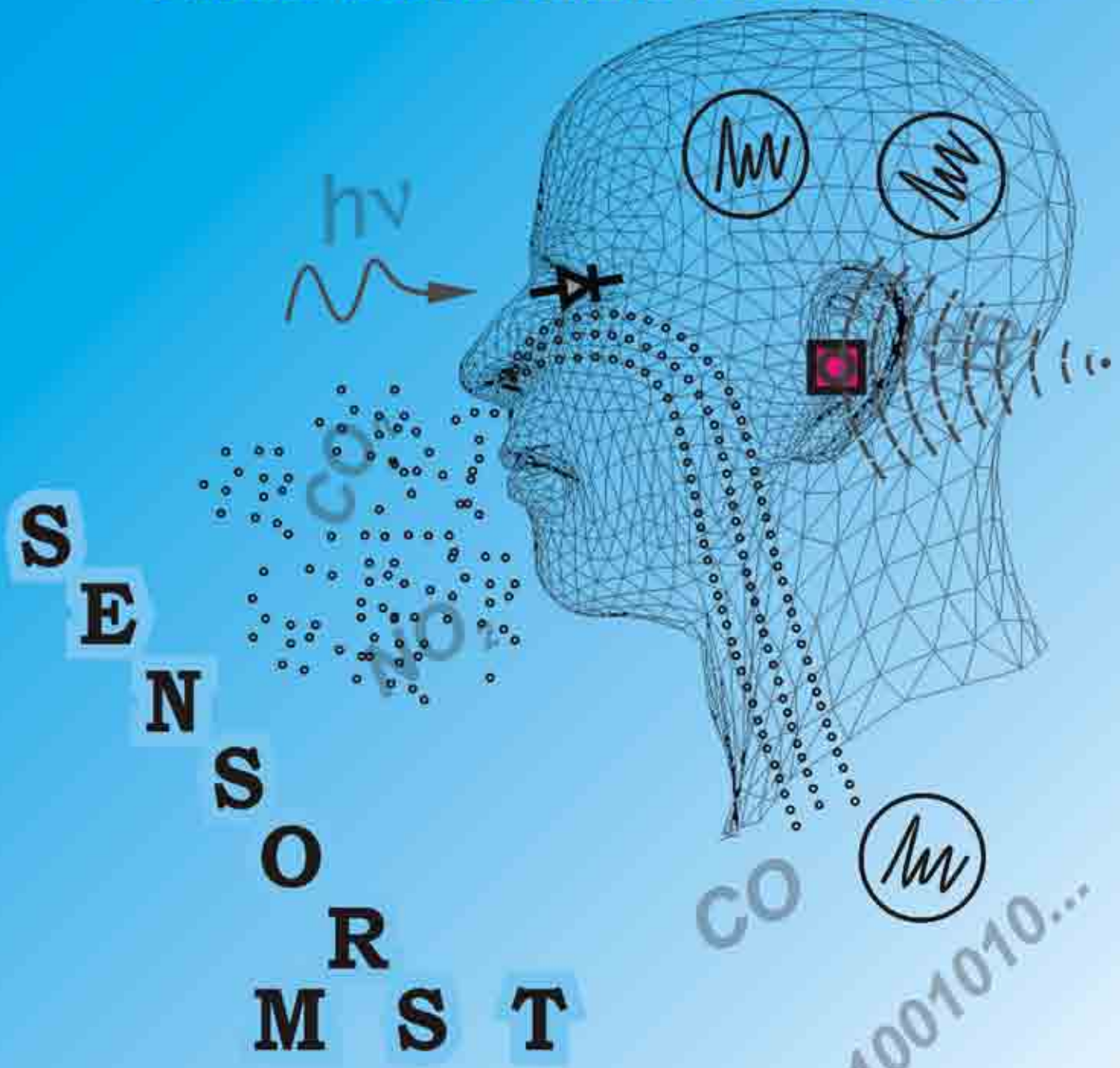
СЕНСОРНА ЕЛЕКТРОНІКА

І МІКРОСИСТЕМНІ ТЕХНОЛОГІЇ



2004 - №2

MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
Odessa I. I. Mechnikov National University

SENSOR ELECTRONICS AND MICROSYSTEM TECHNOLOGIES

№ 2 • 2004

Scientific and Technical Journal

UDC 681.586

Founded by
Odessa I. I. Mechnikov
National **U**niversity

Certificate of State Registration
КВ № 8131

Editor-in-Chief
Smyntyna V. A.

Vice Editor-in-Chief
Lepikh Ya. I.

Editorial Board:

Balaban A. P. — (Odessa, *responsible editor*)
Blonskii I. V. — (Kiev)
Gulyaev Yu. V. — (Moscow)
Gurzhii A. M. — (Kiev)
D'Amiko A. — (Rome)
Krutovertsev S. A. — (Zelenograd)
Kurmashov S. D. — (Odessa)
Litovchenko V. G. — (Kiev)
Machulin V. F. — (Kiev)
Ptashchenko A. A. — (Odessa)
Pokutnii S. I. — (Odessa)
Rarenko I. M. — (Chernovtsy)
Starodub N. F. — (Kiev)
Tretyak A. V. — (Kiev)
Chviruk V. P. — (Kiev)

Publishes on the resolution of Odessa I. I. Mechnikov National **U**niversity Scientific Council.
Transaction № 1, Sept., 28, 2004

Editorial address:
2, Dvoryanskaya Str. RL-3,
Odessa I.I. Mechnikov
National **U**niversity,
Odessa, 65026, Ukraine
ph. +38(0482)23-34-61
fax .+38(0482)23-34-61
E-mail: semst-journal@ukr.net

МІНІСТЕРСТВО ОСВІТИ І НАУКИ УКРАЇНИ
Одеський національний університет ім. І. І. Мечникова

СЕНСОРНА ЕЛЕКТРОНІКА І МІКРОСИСТЕМНІ ТЕХНОЛОГІЇ

№ 2 • 2004

Науково-технічний журнал

Заснований 13.11.2003 року
Виходить 4 рази на рік

УДК 681.586

Засновник
Одеський національний університет
ім. І. І. Мечникова

Свідоцтво про державну реєстрацію
КВ № 8131

Головний редактор
Сминтина В. А.

Заступник головного редактора
Лепіх Я. І.

Редакційна колегія:

Балабан А. П. — (Одеса, *відповідальний секретар*)
Блонський І. В. — (Київ)
Гуляєв Ю. В. — (Москва)
Гуржій А. М. — (Київ)
Д'Аміко А. — (Рим)
Крутоверцев С. А. — (Зеленоград)
Курмашов Ш. Д. — (Одеса)
Литовченко В. Г. — (Київ)
Мачулін В. Ф. — (Київ)
Покутній С. І. — (Одеса)
Птащенко О. О. — (Одеса)
Раренко І. М. — (Чернівці)
Стародуб М. Ф. — (Київ)
Третяк О. В. — (Київ)
Чвирук В. П. — (Київ)

Видається за рішенням Вченої ради Одеського національного університету ім. І. І. Мечникова.
Протокол № 1 від 28 вересня 2004 р.

Адреса редакції:
вул. Дворянська, 2, НДЛ-3,
Одеський національний університет
ім. І. І. Мечникова,
Одеса, 65026, Україна.
Тел. +38(0482)23-34-61
Факс +38(0482)23-34-61
E-mail: semst-journal@ukr.net

© ОНУ ім. І. І. Мечникова, 2004

ЗМІСТ

CONTENTS

Фізичні, хімічні та інші явища, на основі яких можуть бути створені сенсори
Physical, chemical and other phenomena, as the bases of sensors

С. І. Покутній
ПЕРЕХОДИ ВАЖКОЇ ДІРКИ В НАПІВПРОВІДНИКОВИХ КВАНТОВИХ ТОЧКАХ І МОЖЛИВОСТІ ЇХ ВИКОРИСТАННЯ В НАНОЛАЗЕРІ 3

A.V. Glushkov, G.P. Prepelitsa and A.A.Svinarenko
SENSING THE STOCHASTIC LASER PULSE STRUCTURE AND CHAOTIC AND PHOTON-CORRELATION EFFECTS IN THE NON-LINEAR MULTI-PHOTON ATOMIC DYNAMICS IN LASER AND DC ELECTRIC FIELD 8

Shkil M.V., Ilchenko V.V., Tretyak O.V., Chen P.S., Pei Z.W., Tsai M.J.
C–V AND AS STUDY OF SELF-ASSEMBLED GE ISLANDS IN Si P-N JUNCTION 15

Yu.G. Chernyakova, V.M.Ignatenko and L.A.Vitavetskaya
SENSING THE TOKAMAK PLASMA PARAMETERS BY MEANS HIGH RESOLUTION X-RAY THEORETICAL SPECTROSCOPY METHOD: NEW SCHEME 20

Сенсори фізичних величин
Physical sensors

B. Mamikonyan, Kh. Mamikonyan
MICROPROCESSOR MEASURER WITH THERMORESISTIVE SENSOR 25

В. Б. Нерсисян
ВИХРЕТОКОВЫЙ СЕНСОР ТОЛЩИНЫ И СКОРОСТИ ДВИЖУЩЕЙСЯ ПРОВОДЯЩЕЙ НЕМАГНИТНОЙ ПОЛОСЫ 29

Оптичні, оптоелектронні і радіаційні сенсори
Optical and optoelectronic and radiation sensors

Chegel V.I., Shirshov Yu.M.
SURFACE PLASMON RESONANCE SPECTROSCOPY: POTENTIALITIES AND LIMITATIONS 34

S. V. Ambrosov
LASER PHOTOIONIZATION SENSOR OF THE SEPARATING ISOTOPES AND NUCLEAR REACTIONS PRODUCTS: THEORETICAL FOUNDATIONS OF NEW SCHEME 50

Лєнков С.В., Лукомський Д.В., Ликов О.І., Зубарєв В.В.
ПІДВИЩЕННЯ ЕФЕКТИВНОСТІ КРЕМНІЄВИХ ФОТОЕЛЕКТРИЧНИХ ПЕРЕТВОРЮВАЧІВ ЗА ДОПОМОГОЮ ТЕКСТУРУВАННЯ ЇХ ПОВЕРХНІ 58

Біосенсори
Biosensors

Стародуб Н.Ф., Стародуб В.М.
БИОСЕНСОРЫ НА ОСНОВЕ ФОТОЛЮМИНЕСЦЕНЦИИ ПОРИСТОГО КРЕМНИЯ. ОБЩАЯ ХАРАКТЕРИСТИКА И ПРИМЕНЕНИЕ ДЛЯ МЕДИЦИНСКОЙ ДИАГНОСТИКИ 63

Masolova N.V.
COMPUTER SIMULATION OF OPTOCHEMOTRONIC SENSOR RESPONSE IN DIFFERENT MODES OF ANALYSIS 84

Матеріали для сенсорів
Sensor materials

D.Moskal', V.Nadtochiy, N.Golodenko
STRUCTURE CHANGES IN GaAs CHIPS DEFORMED BY PRESSING AT 300 K 89

ОГЛЯД ПУБЛІКАЦІЙ ЖУРНАЛУ IEEE SENSORS JOURNAL №1, №2 ЗА 2004 РІК 94

ФІЗИЧНІ, ХІМІЧНІ ТА ІНШІ ЯВИЩА, НА ОСНОВІ ЯКИХ МОЖУТЬ БУТИ СТВОРЕНІ СЕНСОРИ

PHYSICAL, CHEMICAL AND OTHER PHENOMENA, AS THE BASES OF SENSORS

УДК 535.34

ПЕРЕХОДИ ВАЖКОЇ ДІРКИ В НАПІВПРОВІДНИКОВИХ КВАНТОВИХ ТОЧКАХ І МОЖЛИВОСТІ ЇХ ВИКОРИСТАННЯ В НАНОЛАЗЕРІ

С. І. Покутній

Іллічівський навчально-науковий центр
Одеського національного університету ім. І.І. Мечникова
(вул. Данченка, 17а, Іллічівськ, Одеської обл., 68001;
e-mail: univer@ivt.ilyichevsk.odessa.ua)

Анотація

ПЕРЕХОДИ ВАЖКОЇ ДІРКИ В НАПІВПРОВІДНИКОВИХ КВАНТОВИХ ТОЧКАХ І МОЖЛИВОСТІ ЇХ ВИКОРИСТАННЯ В НАНОЛАЗЕРІ

С. І. Покутній

Приводиться теоретичний аналіз можливості використання переходів важкої дірки між еквідистантною серією рівнів у адіабатичному потенціалі електрона в напівпровідникових квантових точках у оптичному нанолазері.

