E_{HO} caused by a narrow U-shaped state distribution. Surprisingly, hydrogen-terminated surfaces showed even stronger Fermi level pinning at $E_0 = Ec - 0.53$ eV due to high density of amphoteric discrete state which may be due to silicon dangling bonds.

Third International Symposium on "New Phenomena in Mesoscopic Structures" December 4-8, 1995, Hyatt Regency Maui, Hawaii, USA

Quantum Transport in A Schottky In-Plane-Gate Controlled GaAs/AlGaAs Quantum Well Wires

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Transport properties of the novel GaAs/AlGaAs quantum well wires (QWWs) with

Schottky in-plane gates realized by a combination of a electron beam lithography and the in-situ electrochemical technology were investigated. Clear quantized conductance in units of $2e^2/h$ was observed up to 100K. Nonlinealities are found in the current-voltage characteristics at a small applied voltage, resulting in conductance deviation from the value of the quantized conductance. From the breakdown voltage of conductance quantization, a subband energy separation is estimated to be 10 meV or higher.

Third International Symposium on New Phenomena in Mesoscopic Structures December 4-8, 1995, Hyatt Regency Maui, Hawaii, USA

Design and fabrication of GaAs/AlGaAs single electron transistors based on in-plane Schottky gate control of 2DEG

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A novel GaAs-based single electron transistor (SET) based on in-plane Schottky gate control of 2DEG is designed and fabricated to achieve SET operations at higher temperatures than split-gate devices. Coulomb oscillation is observed up to 20K in the novel device.

23rd Conference on the Physics and Chemistry of Semiconductor Interfaces January 21-25, 1996, La Jolla, California, USA

Contactless capacitance-voltage and photoluminescence characterization of ultrathin oxide-silicon interfaces formed on hydrogen terminated (111) surfaces

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Electronic properties of the interfaces between Si and ultrathin (<10 Å) oxides formed by various low-temperature processes were characterized in contactless fashion, using contactless capacitance-voltage (C-V) and photoluminescence surface state spectroscopy (PLS^3) tech-

niques together with X-ray photoelectron spectroscopy (XPS) measurement. Hydrogen (H)-terminated Si (111) surfaces were used as the initial surface. Ultrathin oxides were formed at low temperatures by chemical oxidation processes (hot HNO_3, $H_2SO_4+H_2O_2$), long-time air exposure and low-temperature oxidation processes below 350°C.

The initial H-terminated surfaces showed presence of Fermi level pinning at E0=Ev+0.65 eV due to high density of amphoteric discrete state probably originating from Si dangling bonds. On the other hand, all the ultrathin oxide-Si interfaces exhibited very limited capacitance variations with voltage at low capacitance levels similar to GaAs MIS systems, and indicated that Fermi level is pinned near the charge neutrality level EHO due to presence of interface states with narrow U-shaped continuous distributions. Low-temperature oxidation at 350°C slightly weakens such pinning. The present work indicates difficulty of realizing unpinned ultrathin oxide-silicon interface by low-temperature processes.

23rd Conference on the Physics and Chemistry of Semiconductor Interfaces January 21-25, 1996, La Jolla, California, USA

Surface Passivation of $In_{0.53}Ga_{0.47}As$ Ridge Quantum Wires Using Silicon Interface Control Layers

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Surface state effects in $In_{0.53}Ga_{0.47}As$ one-dimensional quantum wires and the effectiveness of the Si interface control layer (SiICL) -based passivation technique are investigated using photoluminescence as the probe. Scanning electron microscope (SEM) and x-ray photoelectron spectroscopy (XPS) measurements were made to characterize the structure and the interface properties. The $In_{0.53}Ga_{0.47}$ As quantum wires embedded in $In_{0.52}Al_{0.48}$ As barrier material were fabricated by selective molecular beam epitaxy (MBE) growth on patterned InP substrates.

