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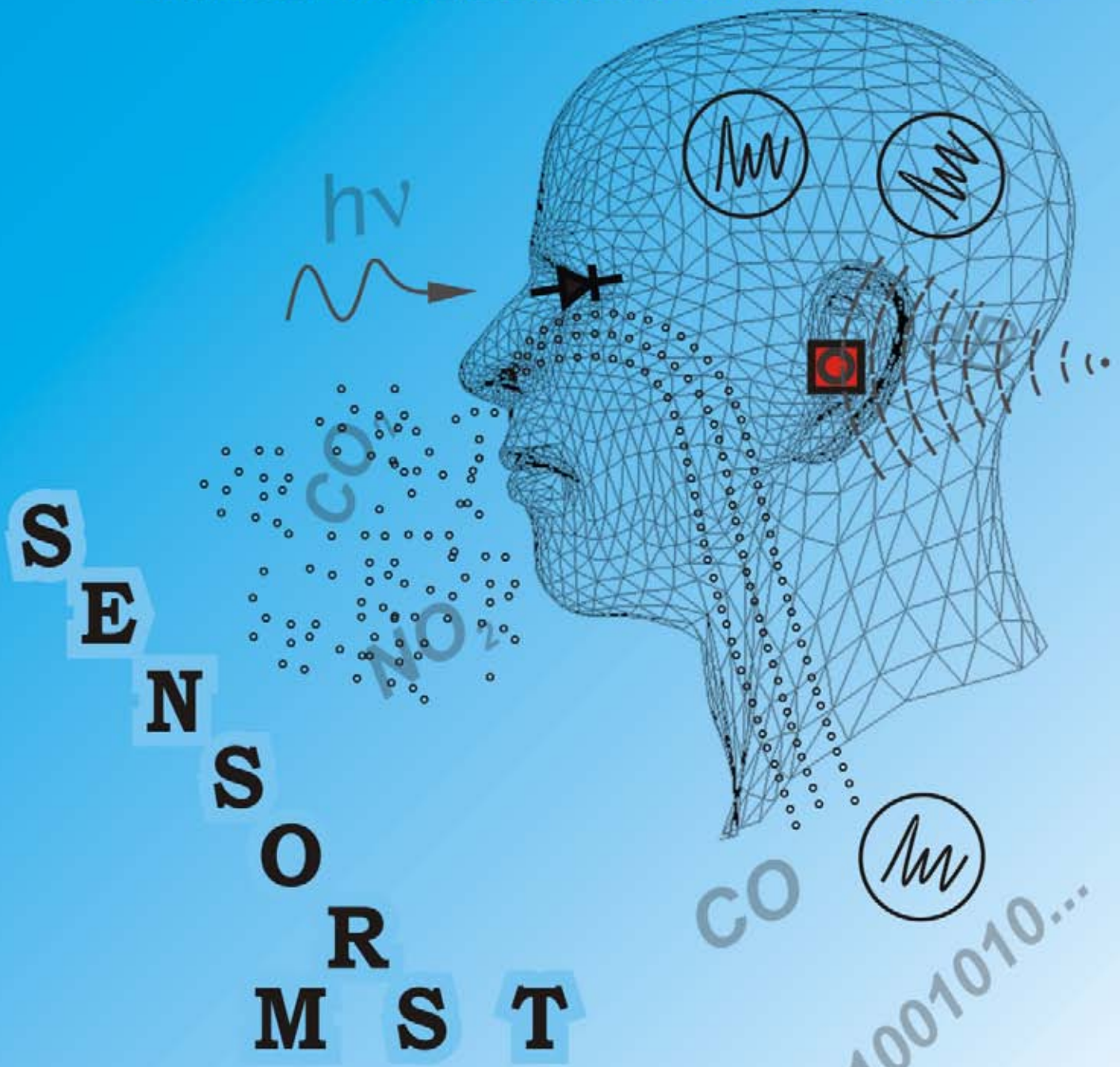

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Одеський національний університет імені І. І. Мечникова