Ключові слова: переходи важкої дірки, адіабатичний потенціал, квантові точки, нанолазер

Аннотация

ПЕРЕХОДЫ ТЯЖЕЛОЙ ДЫРКИ В ПОЛУПРОВОДНИКОВЫХ КВАНТОВЫХ ТОЧКАХ И ВОЗМОЖНОСТИ ИХ ИСПОЛЬЗОВАНИЯ В НАНОЛАЗЕРЕ

С. И. Покутний

Проводится теоретический анализ возможности использования переходов тяжелой дырки между эквидистантной серией уровней в адиабатическом потенциале электрона в полупроводниковых квантовых точках в оптическом нанолазере.

Ключевые слова: переходы тяжелой дырки, адиабатический потенциал, квантовые точки, нанолазер

Summary

HEAVY HOLE TRANSITIONS IN SEMICONDUCTOR QUANTUM DOTS AND THEIR POSSIBLE USE IN NANOLASER

S. I. Pokutnyi

We discuss energy spectrum of electron-hole pairs in a quasi-zero-dimensional system consisting of spherical semiconductor quantum dots placed in transparent dielectric matrice. We study theoretically the prospect of using hole transitions between equidistant series of quantum levels observed in quantum dots iv design of a nanoleser.

Keywords: transitions the heavy hole, adiabatic potential, quantum dots, nanolaser

PACS 32.80.Rm; 05.45.+b;
УДК 539.184, 539.186

SENSING THE STOCHASTIC LASER PULSE STRUCTURE AND CHAOTIC AND PHOTON-CORRELATION EFFECTS IN THE NON-LINEAR MULTI-PHOTON ATOMIC DYNAMICS IN LASER AND DC ELECTRIC FIELD

A. V. Glushkov, G. P. Prepelitsa and A. A. Svinarenko

Institute of Applied mathematics OSEU, P.O.Box 108, Odessa-9, 65009, Ukraine
Phone: +380-482-637227 E-mail: glushkov@paco.net

Abstract

SENSING THE STOCHASTIC LASER PULSE STRUCTURE AND CHAOTIC AND PHOTON-CORRELATION EFFECTS IN THE NON-LINEAR MULTI-PHOTON ATOMIC DYNAMICS IN LASER AND DC ELECTRIC FIELD

A. V. Glushkov, G. P. Prepelitsa and A. A. Svinarenko

A new method for sensing a structure of the stochastic, multi-mode laser pulse field and photon-correlation, chaotic features of atomic and nano-optical systems in this field is developed and a dynamics of multi-photon ionization in intense field is studied. As a basis for developing a new method for sensing stochasticity and chaotic features we use new quantum approach to calculation of the multi-photon resonances spectra characteristics for atomic systems in a stochastic laser field and the same field plus DC electric field. Some numerical illustrations regarding the multi-photon resonance spectra and stochasticity sensing for a number of atomic systems are presented.

Key words: laser pulse structure, stochasticity, sensing, atom, stochastic laser and electric field

Анотація

ДЕТЕКТУВАННЯ СТРУКТУРИ СТОХАСТИЧНОГО ЛАЗЕРНОГО ІМПУЛЬСУ І ХАОТИЧНИХ, ФОТОН-КОРЕЛЯЦІЙНИХ ЕФЕКТІВ В НЕЛІНІЙНІЙ БАГАТОФОТОННІЙ АТОМНІЙ ДИНАМИЦІ У ЛАЗЕРНОМУ Й СТАЛОМУ ЕЛЕКТРИЧНОМУ ПОЛЯХ

О. В. Глушков, Г. П. Препелица, А. А. Свинаренко

Розвинуто новий метод детекування структури стохастичних багатоомодових лазерних імпульсів і хаотичних, фотон-кореляційних ефектів для атомних і нано-оптичних систем в полі лазерного імпульсу. Вивчається динаміка багатофотонної іонізації в інтенсивних полях. В якості теоретичної основи нового методу детектування використано новий квантовий підхід до обчислення характеристик спектра багатофотонних резонансів для атомних систем у стохастичному лазерному полі й сталому електричному полі. Для ряда атомних систем наведені чисельні приклади обчислення спектру, характеристик багатофотонних резонансів і детектування стохастичності у системі.

Ключові слова: структура лазерного імпульсу, стохастичність, детектування, атомна система, стохастичне лазерне і електричне поле

Аннотация

ДЕТЕКТИРОВАНИЕ СТРУКТУРЫ СТОХАСТИЧЕСКОГО ЛАЗЕРНОГО ИМПУЛЬСА И ХАОТИЧЕСКИХ, ФОТОН-КОРРЕЛЯЦИОННЫХ ЭФФЕКТОВ В НЕЛИНЕЙНОЙ МНОГОФОТОННОЙ АТОМНОЙ ДИНАМИКЕ В ЛАЗЕРНОМ И ПОСТОЯННОМ ЭЛЕКТРИЧЕСКОМ ПОЛЯХ

А. В. Глушков, Г. П. Препелица, А. А. Свинаренко

Развит новый метод детектирования структуры стохастических многомодовых лазерных импульсов и хаотических, фотон-корреляционных эффектов для атомных и нано-оптических систем в поле лазерного импульса. Изучается динамика многофотонной ионизации в интенсивных полях. В качестве теоретической основы нового метода детектирования используется новый квантовый подход к вычислению характеристик спектра многофотонных резонансов для атомных систем в стохастическом лазерном поле и постоянном электрическом поле. Для ряда атомных систем приведены численные примеры вычисления спектра, характеристик многофотонных резонансов и детектирования стохастичности в системе.

Ключевые слова: структура лазерного импульса, стохастичность, детектирование, атомная система, стохастическое лазерное и электрическое поле

PACS numbers: 85.35.Be, 73.22. - f.
УДК 621.317; 538.9

C–V AND AS STUDY OF SELF-ASSEMBLED GE ISLANDS IN SI P-N JUNCTION

M. V. Shkil, V. V. Ilchenko, O. V. Tretyak, P. S. Chen[1], Z. W. Pei[1], M. J. Tsai[1]

Kyiv National Taras Shevchenko University, 64,Volodymyrska str., Kyiv, Ukraine 01033
[1]Industrial Technology Research Institute, ERSO/ITRI Bldg.15,195-4,Sec.4, Chung Hsing Rd., Hsinchu, Taiwan 310, R.O.C

Summary

C–V AND AS STUDY OF SELF-ASSEMBLED GE ISLANDS IN SI P-N JUNCTION

M. V. Shkil, V. V. Ilchenko, O. V. Tretyak, P. S. Chen, Z. W. Pei, M. J. Tsai

The electrical properties of self-assembled Ge quantum dots (QDs) and Ge quantum wells (QWs) embedded in Si p-i-n diodes were studied using capacitance-voltage(C-V) measurements and admittance spectroscopy(AS). The investigated samples were grown on Si(001) substrates by an ultra high vacuum chemical vapour deposition (UHV-CVD) system. A linear increase of the thermal activation energy observed in voltage-dependent admittance spectroscopy(from 250meV up to 380meV) for the sample with quantum dots shows that the ensemble of Ge islands has a low, continuous averaged density of states. For the sample without Boron pretreatment we found two levels with activation energies about 132meV and 202meV which were about constant in some reverse bias region.

Key-Words: Quantum dot, quantum well, admittance spectroscopy, activation energy.

Анотація

ВОЛЬТ-ФАРАДНІ ВИМІРИ ТА СПЕКТРОСКОПІЯ ПРОВІДНОСТІ САМООРГАНІЗОВАНИХ ГЕРМАНІЄВИХ ОСТРІВЦІВ В КРЕМНІЄВИХ P-N З'ЄДНАННЯХ

М. В. Шкіль, В. В. Ільченко, О. В. Третяк, П. Ш. Чен, З. В. Пей, М. І. Тсаі

За допомогою вольт-фарадних вимірів та спектроскопії провідності досліджувалися електричні властивості самоорганізованих германієвих квантових точок та квантових ям, що були вбудовані в кремнієві p-i-n діоди. Досліджувані зразки були вирощені на кремнієвій підкладинці з орієнтацією 001 за допомогою надвисоковакуумного хімічного парового осадження. Лінійний ріст термічної енергії активації (з 250 меВ до 380 меВ), який отримується після обробки даних спектроскопії провідності для зразку з квантовими точками, показує, що ансамбль германієвих острівців має малу за величиною та в середньому неперервну густину станів. Для зразку без попередньої обробки бором ми знайшли два рівня з енергіями активації біля 132 меВ та 202 меВ, значення яких майже не змінювалися в деякому діапазоні зворотніх напруг.

Ключові слова: Квантова точка, квантова яма, спектроскопія провідності, енергія активації.

Аннотация

ВОЛЬТ-ФАРАДНЫЕ ИЗМЕРЕНИЯ И СПЕКТРОСКОПИЯ ПРОВОДИМОСТИ САМООРГАНИЗОВАННЫХ ГЕРМАНИЕВЫХ ОСТРОВКОВ В КРЕМНИЕВЫХ P-N СОЕДИНЕНИЯХ

Н. В. Шкиль, В. В. Ильченко, О. В. Третьяк, П. Ш. Чен, З. В. Пей, М. И. Тсаи

С помощью вольт-фарадных измерений и спектроскопии проводимости исследовались электрические свойства самоорганизованных германиевых квантовых точек и квантовых ям, встроенных в кремниевые p-i-n диоды. Исследуемые образцы были выращены на кремниевой подложке с ориентацией 001 с помощью сверхвысоковакуумного химического парового осаждения. Линейный рост термической энергии активации (с 250 мэВ до 380 мэВ), который получается после обработки данных спектроскопии проводимости для образца с квантовыми точками, показывает, что ансамбль германиевых островков имеет малую по величине и в среднем непрерывную плотность состояний. Для образца без предварительной обработки бором мы нашли два уровня с энергиями активации около 132 мэВ и 202 мэВ, значения которых не изменялись в некотором диапазоне обратных напряжений.

Ключевые слова: Квантовая точка, квантовая яма, спектроскопия проводимости, энергия активации.

PACS 32.80.Rm; 05.45.+b;
УДК 539.184, 539.186

SENSING THE TOKAMAK PLASMA PARAMETERS BY MEANS HIGH RESOLUTION X-RAY THEORETICAL SPECTROSCOPY METHOD: NEW SCHEME

Yu. G. Chernyakova, V. M. Ignatenko and L. A. Vitavetskaya

Institute of Applied mathematics OSEU, P.O.Box 108, Odessa-9, 65009, Ukraine
Phone: +380-482-637227 E-mail: glushkov@paco.net

Abstract

SENSING THE TOKAMAK PLASMA PARAMETERS BY MEANS HIGH RESOLUTION X-RAY THEORETICAL SPECTROSCOPY METHOD: NEW SCHEME

Yu. G. Chernyakova, V. M. Ignatenko and L. A. Vitavetskaya

A new high resolution theoretical spectroscopy scheme is developed and used for sensing and diagnostics the tokamak plasma parameters. Some numerical illustrations regarding sensing the tokamak plasma parameters (electron temperature etc.) and calculation results for wavelengths atomic characteristics of satellite spectrum of the He-like ions from Ar^{16+} to Mn^{23} are presented and are in a good agreement with the tokamak de Fontenau-aux-Roses measurements..