Unpassivated near-surface quantum wires showed an exponential decrease of PL intensity with reduction of surface-to-well distance, t_{ws}, similarly to the near-surface quantum wells. By applying the SiICL based passivation, a nearly complete recovery of PL intensity was achieved with an observed maximum recovery factor of 250 for the InGaAs quantum wire directly passivated with SiO_2/SiICL ($t_{ws}=0$). The mechanism for the PL recovery is explained in terms of suppression of surface states by passivation.

8th International Conference on Indium Phosphide and Related Materials, April 21-25, 1996, Convention Center " Stadtgarten ", Schwabisch Gmund, Germany

SURFACE PASSIVATION OF InP-BASED $In_{0.53}Ga_{0.47}As$ QUANTUM WIRES USING SILICON INTERLAYER-BASED PASSIVATION TECHNIQUE

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Surface control of compound semiconductor quantum structures is one of the key issues for realizing quantum LSIs, since such structures should be placed near the surface. For example, presence of severe surface effects on photoluminescence (PL) properties of quantum structures have been reported so far by several groups(1)-(3). According to these reports, PL intensity from near-surface quantum wells (QWs) and that from QW-based etched quantum wires (QWRs) decreased rapidly with reducing the well-to-surface distance and the lateral dimension of the wire, respectively, due to rapid nonradiative recombination process at the compound semiconductor surfaces.

Recently, we proposed a new passivation layer for compound semiconductor including a Si interface control layer (SiICL) between compound semiconductor substrate and outer SiO_2 and succeeded in a complete suppression of the surface effect on the near-surface QWs(4)-(7). In this paper, the SiICL technique was applied to an $In_{0.53}Ga_{0.47}As$ QWRs fabricated by using selective molecular beam epitaxy (MBE)(8), (9) with different values of the wire-to-surface distance (tws). The surface effects and the effectiveness of passivation were investigated by PL method. X-ray photoelectron spectroscopy (XPS) measurements were also made to characterize the interface properties of the samples.

8th International Conference on Indium Phosphide and related Materials, April 21-25, 1996, Schwabisch Gmund, Germany

GROWTH TEMPERATURE DEPENDENCE OF COMPOSITION IN $In_{1-x}Ga_xP$ ALLOY SYSTEM GROWN BY GSMBE USING TERTIARYBUTYLPHOSPHINE

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$In_{1-x}Ga_xP$ is a promising material for optoelectronic devices in the visible wavelength and long wavelength ranges as well as for use in high-speed electronic devices such as hetero-bipolar transistors (HBTs) and high electron mobility transistors (HEMTs). However its controlled epitaxial growth is known to be difficult because that the alloy composition x of $In_{1-x}Ga_xP$ strongly depends on the growth temperature Tg. In the case of gas source molecular beam epitaxy (GSMBE) growth of $In_{1-x}Ga_xP$, there has been no report on the relationship between x and Tg.

The purpose of the present paper is to investigate growth-temperature dependence of growth rate and composition for GSMBE growth of $In_{1-x}Ga_xP$ using tertiarybutylphosphine (TBP) and to clarify the underlying mechanism. TBP is a promising substitute for PH_3 due to its relatively low toxicity.

the 1996 International Conference on Indium Phosphide and Related Materials, April 21-25, 1996, Convention Center "Stadtgarten", Germany

Fabrication of high-performance InP MESFETs with in-situ pulse-plated metal gates

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Although InP has higher saturation velocity and higher thermal conductivity than GaAs, its use in the active channel of electron devices has been limited by lack of suitable Schottky gate

technology. The purpose of this paper is to demonstrate that high-performance InP MESFETs with Schottky barrier heights (SBHs) = 0.85-0.89 eV can be realized by the novel in-situ electrochemical etching/plating technique.