СЕНСОРНА ЕЛЕКТРОНІКА І МІКРОСИСТЕМНІ ТЕХНОЛОГІЇ

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

УДК 621.315.592:537.312

АНАЛІЗ ГАЗОЧУТЛИВИХ ЕФЕКТІВ В КЕРАМІЧНИХ СИСТЕМАХ НА ОСНОВІ ОКСИДУ ЦИНКУ

О. Ю. Ляшков, О. С. Тонкошкур, І. В. Гомілко

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Анотація

АНАЛІЗ ГАЗОЧУТЛИВИХ ЕФЕКТІВ В ЕЛЕКТРОПРОВІДНОСТІ КЕРАМІЧНИХ СИСТЕМ НА ОСНОВІ ОКСИДУ ЦИНКУ

О. Ю. Ляшков, О. С. Тонкошкур, І. В. Гомілко

Запропонована модель опису чутливості електропроводності кераміки кераміки ZnO-Ag_2O до парів етилового спирту. Ця модель використовує уявлення про розкладання парів спиртів на оксиді цинку, у ході якого відбувається розпад молекули спирту на альдегід і водень. Отримані результати свідчать про адекватність запропонованої моделі експериментальним даним.

Ключові слова: Оксид цинку, спирт, пари, газочутливість, математична модель, електропровідність.

Abstract

THE ANALYSIS OF GAS SENSITIVE EFFECTS IN THE ZINC OXIDE BASED CERAMICS SYSTEMS

A. Yu. Lyashkov, A. S. Tonkoshkur, I. V. Gomilko

The description of the ethyl alcohol vapor influence on the electrical conductivity of ZnO-Ag_2O ceramics was offered. The model based on dissociation of the alcohol molecules to the hydrogen and aldehyde on the zinc oxide surface. The obtained experimental results well agreed with the offered models.

Key words: Zinc oxide, alcohol, vapor, gas sensitive, mathematics model, electrical conductivity.

Аннотация

АНАЛИЗ ГАЗОЧУВСТВИТЕЛЬНЫХ ЭФФЕКТОВ В ЭЛЕКТРОПРОВОДНОСТИ КЕРАМИЧЕСКИХ СИСТЕМ НА ОСНОВЕ ОКСИДА ЦИНКА

А. Ю. Ляшков, А. С. Тонкошкур, И. В. Гомилко

Предложена модель описания чувствительности электропроводности керамики ZnO-Ag_2O к парам этилового спирта. Эта модель использует представления о распаде паров этилового спирта на оксиде цинка в ходе которого происходит распад молекулы спирта на альдегид и водород. Полученные результаты свидетельствуют о адекватности предложенной модели экспериментальным данным.

Ключевые слова: Оксид цинка, спирт, пары, газочувствительность, математическая модель, электропроводность.

УДК 621.382.3

ФІЗИЧНІ ТА МОДЕЛЬНІ УЯВЛЕННЯ ПРО ГАЛЬВАНОМАГНІТНІ ЕФЕКТИ В БІПОЛЯРНИХ НАПІВПРОВІДНИКОВИХ СТРУКТУРАХ

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Анотація

ФІЗИЧНІ ТА МОДЕЛЬНІ УЯВЛЕННЯ ПРО ГАЛЬВАНОМАГНІТНІ ЕФЕКТИ В БІПОЛЯРНИХ НАПІВПРОВІДНИКОВИХ СТРУКТУРАХ

М. А. Глауберман, В. В. Єгоров, Н. А. Каніщева, В. В. Козел

Аналізуються основні фізичні механізми роботи біполярних напівпровідникових магніточутливих структур (БМС). Показано, що вертикальні магніточутливі структури підлягають вилученню з класу БМС, а горизонтальні з точки зору модельних уявлень складають єдиний клас незалежно від напрямку магнітної осі. Механізми чутливості БМС, в яких визначаючим параметром є рухливість носіїв, допускають єдине по формі модельне представлення і тому можуть розглядатися як єдиний механізм перерозподілу. Магніточутливість БМС при визначенні її ефективністю перетворення досить коректно описується одновимірним рівнянням безперервності, причому незалежно від конкретних межових умов.

Ключові слова: напівпровідникові структури, магніточутливі структури, магнітотранзистори, моделювання.

Abstract

PHYSICAL AND MODELLING CONCEPTS OF GALVANOMAGNETIC EFFECTS IN BIPOLAR SEMICONDUCTOR STRUCTURES

M. A. Glauberman, V. V. Yegorov, N. A. Kanischeva, V. V. Kozel

The basic physical operation mechanisms of bipolar semiconductor magnetosensitive structures (BMSs) are analysed. The vertical structures have been shown to be subject to exclusion from the BMS class, and horizontal BMSs form a single class irrespective of their magnetic axis orientation. The BMS's sensitivity mechanisms having the charge mobility as the determining parameter allow a in-single model notion, and can be viewed as a single redistribution mechanism. When determined by transduction efficiency, the BMS magnetic sensitivity is quite correctly described by one-dimensional continuity equation irrespective of the boundary conditions.