Key words: tokamak plasma, parameters sensing, theoretical spectroscopy method

Анотація

ДЕТЕКТУВАННЯ ПАРАМЕТРІВ ПЛАЗМИ ТОКАМАКА НА ОСНОВІ МЕТОДУ ВИСОКО ВИРІШЕНОЇ РЕНТГЕНІВСЬКОЇ ТЕОРЕТИЧНОЇ СПЕКТРОСКОПІЇ: НОВА СХЕМА

Ю. Г. Чернякова, В. М. Ігнатенко, Л. А. Вітавецька

Запропонований новий метод високо вирішеної рентгенівської теоретичної спектроскопії для детектування та діагностики параметрів плазми токамака. Приведені чисельні илюстрації визначення параметрів плазми токамака (електронна температура тощо), а також результати розрахунку довжин хвиль і атомних характеристик сателітних спектрів для He-подібних іонів від Ar^{16+} до Mn^{23+} , які знаходяться у добрій згоді із даними вимірювань на токамаці de Fontenau-aux-Roses.

Ключові слова: плазма токамака, метод детектування, теоретична спектроскопія

Аннотация

ДЕТЕКТИРОВАНИЕ ПАРАМЕТРОВ ПЛАЗМЫ ТОКАМАКА НА ОСНОВЕ МЕТОДА ВЫСОКО РАЗРЕШАЕМОЙ РЕНТГЕНОВСКОЙ ТЕОРЕТИЧЕСКОЙ СПЕКТРОСКОПИИ: НОВАЯ СХЕМА

Ю. Г. Чернякова, В. М. Игнатенко, Л. А. Витавецкая

Предложена новый метод высоко разрешаемой рентгеновской теоретической спектроскопии для детектирования и диагностики параметров плазмы токамака. Приведены численные иллюстрации определения параметров плазмы токамака (электронная температура и т.д.), а также результаты расчета длин волн и атомных характеристик сателлитных спектров для He-подобных ионов от Ar^{16+} до Mn^{23+} , находящиеся в хорошем согласии с данными измерений на токамаке de Fontenau-aux-Roses.

Ключевые слова: плазма токамака, метод детектирования, теоретическая спектроскопия

УДК 621.317.7(088.7)

MICROPROCESSOR MEASURER WITH THERMORESISTIVE SENSOR

B. Mamikonyan, Kh. Mamikonyan

Gyumri Branch of State Engineering University of Armenia, M. Mkrtchyan st., 2,
Gyumri, 377503, Republic of Armenia. Tel: (37441) 3-68-32, fax: (37441) 3-15-28.
E-mail of authors: bomam@yandex.ru
mamikonyan@yandex.ru

Abstract

MICROPROCESSOR MEASURER WITH THERMORESISTIVE SENSOR

B. M. Mamikonyan, Kh. B. Mamikonyan

In paper it is described the microprocessor measurer of resistance increase of thermoresistive sensors (S), where the method of errors digital compensation (EDC) is applied, which have either linear and non-linear character. The measurer is assigned for technological process temperature measuring with application of platinum thermoresistor of Pt100 graduation. In main range from +30 to +50 ^{0}C the device provides the temperature measuring with error, not exceeding ± 0,1 ^{0}C.

Keywords: measuring, sensor, thermoresistor, signal, code, temperature, error.

Анотація

МІКРОПРОЦЕСОРНИЙ ВИМІРЮВАЧ З ТЕРМОРЕЗИСТИВНИМ СЕНСОРОМ

Б. М. Маміконян, Х. Б. Маміконян

У статті описаний мікропроцесорний вимірювач збільшення опору терморезистивних сенсорів, у якому використовується метод цифрової компенсації похибок, що мають як лінійний, так і нелінійний характер. Вимірювач призначений для виміру температури технологічного процесу з застосуванням платинового терморезистора градуювання Pt100. В основному діапазоні від +30 до +50 °С прилад забезпечує вимір температури з похибкою, що не перевищує ± 0,1 °С.

Ключові слова: вимір, сенсор, терморезистор, сигнал, код, температура, похибка.

Аннотация

МИКРОПРОЦЕССОРНЫЙ ИЗМЕРИТЕЛЬ С ТЕРМОРЕЗИСТИВНЫМ СЕНСОРОМ

Б. М. Мамиконян, Х. Б. Мамиконян

В статье описан микропроцессорный измеритель приращения сопротивления терморезистивных сенсоров, в котором используется метод цифровой компенсации погрешностей, имеющих как линейный, так и нелинейный характер. Измеритель предназначен для измерения температуры технологического процесса с применением платинового терморезистора градуировки Pt100. В основном диапазоне от +30 до +50 °С прибор обеспечивает измерение температуры с погрешностью, не превышающей ± 0,1 °С.

Ключевые слова: измерение, сенсор, терморезистор, сигнал, код, температура, погрешность.

УДК 621.317.39:531.767.

ВИХРЕТОКОВЫЙ СЕНСОР ТОЛЩИНЫ И СКОРОСТИ ДВИЖУЩЕЙСЯ ПРОВОДЯЩЕЙ НЕМАГНИТНОЙ ПОЛОСЫ

В. Б. Нерсисян

Государственный инженерный университет Армении.
Кафедра "Теоретические основы электротехники".
375009, г. Ереван, ул. Терана 105 тел: (3741) 521792
e-mail nvardges@freenet.am

Аннотация

ВИХРЕТОКОВЫЙ СЕНСОР ТОЛЩИНЫ И СКОРОСТИ ДВИЖУЩЕЙСЯ ПРОВОДЯЩЕЙ НЕМАГНИТНОЙ ПОЛОСЫ

В. Б. Нерсисян

Проведено исследование электромагнитных процессов в динамическом режиме в вихретоковом сенсоре. Приведена картина магнитных потоков. Определены трансформаторная ЭДС и ЭДС движения, а также токи, обусловленные этими ЭДС. Магнитная индукция и МДС этих токов определены с учетом линейной плотности токов. Разработана методика одновременного измерения скорости и толщины прокатки полосы.

Ключевые слова: динамический режим, магнитный поток, вихретоковый, трансформаторный.

Анотація

ВИХОРОСТРУМОВИЙ СЕНСОР ТОВЩИНИ І ШВИДКОСТІ ПРОВІДНОЇ НЕМАГНІТНОЇ СМУГИ, ЩО РУХАЄТЬСЯ

В. Б. Нерсісян

Проведено дослідження електромагнітних процесів у динамічному режимі у вихорострумовом сенсорі. Наводиться картина магнітних потоків. Визначено трансформаторна ЕРС і ЕРС руху, а також струми, обумовлені цими ЕРС. Магнітна індукція і МРС цих струмів визначені з урахуванням лінійної густини струмів. Розроблено методику одночасного виміру швидкості і товщини прокатки смуги.

Ключові слова: динамічний режим, магнітний потік, вихорострумовий, трансформаторний.

Summary

EDDY CURRENT SENSOR OF THICKNESS AND SPEED OF MOVED CONDUCTING UNMAGNETIZED BAND

V. B. Nersisyan

Electromagnetic processes are investigated in dynamic conditions on the eddy current sensor. The magnetic flux picture is given. E.m.f. and e.m.f motion transformation as well as current conditions by these e.m.f. are determined. Magnetic induction and e.m.f of these currents are determined in terms of linear current density. The technique of simultaneous of speed and band rolling thickness measurement is developed.

Key words: the dynamic mode, magnetic flux, eddy current, transformer.

ОПТИЧНІ, ОПТОЕЛЕКТРОННІ І РАДІАЦІЙНІ СЕНСОРИ

OPTICAL AND OPTOELECTRONIC AND RADIATION SENSORS

УДК 535.394
539.233

SURFACE PLASMON RESONANCE SPECTROSCOPY: POTENTIALITIES AND LIMITATIONS

V. I. Chegel, Yu. M. Shirshov

V. Lashkaryov Institute of Semiconductor Physics
of the National Academy of Sciences of Ukraine, 41 prospect Nauki, 03028 Kyiv, Ukraine
Tel./Fax: +(38-044) 265 18 27, +(380-44) 265 56 26; e-mail: che@isp.kiev.ua, shirshov@isp.kiev.ua

Summary

SURFACE PLASMON RESONANCE SPECTROSCOPY: POTENTIALITIES AND LIMITATIONS

V. I. Chegel, Yu. M. Shirshov

The review deals with (i) investigation of the physical processes of light interaction with multilayer film structures at the "TIR prism surface-medium under investigation" interface and (ii) development of a novel high-sensitivity optoelectronic sensor spectrometer for registration of biological reactions and real-time quantitative determination of medium dielectric characteristics and geometry. The spectrometer is developed on the basis of surface plasmon-polariton resonance in thin gold and silver films.

Keywords: surface plasmon resonance, optoelectronic sensor, biosensor, physical sensor, biomolecule, polarization.

Анотація

СПЕКТРОСКОПІЯ З ВИКОРИСТАННЯМ ПОВЕРХНЕВОГО ПЛАЗМОННОГО РЕЗОНАНСУ: МОЖЛИВОСТІ ТА ОБМЕЖЕННЯ

В. І. Чегель, Ю. М. Ширшов

Представлена оглядова робота присвячена дослідженню фізичних процесів взаємодії світла з багатошаровою плівковою структурою межі поділу: поверхня призми повного внутрішнього відбивання — досліджуване середовище та розробці нового високочутливого оптоелектронного сенсорного спектрометра для реєстрації біологічних реакцій та кількісного визначення діелектричних характеристик та геометрії середовища в реальному режимі часу. В основу розробки було покладене явище поверхневого плазмон-поляритонного резонансу в тонких плівках золота та срібла.

Ключові слова: поверхневий плазмонний резонанс, оптоелектронний сенсор, біосенсор, фізичний сенсор, біомолекула, поляризація.

Аннотация

СПЕКТРОСКОПИЯ С ИСПОЛЬЗОВАНИЕМ ПОВЕРХНОСТНОГО ПЛАЗМОННОГО РЕЗОНАНСА: ВОЗМОЖНОСТИ И ОГРАНИЧЕНИЯ

В. И. Чегель, Ю. М. Ширшов

Представленная обзорная работа посвящена исследованию физических процессов взаимодействия света с многослойной пленочной структурой на границе раздела: поверхность призмы полного внутреннего отражения — исследуемая среда и разработке нового высокочувствительного оптоэлектронного сенсорного спектрометра для регистрации биологических реакций и количественного определения диэлектрических характеристик и геометрии среды в реальном режиме времени. В основу разработки положено явление поверхностного плазмон-поляритонного резонанса в тонких пленках золота и серебра.

Ключевые слова: поверхностный плазмонный резонанс, оптоэлектронный сенсор, биосенсор, физический сенсор, биомолекула, поляризация.

PACS 32.80.Rm, 05.45.+b;
УДК 535.42.,539.184.