Previously, direct metal contacts were formed on InP by conventional techniques. But this results in low SBHs of about 0.4 eV, being independent of metal workfunctions (Fermi level pinning). Such low Schottky barriers make it difficult to use them as the gate of practical MESFETs. To overcome this difficulty, many attempts have been made to enhance SBHs on n-type InP, including incorporation of a thin interfacial oxide layer at the metal/InP interface, incorporation of a p^+ planar-doping layer near the interface and modification of surface properties by plasma treatments. However, such Schottky barriers having various interfacial oxide layers suffer from instability and poor reproducibility due to complex interfacial reactions. Furthermore, MESFETs utilizing Schottky barriers with interlayers generally exhibited drain current fluctuation, kinks and poor pinch-off.

On the other hand, InP Schottky barriers produced by the in-situ electrochemical process used in this paper are free of interfacial oxides and removes Fermi level pinning, realizing workfunction-dependent SBHs. High-barrier height, low-leakage and stable InP MESFETs are realized for the first time using this process.

38th Electronic Materials Conference, June 26-28, 1996, University of California Santa Barbara, California, USA

AlGaAs/GaAs Narrow Quantum Wires Produced by Schottky In-Plane Gate Technology

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The key point of the fundamental devices for future quantum electronics is formation of scattering-free one-dimensional electron waveguide with gate control. A promising approach is to confine two-dimensional electron gas (2DEG) into one dimension by utilizing voltage-adjustable depletion layers. The in-plane-gate (IPG) device utilizes electric field parallel to the 2DEG plane and seems to be potentially more effective for realization of quantum devices working at high temperatures due to strong and efficient electron confinement.

The purpose of the present paper is to report transport properties of the novel Schottky-IPG controlled $Al_{0.3}Ga_{0.7}As$/GaAs quantum well wires (QWWs). IPGs were realized by formation of Schottky contacts to the edges of the 2DEG plane by applying a novel in-situ electrochemical process.

38th Electronic Materials Conference, June 26-28, 1996, University of California Santa Barbara, California, USA

Dominant Deep Level and Its Photocapacitance Quenchingin in LT-GaAs Grown by MBE

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Undoped GaAs layers grown by molecular beam epitaxy (MBE) at low substrate temperatures (LT-GaAs buffer) possess unique semi-insulating properties that are useful for elimination of side-gating in MESFETs and HEMTs. They are also useful for ultra-fast optoelectronic switching. However, the mechanism for their semi-insulating properties have not been clarified yet, being disputed between two models, i. e, the deep level compensation model and the As-precipitate-induced Fermi level pinning model.

The purpose of this paper is to investigate deep level properties of LT-GaAs layers by using deep level transient spectroscopy (DLTS) and photocapacitance (PHCAP) techniques. Si-doped conductive LT-GaAs layers were grown at 300-400°C so as to directly apply the DLTS and PHCAP techniques to the LT-GaAs layer.

Proceedings of International Symposium on Surfaces and Thin Films of Electronic Materials, Hamamatsu, Oct 3 1995 pp. 227-231

Characteristics of Schottky Contacts on n-InP and n-GaAs by a Novel In Situ Electrochemical Process

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Schottky contacts on n-InP and n-GaAs were fabricated by a novel in situ electrochemical process. The characteristics of the Schottky contacts were investigated using atomic force micros copy (AFM), X-ray photoemission spectroscopy (XPS), current-voltage (I-V) and capacitance-voltage (C-V) techniques. The results of AFM and XPS measurements indicate that the novel in situ electrochemical process produces smooth and oxide-free interfaces. The

Schottky contacts show nearly ideal thermionic emission characteristics. The InP Schottky barrier height changes over a wide range from 0.35 eV to 0.86 eV, depending on the work function of the contact metals. The Pt/InP contact gave the highest barrier height of 0.86eV. The Fermi-level pinning is reduced at the InP Schottky contact interfaces. On the other hand, The electrochemical process produces firm level pinning at the GaAs Schottky contact interfaces.