Keywords: semiconductor structures, magnetosensing structures, magnetotransistors, modelling.

Аннотация

ФИЗИЧЕСКИЕ И МОДЕЛЬНЫЕ ПРЕДСТАВЛЕНИЯ О ГАЛЬВАНОМАГНИТНЫХ ЕФФЕКТАХ В БИПОЛЯРНЫХ ПОЛУПРОВОДНИКОВЫХ СТРУКТУРАХ

М. А. Глауберман, В. В. Егоров, Н. А. Канищева, В. В. Козел

Анализируются основные физические механизмы работы биполярных полупроводниковых транзисторных структур (БМС). Показано, что вертикальные магниточувствительные структуры подлежат исключению из класса БМС, а горизонтальные с точки зрения модельных представлений составляют единый класс независимо от направления магнитной оси. Механизмы чувствительности БМС, в которых определяющим параметром является подвижность носителей, допускают единое по форме модельное представление и поэтому могут рассматриваться как единый механизм перераспределения. Магниточувствительность БМС при определении ее эффективностью преобразования достаточно корректно описывается одномерным уравнением непрерывности, причем независимо от конкретных граничных условий.

Ключевые слова: полупроводниковые структуры, магниточувствительные структуры, магнитотранзисторы, моделирование.

ПРОЕКТУВАННЯ І МАТЕМАТИЧНЕ МОДЕЛЮВАННЯ СЕНСОРІВ

SENSORS DESIGN AND MATHEMATICAL MODELING

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

SENSING THE OPTIMAL PLASMA PARAMETERS FOR X-RAY LASING: CALCULATION OF ELECTRON-COLLISION EXCITATION CROSS-SECTIONS FOR AR-LIKE PLASMA IONS

E. P. Gurnitskaya, D. A. Korchevsky and A. V. Loboda

Oddesa National Polytechnical University, Odessa, Ukraine

Abstract

SENSING THE OPTIMAL PLASMA PARAMETERS FOR X-RAY LASING: CALCULATION OF ELECTRON-COLLISION STRENGTHS FOR AR-LIKE PLASMA

E.P.Gurnitskaya, D.A.Korchevsky and A.V.Loboda

A new advanved high-accuracy theoretical spectroscopy scheme is used for sensing the optimal collisionally pumped plasma parameters of X-ray lasing. Within the uniform energy approach, it is carried out calculation of electron collision strengths and cross-sections of electron-collisional excitation for ions of Ba in Ar-plasma.

Key words: sensing plasma parameters, X-ray lasing, electron-collisional excitation cross-section

Резюме

ДЕТЕКТУВАННЯ ОПТИМАЛЬНИХ ПАРАМЕТРІВ ПЛАЗМИ ДЛЯ РЕАЛІЗАЦІЇ ЛАЗЕРНОГО ЕФЕКТУ У РЕНТГЕНІВСЬКОМУ ДІАПАЗОНІ: РОЗРАХУНОК СИЛ ЕЛЕКТРОННИХ ЗІТКНЕНЬ ДЛЯ AR-ПОДІБНОЇ ПЛАЗМИ

Е. П. Гурницька, Д. О. Корчевський, А. В. Лобода

Нова високоточна теоретична схема використана у задачі детектування оптимальних параметрів колізійно накачуємої плазми для лазерного ефекту у рентгенівському діапазоні. Вперше отримані дані про сили електронних зіткнень, перерізи електронного збудження за рахунок зіткнень для іонів Ba в аргоновій плазмі.

Ключові слова: детектування параметрів плазми, лазерний ефект у рентгенівському діапазоні, переріз збудження за рахунок електронних зіткнень

Резюме

ДЕТЕКТИРОВАНИЕ ОПТИМАЛЬНЫХ ПАРАМЕТРОВ ПЛАЗМЫ ДЛЯ РЕАЛИЗАЦИИ ЛАЗЕРНОГО ЭФФЕКТА В РЕНТГЕНОВСКОМ ДИАПАЗОНЕ: РАСЧЕТ СИЛ ЭЛЕКТРОННЫХ СТОЛКНОВЕНИЙ ДЛЯ AR-ПОДОБНОЙ ПЛАЗМЫ

Е. П. Гурницкая, Д. А. Корчевский, А. В. Лобода

Новая высокоточная теоретическая схема использована в задаче детектирования и диагностики параметров стокновительно накачиваемой плазмы и поиске оптимальных плазменных параметров для лазерного эффекта в рентгеновском диапазоне. Впервые получены данные о силах электронных столкновений, сечениях электронно-столкновительного возбуждения для ионов Ba в аргоновой плазме.