LASER PHOTOIONIZATION SENSOR OF THE SEPARATING ISOTOPES AND NUCLEAR REACTIONS PRODUCTS: THEORETICAL FOUNDATIONS OF NEW SCHEME

S. V. Ambrosov

Institute of Applied mathematics OSEU, P.O.Box 108, Odessa-9, 65009, Ukraine
Phone: +380-482-637227 E-mail: glushkov@paco.net

Summary

LASER PHOTOIONIZATION SENSOR OF THE SEPARATING ISOTOPES AND NUCLEAR REACTIONS PRODUCTS: THEORETICAL FOUNDATIONS OF NEW SCHEME

S. V. Ambrosov

It is proposed and studied a new optimal theoretical scheme for the laser photoionization sensor of the separating isotopes, nuclear isomers and nuclear reactions products, which is based on the selective laser excitation of the isotope atoms into excited Rydberg states and further stochastic collisional ionization mechanism. The operator perturbation theory and Focker-Plank stochastic equation method are used for description of stochastic collisional ionization process. The optimal laser action model and density matrices formalism is used for numeric calculation of the optimal scheme of the *Na, U, Cs* and *Cf* isotopes (ions, nuclei) sensing.

Key words: laser photoionization sensor, nuclear reaction products, isotoes

Анотація

ЛАЗЕРНИЙ ФОТОІОНІЗАЦІЙНИЙ СЕНСОР ІЗОТОПІВ ТА ПРОДУКТІВ ЯДЕРНИХ РЕАКЦІЙ: ТЕОРЕТИЧНІ ОСНОВИ НОВОЇ СХЕМИ

С. В. Амбросов

Вперше запропоновано лазерний фотоіонізаційний сенсор ізотопів, ядерних ізомерів та продуктів ядерних реакцій. В основі його реалізації лежить отимальна теоретична схема селективного лазерного збудження атомів ізотопів у рідбергівські стани та механізм подальшої стохастичної іонізації за рахунок зіткнень. Операторна теорія збурень та метод стохастичного рівняння Фоккера-Планка використано для опису процесу стохастичної іоні-зації за рахунок зіткнень. Модель оптимальних лазерних діянь і апарат матриці густини за-стосовано для чисельного моделювання оптимальної схеми детектування ізотопів *Na,U,Cs Cf*

Ключові слова: лазерний фотоіонізаційний сенсор, продукти ядерної реакції, ізотопи

Аннотация

ЛАЗЕРНЫЙ ФОТОИОНИЗАЦИОННЫЙ СЕНСОР ИЗОТОПОВ И ПРОДУКТОВ ЯДЕРНЫХ РЕАКЦИЙ: ТЕОРЕТИЧЕСКИЕ ОСНОВЫ НОВОЙ СХЕМЫ

С. В. Амбросов

Впервые предложен лазерный фото ионизационный сенсор изотопов, ядерных изомеров и продуктов ядерных реакций. В основе его реализации лежат оптимальная теоретическая схема селективного лазерного фото возбуждения атомов в ридберговские состояния и механизме дальнейшей стохастической столкновительной ионизации. Операторная теория возмущений и метод стохастических уравнений применены для описания процесса стохастической столкновительной ионизаци. Модель оптимальных лазерных воздействий и аппарат матрицы плотности использованы для численного моделирования оптимальной схемы детектирования изотопов *Na, U, Cs* и *Cf* .

Ключевые слова: лазерный фотоионизационный сенсор, продуктов ядерной реакции, изотопы

УДК 621.382.2

ПІДВИЩЕННЯ ЕФЕКТИВНОСТІ КРЕМНІЄВИХ ФОТОЕЛЕКТРИЧНИХ ПЕРЕТВОРЮВАЧІВ ЗА ДОПОМОГОЮ ТЕКСТУРУВАННЯ ЇХ ПОВЕРХНІ

С. В. Лєнков[1], Д. В. Лукомський[2], О. І. Ликов[3], В. В. Зубарєв[4]

[1]Д.т.н., проф., ВІТІ НТУУ "КПІ", м. Київ
[2]ВАТ "Квазар", м. Київ
[3]ІЕПБ, м. Київ
[4]К.т.н., Мінпромполітики України

Анотація

ПІДВИЩЕННЯ ЕФЕКТИВНОСТІ КРЕМНІЄВИХ ФОТОЕЛЕКТРИЧНИХ ПЕРЕТВОРЮВАЧІВ ЗА ДОПОМОГОЮ ТЕКСТУРУВАННЯ ЇХ ПОВЕРХНІ

С. В. Лєнков, Д. В. Лукомський, О. І. Ликов, В. В. Зубарєв

Наведені результати дослідження впливу текстурування поверхні на електрофізичні характеристики кремнієвих фотоелектричних перетворювачів (ФЕП). Отриманні результати можуть бути використані при розробці чи удосконаленні технології виробництва кремнієвих фотоперетворювачів для підвищення їх якості і надійності.

Ключові слова: надійність, кремнієві фотоелектричні перетворювачі, текстурування, піраміди, антивідбиваюче покриття

Аннотация

ПОВЫШЕНИЕ ЭФФЕКТИВНОСТИ КРЕМНИЕВЫХ ФОТОЭЛЕКТРИЧЕСКИХ ПРЕОБРАЗОВАТЕЛЕЙ С ПОМОЩЬЮ ТЕКСТУРИРОВАНИЯ ИХ ПОВЕРХНОСТИ

С. В. Ленков, Д. В. Лукомский, А. И. Лыков, В. В. Зубарев

Приведены результаты исследования влияния текстурирования поверхности на электрофизические характеристики кремниевых фотоэлектрических преобразователей (ФЭП). Полученные результаты могут быть использованы при разработке или усовершенствовании технологии производства кремниевых фотопреобразователей для повышения их качества и надежности.

Ключевые слова: надежность, кремниевые фотоэлектрические преобразователи, текстурирование, пирамиды, антиотражающее покрытие

Summary

INCREASE OF PERFORMANCE OF SILICON SOLAR CELLS THROUGH A TEXTURING OF THEIR SURFACE

S. V. Lenkov, D. V. Lukomskyy, A. I. Lykov, V. V. Zubarev

The experiment on definition of influence texturing of a surface on the characteristics of silicon solar cells is described. The obtained results can be utilised at development or refinement of the production technology of silicon cells for increase of their efficiency and reliability.

Keywords: reliability, silicon solar cell, surface texturing, pyramids, antireflective coating

УДК 53.082:612.017.1

БИОСЕНСОРЫ НА ОСНОВЕ ФОТОЛЮМИНЕСЦЕНЦИИ ПОРИСТОГО КРЕМНИЯ. ОБЩАЯ ХАРАКТЕРИСТИКА И ПРИМЕНЕНИЕ ДЛЯ МЕДИЦИНСКОЙ ДИАГНОСТИКИ

Н. Ф. Стародуб, В. М. Стародуб

Інститут биохимии им. А.В. Паладина НАН Украины,
ул. Леонтовича, 9, 01030, Киев-30, Украина, nstarodub@hotmail.com

Аннотация

БИОСЕНСОРЫ НА ОСНОВЕ ФОТОЛЮМИНЕСЦЕНЦИИ ПОРИСТОГО КРЕМНИЯ. ОБЩАЯ ХАРАКТЕРИСТИКА И ПРИМЕНЕНИЕ ДЛЯ МЕДИЦИНСКОЙ ДИАГНОСТИКИ

Н. Ф. Стародуб, В. М. Стародуб

Обсуждаются в суммированном виде экспериментальные результаты по исследованию структуры и свойств пористого кремния, а также относительно разработки на его основе оптических иммунных биосенсоров, предназначенных для медицинской диагностики.

Ключевые слова: пористый кремний, биосенсоры, медицинская диагностика.

Анотація

БІОСЕНСОРИ НА ОСНОВІ ФОТОЛЮМІНЕСЦЕНЦІЇ ПОРУВАТОГО КРЕМНІЮ. ЗАГАЛЬНА ХАРАКТЕРИСТИКА ТА ЗАСТОСУВАННЯ ДЛЯ МЕДИЧНОЇ ДІАГНОСТИКИ

М. Ф. Стародуб, В. М. Стародуб

Обговорюються в підсумованому вигляді експериментальні результати, щодо дослідження структури та властивостей поруватого кремнію та відносно розробки на його основі оптичних імунних біосенсорів для медичної діагностики.

Ключові слова: поруватий кремній, біосенсори, медична діагностика.

Summary

BIOSENSORS BASED ON THE PHOTOLUMINESCENCE OF POROUS SILICON. OVERALL CHARACTERISTICS AND APPLICATION FOR MEDICAL DIAGNOSTICS

N. F. Starodub, V. M. Starodub

It is summarized and discussed the experimental results about the investigation of structure and properties of porous silicon, as well as about the development on its base of optical immune biosensors intended for medical diagnostics.

Keywords: porous silicon, biosensors, medical diagnostics.

UDC 621.586:681.517:61

COMPUTER SIMULATION OF OPTOCHEMOTRONIC SENSOR RESPONSE IN DIFFERENT MODES OF ANALYSIS

N. V. Masolova

Kharkiv national university of radioelectronics,
61166, Kharkiv, Lenin ave. 14, KhNURE, BME chair.,
phone (057) 70-21-364, E-mail: rzh@kture.kharkov.ua

Summary

COMPUTER SIMULATION OF OPTOCHEMOTRONIC SENSOR RESPONSE IN DIFFERENT MODES OF ANALYSIS

N. V. Masolova

A mathematical model of optochemotronic (OC) sensor has been developed. The model describes the OC-sensor response to the analyte in two modes of analysis: batch and flow injection, processes in the volume of OC-sensor with the working electrode modified with Langmuir-Blodgett film. This research is dedicated to revelation of parameters and processes, that are vital for the creation of OC-sensor for analysis of different biological objects and its operation in different mode of analysis.

Keywords: OC-sensor, modelling, flow injection, batch,

Анотація

КОМП'ЮТЕРНЕ МОДЕЛЮВАННЯ РОБОТИ ОПТОХЕМОТРОНОГО (ОХ) СЕНСОРУ В РІЗНИХ РЕЖИМАХ АНАЛІЗУ

Н. В. Масолова

Була розроблена математична модель роботи оптохемотроного (ОХ) сенсору. Модель описує відгук ОХ-сенсору на присутність у ньому аналіту у двох режимах аналізу: проточної інжекції та дозатору, процеси, що протікають в об'ємі ОХ-сенсора з робочим електродом, модифікованим плівкою Лангмюр-Блоджетт. Дане дослідження присвячено визначенню параметрів та процесів, які є важливими для розробки ОХ-сенсора та його експлуатації в різних режимах аналізу.

Ключові слова: ОХ-сенсор, моделювання, проточна інжекція, дозатор

Аннотация

КОМПЬЮТЕРНОЕ МОДЕЛИРОВАНИЕ РАБОТЫ ОПТОХЕМОТРОННОГО (ОХ) СЕНСОРА В РАЗЛИЧНЫХ РЕЖИМАХ АНАЛИЗА

Н. В. Масолова

Была разработана математическая модель работы оптохемотронного (ОХ) сенсора. Модель описывает отклик ОХ-сенсора на присутствие в нем аналита в двух режимах анализа: проточной инжекции и дозатора, процессы, протекающие в объеме ОХ-сенсора с рабочим электродом модифицированным пленкой Лангмюр-Блоджетт. Данное исследование посвящено определению параметров и процессов, важных для создания ОХ-сенсора и его эксплуатации в различных режимах анализа.