The 8th International Conference on Fusion Reactor Materials Sept. 25-29, 1995 Obninsk, Russia

COMPARISON OF MECHANICAL PROPERTIES OF METALS IRRADIATED WITH FISSION AND FUSION NEUTRONS

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Mechanical property change of several metals irradeated with fission neutrons from JMTR (Japanese Materials Test Reactor) and fusion neutrons from RTNS-II (Rotating Target Neutron Source at LLNL) are compared in terms of change in parameters such as yield strength, uniform elongation limit, strain hardening exponent and ultimate tensile strength. A DEPA (damage energy per atom) scale for neutron dose seems to be valid for comparing different irradiation condition, however, all the parameters obtained from both irradiaions by JMTR and RTNS-II do not completely coincide each other at the same time. Because the dose dependency of these parameters are defferent for both irradiation conditions. The correlation is not simple as can be obtained only by shifting plots for doses, and the correlation factor may depend on a neutron dose and a materials constant.

The 2nd International Symposium on Metallic Multilayers Sept. 11-14, 1995 Cambridge, UK

SATURATION MAGNETIC MOMENTS OF Co/Cr MULTILAYERS

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An anomalous magnetization process was observed in multilayers of Cr (8 nm)/[Co(1 nm)/Cr(t nm)]^{19}/Co(1 nm). A magnetic moment per Co atom, σ_s^{Co}, larger than 200 emu/g is obtained for t-values of 1.5 and 3 nm from magnetization curves measured for magnetic fields up to 5T at temperatures down to 5K with a SQUID magnetometer. Also, a transition between a state of a larger magnetic moment and a smaller moment was observed at temperatures below 60K.

The 2nd International Symposium on Metallic Multilayers Sept. 11-14, 1995 Cambridge, UK

SATURATION MAGNETIC MOMENTS OF Co/Mn MULTILAYERS

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Co(1 nm)/Mn(t nm) multilayers were prepared by deposition in an ultra high vacuum of 10^{-10} Torr. The multilayers consist of Mn and Co layers whose (110) and (0001) planes are parallel to the substrate plane, respectively. For multi-layers with Mn layer thickness, t, between 1.3 and 3.5 nm, the lattice spacings of Mn layers dilated in the direction normal to their layer plane and ferromagnetism of Mn layers is presumed at specific thickness of Mn layers. This anomalous magnetism of Mn seems to strongly depend on the deposition conditions of the Mn buffer layer.

1st. International Symposium
on Advanced Physical Fields
(March 25-27, 1996)

Spin-Polarized STM and Exchange Force Microscopy

K. MUKASA

An SP-STM experiment using a ferromagnetic Ni tip and a very thin GaAs sample was demonstrated. Using circularly polarized light, we observed tunneling current which depends on both the helicity of the circular polarization and on the tip magnetization. If it is possible to interchange the roles of the tip and sample, SP-STM with a nonmagnetic tip can be realized. SP-STM will make it possible to observe with atomic resolution both the spin configurations of very thin magnetic films as they nucleate and grow, and polarization configurations of magnetic superlattices. Other important observations may also be possible.

Moreover, we have pointed out the possibility of atomic-resolution images of exchange interaction by exchange force microscopy (EFM), based on the numerical calculations using the simple one-dimensional model. Careful examination of the exchange interaction will lead to new spin craft technology or spin manipulation.

International Genome Informatics Workshop, Dec. 11-13, 1995, Yokohama, Japan

From Augmentation Media to Meme Media : Towards a New Knowledge Media Architecture

(Invited)

Y. TANAKA
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Today's personal computers are considered as augmentation media that provide us with various tools to augment our individual capabilities. Some of them are expanding their target of augmentation from individuals to groups, or further to organizations. They are called respectively groupwares and enterprize integration systems. The IntelligentPad system developed at Hokkaido University since 1987 further expands the target of augmentation from groups and organizations to communities or to societies. While people in a group or in an organization share a definite common goal such as making a decision, designing a system, or solving a problem, people in a society share their achievements and reuse them to produce new achievements. They share a pile of their achievements, namely their culture. This paper reviews the IntelligentPad system from the view points of its motivation, its design philosophy, its system architecture, its applications, and its current state of the art.