Ключевые слова:детектирование параметров плазмы, лазерный эффект в рентгеновском диапазоне, сечение электрон-столкновительного возбуждения.

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ТРАНСФОРМАЦІЯ СТАНІВ НЕСТАЦІОНАРНОЇ ЕЛЕКТРОННОЇ ПІДСИСТЕМИ В УМОВАХ ФОТОРЕФРАКТИВНОГО ГАНН–ЕФЕКТУ

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Анотація

ТРАНСФОРМАЦІЯ СТАНІВ НЕСТАЦІОНАРНОЇ ЕЛЕКТРОННОЇ ПІДСИСТЕМИ В УМОВАХ ФОТОРЕФРАКТИВНОГО ГАНН–ЕФЕКТУ

П. М. Горлей, П. П. Горлей, С. М. Чупира

Для напівпровідника, на який окрім гріючого носії електричного поля діють дві квазімонохроматичні хвилі в умовах домішкового поглинання, у моделі одномірної польової задачі знайдено систему диференційних рівнянь для коефіцієнтів розкладу концентрації електронів і електричного поля у ряд за тригонометричними функціями. За допомогою числових методів досліджено трансформацію динамічних станів системи і описано її в термінах теорії самоорганізації — розмірності Хаусдорфа та показників Ляпунова. Показано, що в залежності від степені компенсації мілких домішок та інтенсивності світлової хвилі досліджувана система може знаходитись у двох суттєво різних за стійкістю коливних станах.

Ключові слова: фоторефрактивний ефект Ганна, динамічна система, фазовий портрет, розмірність Хаусдорфа, показник Ляпунова

Abstract

STATE TRANSFORMATION FOR THE NON-STATIONARY ELECTRON SUBSYSTEM UNDER PHOTO-REFRACTIVE GUNN EFFECT

P. M. Gorley, P. P. Horley, S. M. Chupyra

For the semiconductor subjected to the action of carrier-warming electric field and two quasi-monocromatic waves under impurity absorption the authors determined the differential equation set describing the trigonometric series coefficients for the distributions of carrier concentrations and electric field in the framework of one-dimensional field model. The obtained system was solved numerically that allowed the investigation of its dynamic states using self-organization methodology, namely Hausdorff dimension and Lyapunov exponents. It was shown that

depending on the concentration of the shallow impurity and the intensity of the incident light wave it is possible to switch the system between the two oscillatory states, significantly different in the terms of motion stability.

Key words: photorefractive Gunn effect, dynamical system, phase portrait, Hausdorff dimension, Lyapunov exponent

Аннотация

ТРАНСФОРМАЦИЯ СОСТОЯНИЙ НЕСТАЦИОНАРНОЙ ЭЛЕКТРОННОЙ ПОДСИСТЕМЫ В УСЛОВИЯХ ФОТОРЕФРАКТИВНОГО ГАНН–ЕФФЕКТА

П. Н. Горлей, П. П. Горлей, С. Н. Чупыра

Для полупроводника, на который кроме греющего носители электрического поля действуют две квази-монохроматических волны в условиях примесного поглощения, в модели одномерной полевой задачи получена система дифференциальных уравнений для коэффициентов разложения концентрации электронов и электрического поля в ряд по тригонометрическим функциям. С помощью численных методов исследована трансформация динамических состояний системы и описана в терминах теории самоорганизации — размерности Хаусдорфа и показателей Ляпунова. Показано, что в зависимости от степени компенсации мелких примесей и интенсивности световой волны исследуемая система может находиться в двух существенно разных по стойкости колебательных состояниях.