Ключевые слова: ОХ-сенсор, моделирование, проточная инжекция, дозатор

PACS: 71.10-W, УДК 537.311.33

STRUCTURE CHANGES IN GaAs CHIPS DEFORMED BY PRESSING AT 300 K

D. Moskal', V. Nadtochiy, N. Golodenko

Slovyansk State Pedagogical University,
19, Gen. Batyuk St., 84116, Slovyansk, Donetsk reg., Ukraine
E-mail: slavgpi@slav.dn.ua

Summary

STRUCTURE CHANGES IN GaAs CHIPS DEFORMED BY PRESSING AT 300 K

D. Moskal', V. Nadtochiy, N. Golodenko

Structure changes around an impress of indenter on GaAs single crystals were investigated. Samples in the shape of rectangular parallelepipeds with the sizes $2.4\times3.1\times3.2$ mm^3 conterminous correspondingly to the crystallographic directions $[01\bar{1}]$, $[011]$ and $[100]$ were used. The impresses were being put on side surfaces $(01\bar{1})$ and $(0\bar{1}1)$ with loads on indenter 0.20 N. Then the sample was subjected to pressing along the direction $[100]$ (the greatest dimension) up to the stress $\sigma = 83$ MPa and was being maintained under the loading during 120 h at $T = 300$ K. After the removal of the loading two types of dislocations were revealed by chemical discriminating etching near the indenter impress. They were the prismatic loops, which have issued from the stress concentration area in the process of creeping, and dislocations sliding along the planes {111}. Running off of dislocations along the cleavage planes as a result of splitting off of the chip was observed.

Keywords: GaAs, mechanical pressure, deformation, relaxation, dislocations.

Анотація

СТРУКТУРНІ ЗМІНИ В КРИСТАЛАХ GaAs, ДЕФОРМОВАНИХ СТИСКАННЯМ ПРИ 300 К

Д. С. Москаль, В. О. Надточій, М. М. Голоденко

Досліджувалися структурні зміни навколо відбитка індентора на монокристалах GaAs. Використовувалися зразки у формі прямокутних паралелепіпедів розмірами 2,4×3,1×3,2 мм^3, що відповідають кристалографічним напрямкам $[01\bar{1}]$, $[011]$ і $[100]$. Відбитки наносилися на бічні поверхні $(01\bar{1})$ і $(0\bar{1}1)$ при навантаженнях на індентор 0,20 Н. Потім зразок піддавався стискові уздовж $[100]$ (більшого виміру) до напруження

$\sigma = 83$ Па і витримувався під навантаженням 120 годин при T = 300 К. Після зняття тиску хімічним вибірковим травленням виявлено два типи дислокацій поблизу відбитка індентора: призматичні петлі, що вийшли з області концентрації напруження шляхом переповзання, і дислокації, що ковзають по площинах {111}. Виявлено розбіг дислокацій по площинах спайності в результаті сколу кристала.

Ключові слова: GaAs, механічне стискання, деформація, релаксація, дислокації.

Аннотация

СТРУКТУРНЫЕ ИЗМЕНЕНИЯ В КРИСТАЛЛАХ GaAs, ДЕФОРМИРОВАННЫХ СЖАТИЕМ ПРИ 300 К

Д. С. Москаль, В. А. Надточий, Н. Н. Голоденко

Исследовались структурные изменения вокруг отпечатка индентора на монокристаллах GaAs. Использовались образцы в форме прямоугольных параллелепипедов размерами 2,4×3,1×3,2 мм^3, совпадающими соответственно с кристаллографическими направлениями $[01\bar{1}]$, $[011]$ и $[100]$. Отпечатки наносились на боковые поверхности $(01\bar{1})$ и $(0\bar{1}1)$ при нагрузках на индентор 0,20 Н. Затем образец подвергался сжатию вдоль $[100]$ (большего измерения) до напряжения $\sigma = 83$ Па и выдерживался под нагрузкой 120 часов при $T = 300$ К. После снятия давления, химическим избирательным травлением выявлено два типа дислокаций вблизи отпечатка индентора: призматические петли, вышедшие из области концентрации напряжений путем переползания, и дислокации, скользящие по плоскостям {111}. Обнаружен разбег дислокаций по плоскостям спайности в результате скалывания кристалла.

Ключевые слова: GaAs, механическое давление, деформация, релаксация, дислокации.

ОГЛЯД ПУБЛІКАЦІЙ ЖУРНАЛУ IEEE SENSORS JOURNAL

№1, №2 за 2004 рік
Volume: 4, Issue: 1, Year: Feb. 2004 (ISSN: 1530-437X)

Design and assembly of miniature zirconia oxygen sensors

Benammar M.
Dept. of Appl. Sci., Univ. of Qatar, Doha, Qatar;

On page(s): 3- 8

Abstract:
Zirconia oxygen sensors are highly selective solid-state devices used for many applications, including combustion control for better fuel economy and lower emissions. Stabilized zirconia electrolyte meets the device requirements of adequate ionic conductivity at elevated temperature, chemical stability, and suitable mechanical properties. The device is assembled such that one or two enclosed volumes are obtained. It may be operated in a number of modes: some require the internal volume to be sealed fully, and others necessitate the provision of a diffusion barrier, usually a small hole (30-100 μm in diameter), to connect the internal volume with the external sample gas. The design and fabrication of these devices must meet the practical requirements of their modes of operation. The choice of the dimensions of the sensor, its materials and their processing is critical in making a reliable device; these details are scarce in the literature. The paper gives a detailed description of the design and assembly of these sensors from pre-conditioned components.

CMOS monolithic metal-oxide sensor system comprising a microhotplate and associated circuitry

Graf M., Barrettino D., Zimmermann M., Hierlemann A., Baltes H., Hahn S., Вврsan N., Weimar U.
Phys. Electron. Lab., Swiss Fed. Inst. of Technol., Zurich, Switzerland;

On page(s): 9- 16

Abstract:
A gas sensor system fabricated in industrial CMOS technology is presented, which includes, for the first time, a microhotplate and the necessary driving and control circuitry on a single chip. Post-complementary-metal-oxide-semiconductor (CMOS) fabrication steps, such as micromachining of the membrane structure, the deposition of noble metal on the electrodes, and the processing of the sensitive metal-oxide layer, have been developed to be fully compatible with the industrial CMOS process. Temperatures up to 350 єC were reached on the hotplates using a low-voltage power supply (5 V). A symmetric hotplate design with a temperature homogeneity of better than 2% in the heated area was realized. The integrated temperature controller regulates the membrane temperature with a resolution of ±0.3 °C in the tracking mode. The temperature increase on the bulk chip owing to heat transfer through the membrane is less than 2% of the respective membrane operation temperature (6 °C at 350 °C membrane temperature). The gas sensing performance of the sensor was assessed by test measurements with carbon monoxide (CO). The gas tests evidenced a limit of detection of less than 5 ppm CO.

SnO_2 RGTO UV activation for CO monitoring

Comini E., Ottini L., Faglia G., Sberveglieri G.,
Gas Sensor Lab., INFM, Brescia, Italy;

On page(s): 17- 20

Abstract:
In this paper, we present recent results regarding the activation of sensors with high density power light of energy in the range of the energy gap of the semiconductor. We report the measurements registered for tin-oxide rheotaxial growth and thermal oxidation deposited layers using CO as a target gas. The influence of doping on the activated gas-sensing properties has been investigated. We have found the value of the incident power corresponding to the best gas-sensing performances (response enhancement and kinetics). The comparison between dark and irradiation condition is presented for the different kind of layers tested.

An optical-fiber sensor for use in water systems utilizing digital signal processing techniques and artificial neural network pattern recognition

King D., Lyons W.B., Flanagan C., Lewis E.,
Electr. & Comput. Eng. Dept., Univ. of Limerick, Ireland;

On page(s): 21- 27

Abstract:
An optical-fiber sensor is reported which is capable of detecting ethanol in water. A single optical-fiber sensor was incorporated into a 1-km length of 62.5-μm core diameter polymer-clad silica optical fiber. In order to maximize sensitivity, a U-bend configuration was used for the sensor where the cladding was removed and the core exposed directly to the fluid under test. The sensor was interrogated using optical time domain reflectrometry, as it is intended to extend this

work to multiple sensors on a single fiber. In this investigation, the sensor was exposed to air, water, and alcohol. The signal processing technique has been designed to optimize the neural network adopted in the existing sensor system. In this investigation, a discrete Fourier transform, using a fast Fourier transform algorithm, is chosen and its application leads to an improvement in efficiency of the neural network i.e., minimizing the computing resources. Using the Stuttgart neural network simulator, a feed-forward three-layer neural network was constructed with the number of input nodes corresponding to the number of points required to represent the sensor frequency domain response.

Energy extraction for a self-energized pressure sensor

Theurer C.B., Li Zhang, Kazmer D.O., Gao R.X.
Dept. of Mech. & Ind. Eng., Univ. of Massachusetts, Amherst, MA, USA;

On page(s): 28- 35

Abstract:
With the prolific use of sensors for manufacturing process monitoring, proper power supply and installation scheme has assumed an increasingly central role. Cable-based sensor powering, while commonly used on the factory floor, faces various real-world constraints. It is desirable that the power required by the sensors be "extracted" from the process being monitored itself to enable "self-energized" sensing. Such a novel design for a wireless pressure sensor for injection molding process monitoring is presented in this paper. The focus is on the energy extraction mechanism from the pressure transients exerted by the polymer melt during the injection molding process to power a piezoelectric signal transmitter, which digitally reconstructs the polymer melt pressure profile. An analytical model examining the energy conversion mechanism due to interactions between the mechanical strain and the electric field developed within the energy extraction device is first established. Using a coupled-field analysis, a numerical model is then developed to evaluate the electromechanical properties dependent upon the geometric effects of the energy extraction device. The two models are then compared with experimental results obtained from a functional prototype to evaluate the relevance of the assumptions made and the modeling accuracy. Preliminary experimental results describing the integration of the energy extraction device with the ultrasonic transmitter and the subsequent transmission of pressure information acoustically through a block of steel are also presented. The presented design introduces a new generation of self-energized sensors that can be employed for the condition monitoring of a wide range of high-energy manufacturing processes.

Range sensing with a Scheimpflug camera and a CMOS sensor/processor chip

Cilingiroglu U., Sicheng Chen, Cilingiroglu E.
Electr. Eng. Dept., Texas A&M Univ., College Station, TX, USA;

On page(s): 36- 44

Abstract:
An image-based range-sensing technique is presented. The technique is originally considered for highway collision avoidance applications, but its generality makes it suitable for application in robotics, manufacturing, and metrology, as well. It relies on depth from focus but, unlike conventional techniques, it extracts range with a single unmodulated Scheimpflug camera in continuous time. The range extraction algorithm is memoryless and simple enough to be implemented on the same chip with photosensors. The technique deploys a sensor plane that is tilted at a nonorthogonal angle with respect to the optical axis of the lens and the optical axis intersects the sensor plane at the focal point. This optical arrangement creates a focusable object plane in an orientation parallel to the optical axis and, thus, enables range sensing along the same axis. This paper elaborates on the details of focus sensing on the tilted sensor plane, describes the CMOS sensor/processor chip designed and prototyped for this application, and presents experimental results.

Improvement in sensitivity and selectivity of InP-based gas sensors: pseudo-Schottky diodes with palladium metallizations

Talazac L., Barbarin F., Mazet L., Varenne C.
LASMEA, Univ. of Clermont-Ferrand II, Aubiere, France;

On page(s): 45- 51

Abstract:
The possibility of using single resistive n-type InP semiconductor gas sensors to perform accurate measurements of ozone or nitrogen dioxide concentration in air comes up against their low sensitivity and the inability to discriminate between the influence of each gas on the sensors without any exterior apparatus. To improve these two fundamental aspects of gas sensors, the sensitive n-InP layers have been included in more complex devices, called pseudo-Schottky diodes. Made by successive evaporation of metallic thin layers on p-InP substrates, their Schottky metallization schemes (Pd/Ge/Pd) satisfy a double objective: the creation of the necessary n-InP gas sensitive layer by activation of Ge dopants and the ozone catalytic conversion by palladium layers. Comparisons between the sensing performances of the two gas sensors (resistive and Schottky diode-type ones) show that sensitivity of the

laters is largely higher than that of single resistive gas sensors. On the other hand, a good selectivity toward ozone is achieved with Pd/Ge/Pd/p-InP gas sensors, resulting from different reaction kinetics between O_3 or NO_2 and the sensitive layer. These differences can be attributed to the palladium metallization catalytic activity.