The 1995 Pan Asia Multimedia Conference, Sept., 1995, Hong Kong

Case Study: Interactive Multimedia in University Education

(Invited)

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In an IntelligentPad system, wide varieties of intellectual resources can be represented as pads. Among them are multimedia documents, system utilities, application programs, and user environments. Among system utilities are for example E-mail utilities, file utilities, and database utilities. Now we have more than 400 different primitive pads. You can easily compose a document or a tool by directly pasting some pads on top of another. Such a paste operation simultaneously defines both the layout of its components in the composed pad and the functional linkage among component pads. Since 1990, our project has been also trying to apply IntelligentPad to education in universities, which has resulted in several joint projects. Among them are one with Prof. T, Noguchi in Kushiro Technical College, one with Prof. Sunaga in Graduate School of Information Design in Tama Art College, and one with a group of professors teaching Japanese to foreign students.

ISOTAS 96, Mar. 13-15, 1996, Kanazawa, Japan

A Meme Media Architecture for Fine-Grain Component Software

(Invited)

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Computers as meta media are now evolving from augmentation media vehicles to meme media vehicles. While an augmentation media system provides individuals, groups or organizations with a seamlessly integrated environment of various tools and documents, meme media system provides communities or societies with further functions to edit, to distribute, and to share tools and documents. Meme media work as memes, i. e., cultural genes. Documents and tools on meme media can easily replicate themselves, recombine themselves, and are naturally selected by their environment, namely the society of their authors and users. Their accumulation in their users' community will form a meme pool, which will bring rapid evolution of documents and tools. The IntelligentPad architecture provides a standard framework called a pad that works as a meme medium for documents and software components. Its pad distribu-

tion system architecture using Netscape as their catalog works as a meme pool. Meme media promises to help the application developers by the use of patterns and frameworks for varieties of typical applications. A pattern in meme media means a common composition structure and hence a common editing structure of meme media shared by the composite tools for the same typical application. A framework in meme media means a set of meme media components and the composition rules that are typically used in the development of a specific kind of applications. Patterns and frameworks allow users to develop their applications just by editing these patterns or by playing with these frameworks.

European Japanese Seminar on Information Modelling and Knowledge Bases June 27-31, 1996, Copenhagen, Denmark

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Media-Based Architectures for Databases and Office Information Systems

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The recent development of multimedia technologies and object-oriented modeling and development technologies are expanding the ways of modeling, presenting, accessing, and manipulating various kinds of information stored in databases. However, we still lack systematic ways of integrating database systems with application systems that deal with multimedia documents and tools. Information, when presented to users or manipulated by users, can not exist without any media. We need a unified framework that supports the continual process of recording, storing, distributing, sharing, editing and representing various kinds of information in an integrated manner on the computer. This paper proposes an integrated framework for media objects and databases. This framework uses the IntelligentPad system not only to support the continual process of recording, storing, distributing, sharing, editing and representing various intellectual resources, but also to assimilate database systems into the integrated environment of media objects.

The 6th International Workshop on Algorithmic Learning Theory, ALT'95 1995. 10.18-10.20

On Rejecting Inappropriate Similarities in Analogical Logic Program Synthesis Systems

Ken SADOHARA and Makoto HARAGUCHI

This paper presents an algorithmic learning theory for analogical synthesis of logic programs from their examples. An analogical synthesizer is defined as a kind of inductive inference machine that uses analogy. More precisely speaking, it synthesizes target programs from their examples, given a source program to which the target programs should be similar.

One of the difficulties in realizing an efficient analogical synthesizer is to distinguish useless and inappropriate similarities from the other. A similarity is inappropriate if every similar program with respect to the similarity is not correct. If our synthesizer cannot refute such similarities then it would waste computational resources without succeeding to find a desired program.