Ключевые слова: фоторефрактивный эффект Ганна, динамическая система, фазовый портрет, размерность Хаусдорфа, показатель Ляпунова

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УДК 539.184, 539.186

STUDY OF ATOMIC SYSTEMS IN STRONG LASER FIELDS: SPECTRAL HIERARCHY, DYNAMICAL STABILIZATION AND GENERATION OF ULTRA-SHORT VUV AND X-RAY PULSES

A. V. Glushkov*, I. M. Shpinareva, V. M. Ignatenko and V. I. Gura

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Summary

STUDY OF ATOMIC SYSTEMS IN STRONG LASER FIELDS: SPECTRAL HIERARCHY, DYNAMICAL STABILIZATION AND GENERATION OF ULTRA-SHORT VUV AND X-RAY PULSES

A. V. Glushkov, I. M. Shpinareva, V. M. Ignatenko and V. I. Gura

A new method for sensing a spectral hierarchy and dynamical stabilisation in atomic systems in the intense laser field is presented.It is carried out modeling generation of the atto-second VUV and X-ray pulses under ionization of atomic systems by femto-second optical pulse. The theory of studied phenomena is the physical basis for construction of the new nano-atomic elements and devices, including sensors, sources of VUV and X-ray radiation, quantum Carnot engine, single-atomic lasers, quantum computers elements etc.

Key words: sensing, atomic system, laser field, spectral hierarchy, stabilisation, attosecond VUV and X-ray pulses

Анотація

ВИВЧЕННЯ АТОМНИХ СИСТЕМ У ІНТЕНСИВНОМУ ПОЛІ ЛАЗЕРНОГО ВИПРОМІНЮВАННЯ: СПЕКТРАЛЬНА ІЄРАРХІЯ, ДИНАМІЧНА СТАБІЛІЗАЦІЯ ТА ГЕНЕРАЦІЯ УЛЬТРАКОРОТКИХ ІМПУЛЬСІВ ВУФ ТА РЕНТГЕНІВСЬКОГО ДІАПАЗОНІВ

О. В. Глушков, І. М. Шпінарева, В. М. Ігнатенко, В. І. Гура

Розвинуто новий метод детектування ефектів спектральної ієрархії і динамічної стабілізації в атомних системах у сильному полі лазерного випромінювання. Виконано моделювання генерації аттосекундних імпульсів ВУФ а рентгенівського діапазону при іонізації втомних систем фемтосекундним оптичним імпульсом. Теорія шуканих явищ може служити фізичною основою для побудування нових нано-атомних елементів, приладів та технологій (сенсори, джерела ВУФ та рентгенівського випромінювання, квантові машини Карно, одноатомні лазери, елементи квантових комп'ютерів тощо).

Ключові слова: детектування, атомна система, поле лазерного випромінювання, спектральна ієрархія, стабілізація, аттосекундні ВУФ та рентгенівські імпульси

Аннотация

ИЗУЧЕНИЕ АТОМНЫХ СИСТЕМ В ИНТЕНСИВНОМ ПОЛЕ ЛАЗЕРНОГО ИЗЛУЧЕНИЯ: СПЕКТРАЛЬНАЯ ИЕРАРХИЯ, ДИНАМИЧЕСКАЯ СТАБИЛИЗАЦИЯ И ГЕНЕРАЦИИ УЛЬТРАКОРОТКИХ ИМПУЛЬСОВ ВУФ И РЕНТГЕНОВСКОГО ДАИПАЗОНОВ

А. В. Глушков, И. М. Шпинарева, В. М. Игнатенко, В. И. Гура

Развит новый метод детектирования эффектов спектральной иерархии и динамической стабилизации в атомных системах в сильном поле лазерного излучения. Теория искомых явлений может служить физической основой для создания новых нано-атомных элементов и приборов (сенсоры, источники ВУФ и рентгеновского излучения, квантовые машины Карно, одноатомные лазеры, элементы квантовых компьютеров и т.д.).

Ключевые слова: детектирование, атомная система, поле лазерного излучения, спектральная иерархия, стабилизация, аттосекундные ВУФ и рентгеновские импульсы