High-sensitivity sensor of low relative humidity based on overlay on side-polished fibers

Alvarez-Herrero A., Guerrero H., Levy D.
Laboratorio de Instrumentacion Espacial, Inst. Nacional de Tecnica Aerospacial, Madrid, Spain;

On page(s): 52- 56

Abstract:
A low relative humidity (RH) sensor based on overlay on side-polished fiber is presented. The evanescent field from a single-mode optical fiber is coupled to a TiO_2 waveguide overlay. The transmission response exhibits sharp resonances whose central wavelengths are linearly shifted with RH. This behavior is due to the porous columnar nanostructure of the TiO_2 film. The water is adsorbed in the pores of the nanostructure changing the refractive index of the layer and causing a shift of the wavelength resonances. The response of the sensor is determined by the shape and size of the pores. The optical fiber evanescent field sensor developed has a linear response and high sensitivity (0.5 nm/% RH) for low RH (RH~0%-15%) at 26.1 °C ± 0.6 °C. The lack of hysteresis in the adsorption-desorption cycle has been checked. The development of a sensor with tailored response is envisaged using properly techniques to control the porosity of the material.

Optimization of endoluminal loop radiofrequency coils for gastrointestinal wall MR imaging

Armenean M., Beuf O., Pilleul F., Saint-Jalmes H.
Lab. de RMN, Univ. Claude Bernard Lyon Lyon, Villeurbanne, France;

On page(s): 57- 64

Abstract:
In this paper, we describe the optimization of endoluminal planar coils for high-resolution magnetic resonance imaging of gastrointestinal walls. For maximizing the coil performances, electromagnetic parameters of planar rectangular radio frequency (RF) coils were simulated using the finite element method. The eddy currents were fully computed to determine the electromagnetic losses in both wires and surrounding environment. Geometric parameters of the coils (length, conductive layer section, number of layers, and turns number) were varied. Based on simulations, five loop RF coil prototypes with planar geometry were designed to fit in a 5-mm inner diameter catheter. In the immediate vicinity of single-loop coils, the signal-to-noise ratio (SNR) decreases with the length of the coil, whereas penetration depth increases with it. The double-loop coil offers a greater penetration depth in comparison to the same length single-loop coil. The multilayer coil preserves the RF field B_1 by inducing a reduction in the electrical resistance of the conductor, therefore resulting in an increase in SNR. Experimental verifications were performed on a 1.5 T clinical scanner. Simulation results were found to be in good agreement with that of MR experiments. Developed prototypes provided a dramatic increase in SNR at the region of interest.

Computational fluid dynamic model of diffusion and convection processes in electrochemical sensor

Barak-Shinar D., Rosenfeld M., Rishpon J., Neufeld T., Abboud S.
Biomed. Eng. Dept., Tel-Aviv Univ., Israel;

On page(s): 65- 71

Abstract:
Electrochemical amperometric transducers monitor the electric current through the electrochemical cell and measure, with high sensitivity, the concentration of biological or chemical species. The present study examined the physical phenomena of mass transfer in the vicinity of an electrochemical sensor operating in flow conditions using a theoretical model. A three-dimensional (3-D) geometry of the electrochemical cell with computational fluid dynamic simulations of time-dependent convection and diffusion are used. The study focused mainly on the contribution of the convection, while migration due to ion movement by the electric field and kinetics limitations due to enzyme activity have been neglected. The concentration of the electroactive species from a thin layer close to the electrode is calculated by numerical simulations. This calculated concentration has been compared with the concentration obtained from the electric current measured by an amperometric experimental system. Comparison between the simulations and experimental patterns shows good agreement. Only a short delay at the onset of the measured experimental concentration was observed, compared to the simulation data. The source for the small disagreements could be connected to the manual procedures of the incomplete bubble removal in the experimental setup and to the migration effect that was neglected in the model assumptions.

Characteristics of Pd/InGaP Schottky diodes hydrogen sensors

Kun-Wei Lin, Huey-Ing Chen, Hung-Ming Chuang, Chun-Yuan Chen, Chun-Tsen Lu, Chin-Chuan Cheng, Wen-Chau Liu
Dept. of Electr. Eng., Nat. Cheng-Kung Univ., Taiwain, Taiwan;

On page(s): 72- 79

Abstract:
Pd/InGaP hydrogen sensors based on the metal-oxide-semiconductor (MOS) and metal-semiconductor Schottky diodes have been fabricated and systematically studied. The effects of hydrogen adsorption on device performances such as the current-voltage characteristics, barrier height variation, hydrogen coverage, and heat of adsorption are investigated. The studied devices exhibit very wide hydrogen concentration detection regimes and remarkable hydrogen-sensing properties. Particularly, an extremely low hydrogen concentration of 15 ppm H_2/air at room temperature can be detected. In addition, under the presence of oxide layers in the studied MOS device structure, the enhancements of barrier height and high-temperature operating capability are observed. The initial heat of adsorption for Pd/oxide and Pd/semiconductor interface are calculated as 355 and 65.9 meV/atom, respectively. Furthermore, the considerably short response times are found in studied devices.

Dynamic characteristics of vibratory gyroscopes

Feng Z.C., Gore K.
Dept. of Mech. & Aerosp. Eng., Univ. of Missouri-Columbia, Columbia, MO, USA;

On page(s): 80- 84

Abstract:
Although there have been test results on microgyroscope dynamic characteristics, quantitative results relating the dynamic properties to microgyro design and operating parameters are not yet available. In this paper, we study the dynamic characteristics of a vibrating wheel microgyroscope. In vibratory microgyroscopes, the mechanical structure is driven into oscillatory motion. Consequently, the angular velocity input to the sensor is multiplied by the periodic driven motion. In order to recover the angular velocity input from the sensor responses, a demodulation must by carried out. Therefore, the differential equation governing the gyro input and output is not time invariant. The frequency response for the time-variant linear system is obtained through the demodulated and low-pass filtered steady-state output to sinusoidal excitations. With further assumptions of large Q value and close frequency match between the driven mode and sense mode, we obtain a time invariant model for the microgyroscope which is much simpler to use in the design of the microgyroscopes.

Location information-aided task-oriented self-organization of ad-hoc sensor systems

Premaratne K., Jinsong Zhang, Dogruel M.
Dept. of Electr. & Comput. Eng., Univ. of Miami, Coral Gables, FL, USA;

On page(s): 85- 95

Abstract:
A novel task-oriented self-organization algorithm that accounts for mostly location-dependent tasks and heterogeneous sensors inherent in dense ad-hoc sensor systems is proposed. It forms a sensor group for an announced task by sequentially selecting the best matched sensors using a leader election algorithm and a residual task calculation algorithm. To improve the associated communication overhead, the sensor node location information is used in task broadcasting, thus confining the algorithm implementation to a dynamically maintained *contributor group* which comprises of those sensors which may contribute to the task. Sensor localization is based on a refinement of an algorithm in [1] which utilizes only the neighborhood information of each sensor node corresponding to its each preset radio transmission power level. The proposed self-organization algorithm and how various system parameters affect its performance are examined via extensive simulations. In a densely deployed sensor system, when the refined localization scheme is demonstrated to achieve very good localization, the proposed self-organization algorithm consistently yields a sensor group that covers the announced task.

A novel resolver-to-360° linearized converter

Benammar M., Ben-Brahim L., Alhamadi M.A.
Qatar Coll. of Technol., Univ. of Qatar, Doha, Qatar;

On page(s): 96- 101

Abstract:
A novel and simple resolver-to-dc converter is presented. It is shown that by appropriate processing of the sine and cosine resolver signals, the proposed converter may produce an output voltage proportional to the shaft angle. A dedicated compensation method is applied to produce an almost perfectly linear output. This enables determination of the angle with reasonable accuracy without a processor and/or a look-up table. The tests carried out under various operating conditions are satisfactory and in good agreement with

theory. This paper gives the theoretical analysis, the computer simulation, the full circuit details, and experimental results of the proposed scheme.

Tri-axial sensors and actuators made of a single piezoelectric cylindrical shell

Wakatsuki N., Kagawa Y., Haba M.
Dept. of Electron. & Inf. Syst., Akita Prefectural Univ., Japan;

On page(s): 102- 107

Abstract:
Electromechanical transducers for sensing and actuating disturbances or vibrations have been used in many fields of applications. There have been transducers of different configuration developed for the unidirectional transduction. This paper demonstrates a single element transducer for tri-axial components made of a piezoelectric cylindrical shell. The separation of the tri-axial transductions is achieved by devising a proper electrode arrangement. The structure and the fundamental idea are first presented, and then the numerical analysis by means of the finite element modeling follows, and their characteristics and behaviors are then experimentally verified.

Fundamental noise limit of piezoelectric accelerometer

Levinzon F.A.
Endevco Corp., San Juan Capistrano, CA, USA;

On page(s): 108- 111

Abstract:
Since significant progress is achieved in the development of piezoelectric (PE) accelerometers for small signal applications nowadays (for example, piezoelectric seismic vibration sensors), the question about the fundamental noise limit of these sensors becomes vital. The noise of the PE transducer is the fundamental noise limit of the PE accelerometer and should be taken into account if the noise of the electronics is small enough. The two noise sources of PE transducer, the mechanical-thermal noise of the damped mechanical harmonic oscillator and the electrical-thermal noise of the PE element's material, are analyzed in this paper. The equation of the total fundamental noise limit of the PE accelerometer is presented. This equation can be used for the calculation of the fundamental noise limit of PE accelerometers if their parameters are known or can be obtained by measurement.

Microbolometers on a flexible substrate for infrared detection

Yildiz A., Celik-Butler Z., Butler D.P.
Dept. of Electr. Eng., Southern Methodist Univ., Dallas, TX, USA;

On page(s): 112- 117

Abstract:
Uncooled semiconducting YBaCuO infrared microbolometers have been fabricated on a flexible polyimide substrate formed by spin-coating a silicon wafer with a release layer. The wafer was used as a carrier for the flexible substrate during fabrication. The finished microbolometers on the flexible substrate showed a temperature coefficient of resistance (TCR) TCR = $=(1/R)(dR/dT)$ of –3.03% K^{-1}, at room temperature, which is comparable to the TCR values observed for semiconducting YBaCuO microbolometers fabricated directly on Si. In order to provide protection and better mechanical integrity, some of the devices were encapsulated. The microbolometers attained a responsivity and detectivity as high as $3.5 \cdot 10^3$ V/W and $1 \cdot 10^7$ cm·$Hz^{1/2}$/W, respectively, at 2.88 μA of current bias. The responsivity and detectivity of the encapsulated microbolometers, on the other hand, were $1.6 \cdot 10^3$ V/W and $4.9 \cdot 10^6$ cm·$Hz^{1/2}$/W, respectively at 1 μA of current bias. Spin-coated liquid polyimide solved two major problems previously encountered with the solid polyimide sheets when used as a flexible substrate. First, flatness of the flexible substrate was maintained with no air bubbles. Second, the thermal expansion of the flexible substrate during the fabrication process due to thermal cycling was minimal. All measurements reported in this paper, were taken prior to releasing the flexible substrate from the Si wafer containing the finished microbolometers.

Sensors for harsh environments by direct-write thermal spray

Longtin J., Sampath S., Tankiewicz S.,
Gambino R.J., Greenlaw R.J.
Center for Thermal Spray Res., State Univ. of New York, Stony Brook, NY, USA;

On page(s): 118- 121

Abstract:
High-temperature thermocouple sensors for harsh environments have been fabricated using thermal spray technology with excellent performance demonstrated. Concepts for strain sensors fabricated with thermal spray technology are also being developed. This work

reports on functional high-temperature thermocouples and strain gauge concepts fabricated using thermal spray processing.