To cope with this hard problem on analogical synthesis, this paper first applies the notion of refutably inferable class of linear programs, and obtains a basic synthesizer. It has a function of refuting inappropriate similarities.

Secondly this paper investigates another method of refuting inappropriate similarities, using an analogous technique that has been employed for theorem proving with abstraction. Incorporating this method into the basic synthesizer, we obtain a more efficient one.

All the synthesizers presented in this paper are proved to identify a similar correct program in the limit, given a source program.

International Workshop on Machine-Intelligence 1995. 7.26-7.28

PAC-learning of Preference Relation over Interpretations in Lazy Nonmonotonic Reasoning

Ken SATOH

This paper presents a method of learning a class of preference order over interpretations in a propositional language which is a generalization of circumscription. The order considered in this paper is based on the distance in a weighted Euclidean space between the most preferable interpretation among all the interpretations and an interpretation represented as lattice points whose elements take values of either 0 or 1. Nonmonotonic reasoning defined by this order is a subclass of lazy nonmonotonic reasoning where nonmonotonicity emerges only when new

added knowledge is contradictory to the previous belief.

We learn the weight which defines the order from relative preference information between two interpretations. The relative preference information represents whether an interpretation is more preferable to another interpretation. We give a PAC (probably approximately correct)-learning analysis for the method.

By using the method, we can efficiently learn a weight which approximates a true weight with high probability. We also show experimental results on the sample size and the error rate under the assumption of uniform probability distribution over interpretations.

Symposium on Abstraction, Reformulation and Approximation, SARA-95, 1995. 8.16-8.19

Using Abstraction to Multiple Generalization Problem

Yoshiaki OKUBO and Makoto HARAGUCHI

This paper is concerned with multiple generalization problem (MGP) in an order-sorted logic with sorted-generalization (SG-generalization). MGP is that " when there exist more than one possible SG-generalization, which one should we select as an appropriate one?". SG-generalization is a process of replacing a variable in an order-sorted rule into another one of more general sort along a given sort hierarchy. Since a sort in general has more than one super sort in the hierarchy, we encounter MGP. This paper proposes to use abstraction in order to address such a MGP.

By a translation operator " unsorted ", we can deal with sort information in an order-sorted representation as sort predicates in a first-order one, and then we can consider a " predicate mapping " for each SG-generalization in MGP. In order to address MGP, an appropriateness of SG-generalization is defined from the viewpoint of abstraction based on predicate mapping. Intuitively speaking, we can consider a SG-generalization appropriate if the generated rule by the generalization is an abstract clause based on a predicate mapping constructed from the generalization. When we encounter MGP, we select a SG-generalization from possible ones according to the appropriateness. It is expected that we can reject generalizations by the appropriateness that might derive undesirable consequences.

CLEO/Pacific Rim'95, July
10-14, 1995, Chiba, Japan

A Simple and Efficient Scalar Finite Element Approach to Nonlinear Optical Channel Waveguides

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A unified approach based on the scalar finite element method is developed for both TE-like and TM-like nonlinear waves in optical channel waveguides. In order to faithfully evaluate the intensity-dependent refractive index within each element according to the electric field distributions and to treat arbitrarily shaped nonlinear optical waveguides, quadratic isoparametric curvilinear elements and numerical integration formulae derived by Hammer and his co-workers are introduced. Propagation characteristics of nonlinear elliptical core optical fibers and graded-index nonlinear optical channel waveguides are investigated for the first time.

CLEO/Pacific Rim'95, July
10-14, 1995, Chiba, Japan

An Efficient Analysis and Design Tool for Integrated Optical Components

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A software package for longitudinally varying optical waveguides is developed. This package consists of three modules: graphic-based interactive pre-processor editing layouts of integrated optical components, a variety of solvers using FFT-BPM (beam proagation method based on fast Fourier transform), SSFE-BPM (BPM based on split-step finite element method), and FE-BPM (BPM based on explicit FEM without split-step procedure), and post-processor giving wide and flexible facilities for the graphical display and numerical assessment. Included in the library of the pre-processor are straight/angled waveguides, tapers, S-bends, and polygons.