A novel logarithmic response CMOS image sensor with high output voltage swing and in-pixel fixed-pattern noise reduction

Liang-Wei Lai, Cheng-Hsiao Lai, Ya-Chin King
Dept. of Electr. Eng., Nat. Tsing-Hua Univ., Taiwan, Taiwan;

On page(s): 122- 126

Abstract:
A novel logarithmic response CMOS image sensor fabricated by 0.25 μm CMOS logic process is proposed. The new cell has an output voltage swing of 1 V in the targeted illumination range, which makes it less susceptible to noises in the readout system. Furthermore, the proposed new cell with in-pixel CDS control drastically reduces the fixed pattern noise in logarithmic mode CMOS APS. Comparing with a conventional pixel, a reduction of 10 times in fixed-pattern noise is demonstrated in the new logarithmic response CMOS image sensor.

Incorporation of fiber-optic sensors in concrete specimens: testing and evaluation

Wade S.A., Grattan K.T.V., McKinley B., Boswell L.F., D'Mello C.
Opt. Technol. Res. Lab., Victoria Univ., Melbourne, Vic., Australia;

On page(s): 127- 134

Abstract:
As series of tests has been carried out on the performance of several fiber-optic temperature sensors, operating on the fluorescence lifetime principle using neodymium-doped fiber and configured into ruggedized temperature probes, mounted in a number of different concrete samples. The aim has been to evaluate the performance of probes fitted into concrete specimens to simulate the conditions experienced in structures used in civil applications, such as bridges and dams. A key feature of the investigation was observing the integrity of the sensors under investigation while obtaining temperature data from the device. The results show the sensors operated well from below room temperature to beyond 300 °C, preserving their integrity under adverse test conditions.

Design, optimization, and performance analysis of new photodiode structures for CMOS active-pixel-sensor (APS) imager applications

Chung-Yu Wu, Yu-Chuan Shih, Jeng-Feng Lan, Chih-Cheng Hsieh, Chien-Chang Huang, Jr-Houng Lu
Dept. of Electron. Eng., Nat. Chiao-Tung Univ., Taiwan, Taiwan;

On page(s): 135- 144

Abstract:
The dark current in the active-pixel-sensor (APS) cell of a CMOS imager is known to be mainly generated in the regions of bird's beak after the local oxidation of silicon process as well as the surface damage caused by the implantation of high doping concentration. Furthermore, shallow and deep pn-junctions can improve the photo-sensitivity for light of short and long wavelengths, respectively. In this paper, two new photodiode structures using p-substrate and lightly-doped sensor implant SN- as pn-junction photodiode with the regions of bird's beak embraced by SN- and p-field implants, respectively, are proposed and analyzed to reduce dark current and enhance the overall spectral response. 5 *м*mЧ5 *м*m APS cells fabricated in a 0.35-μm single-poly-triple-metal (1P3M) 3.3-V CMOS process are designed by using the proposed photodiode structures. As shown from the experimental results, the two proposed photodiode structures of 5 μm·5 μm APS cells have lower dark currents of 30.6 mV/s and 35.2 mV/s at the reverse-biased voltage of 2 V and higher spectral response, as compared to the conventional structure and other photodiode structures. Thus, the two proposed new photodiode structures can be applied to CMOS imager systems with small pixel size, high resolution, and high quality.

A CMOS smart pixel for active 3-D vision applications

Viarani L., Stoppa D., Gonzo L., Gottardi M., Simoni A.
Integrated Opt. Sensors Group, Trento, Italy;

On page(s): 145- 152

Abstract:
A CMOS smart pixel aimed at three-dimensional vision applications is introduced. It is suitable for scannerless laser ranging systems which employ the indirect time-of-flight measuring technique to recover distance information. The pixel is operated with trains of light pulses generated by an external source to illuminate the scene and contains most of the processing electronics to perform signal accumulation and noise reduction operations. The smart pixel architecture includes an N-well photodiode plus a self-biasing voltage amplifier and a switched-capacitor fully differential stage.

The pixel is fabricated in standard CMOS 0.6 μm technology and measures 180·160 μm^2 (including the photodiode) with a fill factor of 14%. Electrooptical test results confirm the smart pixel functionality in a range of distance from 3 m to 9 m, and the accuracy achieved for preliminary distance measurements is 15 cm. Both the accuracy and the extension of the range of distance are supposed to be improved by reducing setup and environmental noise contributions that limit the pixel performance.

Addressing multiple indicators on a single optical fiber-digital signal processing approach for temperature compensated oxygen sensing

Stehning C., Holst G.A.
Max Planck Insitute for Marine Microbiol., Bremen, Germany;

On page(s): 153- 159

Abstract:
A digital signal processing approach for hybrid fiberoptical microoptodes based on the measurement of the luminescence lifetime of appropriate indicators is presented. Numerical algorithms are applied to resolve individual decay times in a heterogeneous luminescence emission to enable the application of optodes with multiple indicators combined on a single fiber tip. We applied a hybrid optode that senses the oxygen concentration in line with the temperature, and used the latter information to compensate for the temperature drift of the oxygen measurement. We used a blue light-emitting diode to generate the excitation signal, and a standard photodiode with integrated pre-amplifier stage to detect the luminescence signal. Both signals were sampled using a stereo audio codec, and the further signal processing routines were entirely implemented on a commercially available digital signal processing evaluation board.

Improvement of the *μ*-Hall magnetic sensor sensitivity at low frequency

Qasimi A., Dolabdjian C., Bloyet D., Mosser V.
Caen Univ., France;

On page(s): 160- 166

Abstract:
We have developed a configuration for precision magnetic measurements associating a μ-Hall sensor, a modulated ferromagnetic antenna, and an analog electronic circuitry. This association is not only able to remove the 1/f noise of the Hall sensor, but also to achieve an ultimate noise level even lower than thermal white noise of the Hall sensor. The system main characteristics are the following: bandwidth 645 Hz, noise level white and lower than 10 nT/vHz above 0.1 Hz, slew rate 10^{-1} T/s and system dynamic 84 dB in a 1-Hz bandwidth. The performances of the modulated sensor are compared to those of a dc operated sensor.

Volume: 4, Issue: 2, Year: April 2004 (ISSN: 1530-437X)

Electrode coating with ultrathin films containing electroactive molecules for biosensor applications

Mecheri B., Piras L., Ciotti L., Caminati G.
Chem. Dept., Univ. of Florence, Italy;

On page(s): 171- 179

Abstract:
Redox molecules, i.e., ferrocene (Fc), ferrocene carboxylic acid (Fc-COOH), and 3-3', 5-5'-tetramethylbenzidine (TMB), are good mediators for typical coenzymes of several dehydrogenases. Such mediators were immobilized in monolayers of dipalmitoylphosphatidic acid (DPPA) by means of the cospreading technique at the water-air interface. TMB was found to interact more strongly than Fc and Fc-COOH with the DPPA matrix; moreover, we observed that DPPA/TMB monolayers could be transferred on different solid supports with the Langmuir-Blodgett (LB) technique. LB films, containing TMB immobilized by means of cospreading and incubation procedure, were characterized recording UV-Vis absorption spectra. Such investigation evidenced the presence of TMB with different oxidation states. Hybrid films containing the mediators were prepared combining two techniques: LB and self-assembly of octadecylmercaptane and octylmercaptane on gold. The resulting structures were characterized by means of ellipsometry and contact angle measurements. Information on the influence of the multilayer structure on the electrode currents and on the redox activity of the immobilized mediators was obtained by cyclic voltammetry. A significant electrochemical signal was observed for TMB included in LB films. The sets of results independently evidenced that TMB can be quantitatively embedded in the ultrathin films of a lipid matrix maintaining its electroactive behavior.

Chemical sensing systems using xerogel-based sensor elements and CMOS photodetectors

Davenport M., Titus A.H., Tehan E.C., Zunyu Tao, Ying Tang, Bukowski R.M., Bright F.V.,
State Univ. of New York, Amherst, NY, USA;

On page(s): 180- 188

Abstract:
We present the first example of an integrated complementary metal-oxide-semiconductor (CMOS) photodetector coupled with a solid-state xerogel-based thin-film sensor to produce a compact chemical sensor system. We compare results using two different CMOS-based detector systems to results obtained by using a standard photomultiplier tube (PMT) or charge-coupled device (CCD) detector. Because the chemical sensor elements are governed by a Stern-Volmer relationship, the Stern-Volmer quenching constant is used as the primary comparator between the different detectors. All of the systems yielded Stern-Volmer constants from 0.042 to 0.049 $O_2\%^{-1}$. The results show that the CMOS detector system yields analytical data that are comparable to the CCD- and PMT-based systems. The disparity between the data obtained from each detector is primarily associated with the difference in how the signals are obtained by each detector as they presently exist. We have also observed satisfactory reversibility in the operation of the sensor system. The CMOS-based system exhibits a response time that is faster than the chemical sensor element's intrinsic response time, making the CMOS suitable for time-dependent measurements. The CMOS array detector also uses less than 0.1% the power in comparison to a standard PMT or CCD. The combined xerogel/CMOS system represents an important step toward the development of a portable, efficient sensor system.

Iridium oxide as low temperature NO_2-sensitive material for work function-based gas sensors

Karthigeyan A., Gupta R.P., Scharnagl K., Burgmair M., Zimmer M., Sulima T., Venkataraj S., Sharma S.K., Eisele I.
Fac. of Electr. Eng., Univ. der Bundeswehr, Neubiberg, Germany;

On page(s): 189- 194

Abstract:
This paper presents the results on work function-based NO_2-sensing properties of iridium-oxide thin films at 130 °C. Films of 20-nm and 100-nm thickness were deposited on silicon substrates using dc sputtering followed by annealing in oxygen ambient. Sensitivity of these films to different concentrations of NO_2, H_2, CO, Cl_2, and NH_3 in synthetic air was measured using a Kelvin probe. It was observed that work function of 20-nm-thick iridium-oxide film changed by ~100 mV on exposure to 5-ppm NO_2 (German safety limit). Cross sensitivity to other gases (except NH_3) and interference of humidity was found to be negligibly small. The film was incorporated as a gate electrode in a hybrid suspended gate field effect transistor (HSGFET) structure to examine its suitability in FET-type sensors. The films were characterized using Rutherford backscattering spectroscopy, X-ray diffraction analysis, and scanning electron microscopy to determine their composition, phase, and surface morphology. The results suggest that iridium-oxide film is a promising material for the realization of a FET-based NO_2 sensor.

A glass/silicon technology for low-power robust gas sensors

Plaza J.A., Lopez-Bosque M.J., Gracia I., Cane C., Wollenstein J., Kuhner G., Plescher G., Bottner H.,
Centro Nacional de Microelectron., Univ. Autonoma de Barcelona, Spain;

On page(s): 195- 206

Abstract:
Semiconductor gas sensors are devices based on metallic oxides that operate at high temperatures for achieving good sensitivities to the gases of interest. Silicon micromachined structures are often used as platforms for obtaining both high temperatures and low-power consumption at the same time. In this paper, a microstructure based on the combination of micromachined silicon substrates and glass wafers is presented. The device incorporates an array of four different thin-film gas sensors that, depending on the design, can operate at the same or at different temperatures. The designs have been optimized by the finite element method (FEM) and the geometrical parameters of the structure have been selected in order to reduce the power consumption. The full process fabrication is presented. It is based on the combination of bulk micromachining, glass structuring, anodic bonding, and sensitive material deposition. Electrical, thermal, and mechanical tests have been done to demonstrate that the devices show high robustness and can reach high temperatures with low-power consumption.

A method of suppressing self-heating signal of bolometers

Neuzil P., Ting Mei
Inst. of Microelectron., Singapore;

On page(s): 207- 210

Abstract:
A scheme of full self-heating compensation for the bolometer-based infrared (IR) sensors was proposed. In-

frared-sensitive and infrared-insensitive bolometers with nearly identical self-heating characteristics were connected in parallel in a Wheatstone bridge to suppress the common mode. The time-dependent component of the output signal due to the self-heating effect was substantially limited. The effectiveness of the scheme was demonstrated by testing of micromachined bolometers. The output signals from the bridge were fed into a differential amplifier and the self-heating component of the output signal dropped from 34 to 1.5 mV. The signal was then dominated by the IR radiation response. The proposed scheme enabled signal integration time to increase for the purpose of signal-to-noise ratio improvement.

High-sensitivity accelerometer based on cold emission principle

Shashkin V.I., Vostokov N.V., Vopilkin E.A., Klimov A.Yu., Volgunov D.G., Rogov V.V., Lazarev S.G.
Inst. for Phys. of Microstructures, Russia Acad. of Sci., Nizhny Novgorod, Russia;

On page(s): 211- 215

Abstract:
A possibility for fabrication of a high-sensitivity accelerometer is considered. The linear acceleration of a sensor causes displacement of the proof mass electrode. The displacement detector is based on a strong dependence of the tunneling or cold emission current on the gap between the electrodes. The geometry of the electrodes that provides the best sensitivity is determined. The accelerometer with tunneling-emission electrodes is fabricated. At frequencies up to 5 kHz the resolution reaches 10^{-4} g/Hz$^{1/2}$ in the tunneling mode and 10^{-3} g/Hz$^{1/2}$ in the emission mode.

Experimental study of Love wave sensor response by phase and group velocity measurement

Martin F., McHale G., Newton M.I.
Sch. of Sci., Nottingham Trent Univ., UK;

On page(s): 216- 220

Abstract:
The effect of dispersion on acoustic wave sensors is considered experimentally. A recent theoretical prediction that the phase velocity mass sensitivity of guided shear horizontal surface acoustic wave devices can be obtained using measurements of phase and group velocity, and that the group velocity is highly sensitive to mass loading, is investigated. Experimental data for a polymer-coated surface-skimming bulk wave device on an ST quartz substrate is presented. Measurements of phase velocity, group velocity, and insertion loss determined by a network analyzer were obtained by systematically increasing the guiding layer thickness. Liquid sensing using poly (ethylene glycol) solutions with increasing densities were performed and phase and group velocities measured. The increase in mass sensitivity with the guiding layer thickness is significant and the data confirms the theoretical prediction that group velocity is a more sensitive parameter than the phase velocity to liquid loading.

High temperature circular position sensor based on a giant magnetoresistance nanogranular Ag/sub x/Co/ sub 1-x/ alloy

Arana S., Castano E., Gracia F.J.,
Centro de Estudios e Investigaciones Tecnicas de Gipuzkoa, San Sebastian, Spain;

On page(s): 221- 225

Abstract:
A new circular position sensor based on giant magnetoresistances has been developed. The sensing film is an AgCo nanogranular thin film patterned in a circular Wheatstone bridge configuration. This alloy shows a high magnetoresistance (8%) at room temperature within the field generated by an NdFeB permanent magnet that provides a sensitivity of 440 μV/V/(°). The operational temperature range of this sensor is –40 °C/+120 °C, although the magnetic film tolerates higher temperatures up to 200 °C. These parameters and the contactless way of sensing make this device appropriate for automotive applications. The developed sensor presents excellent characteristics for life, since it is not sensitive to pollution; it is frictionless and does not present any type of electrical noise generated by contacts.

Magnetic-to-digital converters using single-amplifier-based second-order delta-sigma modulators

Chien-Hung Kuo, Shr-Lung Chen, Shen-Iuan Liu
Dept. of Electr. Eng., Tamkang Univ., Taipei, Taiwan;

On page(s): 226- 231

Abstract:
In this paper, two magnetic-to-digital converters (MDCs) using single-amplifier-based second-order delta-sigma modulators (DSMs) are presented to detect the dc magnetic field. The proposed second-order DSM required only a single-operational amplifier to achieve the second-order noise shaping. Both the proposed circuits have been fabricated in a 0.5-μm CMOS DPDM process, and the resolution of 11 bits can be

achieved. The measured sensitivities are 1.486 and 0.459 mV/mT, and the minimum detectable magnetic fields are 0.6 mT and 0.4 mT for the MDC with and without the pre-amplifier, respectively. Both the measured nonlinearities are smaller than 1.3% within the range of ± 100 mT.

Optical and electrical H_2- and NO_2-sensing properties of Au/$In_xO_yN_z$ films

Ando M., Steffes H., Chabicovsky R., Haruta M., Stangl G.
Photonics Res. Inst., Japanese Nat. Inst. of Adv. Ind. Sci. & Technol., Ikeda, Japan;

On page(s): 232- 236

Abstract:
In this paper, we describe the optical and electrical gas-sensing properties of $In_xO_yN_z$ films with an ultrathin gold promoter overlayer. We have fabricated $In_xO_yN_z$ films with a nanocrystalline porous structure by RF-sputtering in Ar/N_2 followed by an annealing process. Gold particles with 20-30-nm diameter have been formed on top of the $In_xO_yN_z$ films by dc sputtering and an annealing process. We have investigated the optical H_2- and NO_2-sensing properties (change of absorbance) and also the electrical sensing effect (change of electrical resistance) for these two gases. A combined optical/electrical sensor for H_2/NO_2 is proposed.

A ray-tracing approach for simulating recognition abilities of active infrared sensor arrays

Iske B., Jager B., Ruckert U.,
Heinz Nixdorf Inst., Univ. of Paderborn, Germany;

On page(s): 237- 247

Abstract:
The construction and setup of sensors or sensor arrays determines their maximum resolution and recognition abilities. Therefore, the analysis of certain setups is an important and mandatory task during the design process of a new sensor system. This paper deals with the simulation and evaluation of the recognition abilities of active infrared sensors for autonomous systems. Additionally, the simulation method as well as the results provide useful information for other applications, where infrared sensors are used. The simulation method is based on a Monte Carlo algorithm, which uses ray tracing to calculate the impulse response of the optical channel consisting of the sending and receiving components and the environment. In order to allow a fast simulation of several configurations, an efficient and flexible computation is realized. This means that all rays contribute maximally to the final result, and different sensor characteristics can easily be calculated. Extensive experiments are carried out, and the results show different evaluation options.

Adaptive K-NN for the detection of air pollutants with a sensor array

Roncaglia A., Elmi I., Dori L., Rudan M.
Inst. of Microelectron. & Microsystems, Italian Nat. Res. Council, Bologna, Italy;

On page(s): 248- 256

Abstract:
The field of air-quality monitoring is gaining increasing interest, with regard to both indoor environment and air-pollution control in open space. This work introduces a pattern recognition technique based on adaptive K-nn applied to a multisensor system, optimized for the recognition of some relevant tracers for air pollution in outdoor environment, namely benzene, toluene, and xylene (BTX), NO_2, and CO. The pattern-recognition technique employed aims at recognizing the target gases within an air sample of unknown composition and at estimating their concentrations. It is based on PCA and K-nn classification with an adaptive vote technique based on the gas concentrations of the training samples associated to the K-neighbors. The system is tested in a controlled environment composed of synthetic air with a fixed humidity rate (30%) at concentrations in the ppm range for BTX and NO_2, in the range of 10 ppm for CO. The pattern recognition technique is experimented on a knowledge base composed of a limited number of samples (130), with the adoption of a leave-one-out procedure in order to estimate the classification probability. In these conditions, the system demonstrates the capability to recognize the presence of the target gases in controlled conditions with a high hit-rate. Moreover, the concentrations of the individual components of the test samples are successfully estimated for BTX and NO_2 in more than 80% of the considered cases, while a lower hit-rate (69%) is reached for CO.

Analog sensor design proposal for laser Doppler velocimetry

Le Duff A., Plantier G., Valiere J.-C., Bosch T.
Ecole Superieure d' Electronique de l'Ouest, Angers, France;

On page(s): 257- 261

Abstract:
Laser Doppler velocimetry (LDV) has been widely used for many years in fluid mechanics to measure particle velocity. However, in most applications, i.e., in in-

dustrial processes, such a system is often too expensive. This paper discusses a technique based on the use of an analog phase-locked loop and an analog integrator system for processing laser Doppler velocimeter data to infer particle velocity. This method appears to be suitable for designing low-cost integrated LDV sensors. A SIMULINK program has been written in order to validate the method for velocities in the 10-80 mm/s range. Finally, the performance of the estimator is illustrated by Monte-Carlo simulations obtained from synthesized Doppler signal.

Smart adaptable strain gage conditioner: hardware/ software implementation

Poussier S., Rabah H., Weber S.
Lab. d'Instrum. Electronque de Nancy, Univ. of Nancy, Vandoeuvre, France;

On page(s): 262- 267

Abstract:
In this paper, a smart adaptable strain gage conditioning system is presented. The system is based on analog and digital processing to meet particularly adaptability, flexibility, and complex computations required in calibration and compensation algorithms of apparent strain in strain gage. Analog processing, with adequate amplification and filtering, is used to adjust the strain gage and temperature signals to the full scale of the converters. The flexibility of the digital processing is used to compute automatic calibration and temperature compensations when strain gage and spring element characteristics are known or not. This new architecture, consisting of hardware and software functionality, is implemented on an FPGA including a core processor. Description of the methodology developed for the temperature compensation of the system, the architecture implementation results, and adaptation of the system are reported.

A reliable gyroscope-based gait-phase detection sensor embedded in a shoe insole

Pappas I.P.I., Keller T., Mangold S., Popovic M.R., Dietz V., Morari M.
Autom. Control Lab., Swiss Fed. Inst. of Technol. Zurich, Switzerland;

On page(s): 268- 274

Abstract:
This paper presents results of patient experiments using a new gait-phase detection sensor (GPDS) together with a programmable functional electrical stimulation (FES) system for subjects with a dropped-foot walking dysfunction. The GPDS (sensors and processing unit) is entirely embedded in a shoe insole and detects in real time four phases (events) during the gait cycle: stance, heel off, swing, and heel strike. The instrumented GPDS insole consists of a miniature gyroscope that measures the angular velocity of the foot and three force sensitive resistors that measure the force load on the shoe insole at the heel and the metatarsal bones. The extracted gait-phase signal is transmitted from the embedded microcontroller to the electrical stimulator and used in a finite state control scheme to time the electrical stimulation sequences. The electrical stimulations induce muscle contractions in the paralyzed muscles leading to a more physiological motion of the affected leg. The experimental results of the quantitative motion analysis during walking of the affected and nonaffected sides showed that the use of the combined insole and FES system led to a significant improvement in the gait-kinematics of the affected leg. This combined sensor and stimulation system has the potential to serve as a walking aid for rehabilitation training or permanent use in a wide range of gait disabilities after brain stroke, spinal-cord injury, or neurological diseases.

Здано у виробництво 30.08.2004. Підписано до друку 29.09.2004. Формат 60x84/8.
Папір офсетний. Гарнітура "Таймс". Друк офсетний.
Ум. друк. арк. 12,09. Тираж 300 прим. Зам. № 674.

Надруковано у друкарні видавництва "Астропринт"
(Свідоцтво ДК №1373 від 28.05.2003 р.)
65026, м. Одеса, вул. Преображенська, 24.
Тел.: (0482) 26-98-82, 26-96-82, 37-14-25.
www.astroprint.odessa.ua