The Fifth Sino-Japanese Joint Meeting on Optical Fiber Science and Electromagnetic Theory, Sept. 20-22, 1995, Tianjin, China

A Finite Element Beam Propagation Method for Strongly Guiding Longitudinally Varying Optical Waveguides

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A unified finite element beam propagation method is described for both TE and TM waves propagating in strongly guiding longitudinally varying optical waveguides with magnetooptic materials. The transparent boundary condition is also used for both polarizations. To save computing time and computer memory, finite element sparse matrices are stored in compact forms, and the upper and lower triangular decompostion and the forward and backward substitution processes are performed. The present finite element beam propagation method is the first beam propagation method algorithm for modelling nonreciprocal magnetooptic components.

1995 IEEE International Ultrasonics Symposium, Nov. 7-10, 1995, Seattle, Washington, USA

A Simple Analysis of SAW Resonators by Using Force Factors

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The IDT multi-port equivalent circuit and its transfer matrix using force factors are applied to SAW resonators. The entire structure of the equivalent circuit for SAW devices is depicted clearly, and the characteristics of multi-electrode low-loss SAW filters such as interdigitated IDTs with reflectors used in mobile communication equipments can be easily and efficiently analyzed by using the transfer matrix.

The Seventh Biennial IEEE Conference on Electromagnetic Field Computation, March 18-20, 1996, Okayama, Japan

A Vector Finite Element Formulation for General Bi-Anisotropic Waveguides

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A numerical approach based on the vector finite element method with hybrid edge/nodal elements is described for the analysis of most general bi-anisotropic waveguides. Numerical examples are shown for ferrite-chiral circular waveguides.

The Seventh Biennial IEEE Conference on Electromagnetic Field Computation, March 18-20, 1996, Okayama, Japan

A Two-Dimensional Design and Modeling of Semiconductor Lasers

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A self-consistent analysis based on the finite element method is performed for the investigation of both the electrical and optical properties of semiconductor lasers for the first time. Computed results on channeled-substrate-planar lasers are compared to those evaluated by the finite difference method.

The Seventh Biennial IEEE Conference on Electromagnetic Field Computation, March 18-20, 1996, Okayama, Japan

Wide-Angle Beam Propagation Method Based on a Finite Element Scheme

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A wide-angle finite element beam propagation method using a Pade approximant operator is described for strongly guiding and longitudinally varying optical waveguides. In order to show the validity and robustness of this approach, numerical results are compared with those of other beam propagation algorithms.

The Seventh Biennial IEEE Conference on Electromagnetic Field Computation, March 18-20, 1996, Okayama, Japan

Finite Element Analysis of General Conical Diffraction by Arbitrarily Profiled Gratings

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A numerical approach based on the finite element method is described for the analysis of general three-dimensional, conical diffraction by arbitrarily profiled gratings. In order to show the validity and usefulness of this approach, the calculated conical diffraction efficiencies of groove-type dielectric gratings are presented.

1995 Fourth IEEE International Conference on Universal Personal Communications
Tokyo, Japan, 6-10 November, 1995

Spatial-Domain Path-Diversity Using an Adaptive Array for Mobile Communications

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Frequency-selective fading due to multipath propagation is serious hindrance in high-speed TDMA mobile transmission. The multipath propagation causes degradation because signals with different delay times are received. If we resolve the signals and combine them adjusting the delay difference, we can both reduce the frequency-selective fading and utilize the transmitted signal power efficiently. This technique is called path-diversity. A RAKE realizes the path-diversity in a time domain. We propose an adaptive array with several sets of complex weights. Each set of the complex weights forms a different array pattern. The weights are determined by an SMI (Sample Matrix Inverse) algorithm. The adaptive array resolves multipath components adjusting the array patterns. Thus, we can realize spatial-domain path-diversity for high-speed mobile communications.