БІОСЕНСОРИ

BIOSENSORS

УДК 539.21:535.34:577.32

РЕАКТИВНІСТЬ ОДНОСТІНИХ ВУГЛЕЦЕВИХ НАНОТРУБОК ПРИ ВЗАЄМОДІЇ З БІОЛОГІЧНИМИ МАКРОМОЛЕКУЛАМИ — ДНК І БІЛКАМИ

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Анотація

РЕАКТИВНІСТЬ ОДНОСТІННИХ ВУГЛЕЦЕВИХ НАНОТРУБОК ПРИ ВЗАЄМОДІЇ З БІОЛОГІЧНИМИ МАКРОМОЛЕКУЛАМИ — ДНК І БІЛКАМИ

Г. І. Довбешко, О. Д. Образцова, О. М. Фесенко, К. І. Яковкін

В роботі представлено короткий огляд даних літератури щодо експериментальних і розрахункових відомостей по нековалентній взаємодії ДНК і білків з нефункціоналізованими вуглецевими нанотрубками. Наведено результати, що отримано методом комбінаційного розсіяння і електронної мікроскопії відносно характеристики вуглецевих нанотрубок, а також данні SEIRA (Surface Enhanced Infrared Absorption-підсилення інфрачервоного поглинання металевою поверхнею) спектроскопії по визначенню конформаційного стану ДНК і білка на прикладі бичачого сироваткового альбуміну (БСА) при взаємодії з одностінними вуглецевими нанотрубками. Ці експерименти дозволили зробити висновок про характер нековалентних взаємодій в системі трубка–біомолекула. Аналіз даних показав, що при взаємодії ДНК з нанотрубками відбувається їх зв'язування на поверхні нанотрубки з утворенням достатньо стабільних комплексів за участю Ван-дер-Ваальсових сил, в яких π-стекінгу відводиться головна роль і які перебудовують водневі зв'язки в структурі біологічної молекули. Це означає, що змінюється сила зв'язку та відбувається розрив одних зв'язків з утворенням інших. Вважається, що внаслідок гідрофобної взаємодії і π-стекінга адсорбція альбуміну на поверхні нанотрубки відбувається на звичайні місця (сайти) зв'язування. А саме, це — тирозин (Tyr) та фенілаланін (Phe), аргінін (Arg) та подібні йому по структурі амінокислоти.

Ключові слова: ДНК, БСА (бичачий сироватковий альбумін), одностінні вуглецеві нанотрубки, SEIRA (Surface Enhanced Infrared Absorption — підсилення інфрачервоного поглинання металевою поверхнею).

Abstract

REACTIVITY SINGLE WALLED CARBON NANOTUBES UNDER INTERACTION WITH BIOLOGICAL MOLECULES – DNA AND PROTEINS

Г. І. Довбешко, О. Д. Образцова, О. М. Фесенко, К. І. Яковкін

Literature review of experimental and calculated data on non-covalent interaction of DNA and proteins with nonfunctional carbon nanotubes was done in the paper. The results on characterization of single walled carbon nanotubes with Raman spectroscopy and conformation analysis of main biological polymers — DNA and protein of bovine serum albumin (BSA) under interaction with single walled carbon nanotubes with SEIRA (surface enhanced infrared absorption) was presented.

The experiments give a possibility to conclude about non-covalent interaction in the complex nanotube-biomolecule. Analysis of the experimental data have proved that under DNA interaction with nanotubes, the bounding of DNA occurs at the nanotube surface, forming stable complex with Van-der-Waalse interaction .

In this case, π-stacking has a main role with intra H-bond reconstruction within the biomolecules. We suppose, that albumin adsorbtion on nanotube surface takes place with participation of conventional cite interaction for BSA, due to hydrophobic interaction and π-stacking. Experimental data on structural reconstruction of albumin is an evidence of this fact.

Key words: DNA, BSA (bovine serum albumin), single-walled carbon nanotubes, SEIRA (Surface Enhanced Infrared Absorption).

Резюме

РЕАКТИВНОСТЬ ОДНОСТЕННЫХ УГЛЕРОДНЫХ НАНОТРУБОК ПРИ ВЗАЄМОДЕЙСТВИИ С БИОЛОГИЧЕСКИМИ МАКРОМОЛЕКУЛАМИ — ДНК И БЕЛКАМИ

Г. І. Довбешко, О. Д. Образцова, О. М. Фесенко, К. І. Яковкін

В работе представлен краткий обзор данных литературы относительно экспериментальных и расчетных данных по нековалентному взаимодействию ДНК и белков с нефункционализированными углеродными нанотрубками. Приведены результаты, полученные методом комбинационного рассеяния и электронной микроскопии по характеристике углеродных нанотрубок, а также данные метода SEIRA (Surface Enhanced Infrared Absorption) спектроскопии по изменению конформационного состояния ДНК и белка на примере бычьего сывороточного альбумина (БСА) при взаимодействии с одностенными углеродными нанотрубками. Последнее позволило сделать выводы о характере нековалентных взаимодействий в системе трубка–биомолекула. Анализ данных показал, что при взаимодействии ДНК с нанотрубками происходит их связывание на поверхности нанотрубки с образованием достаточно стабильных комплексов при участии Ван-дер-Ваальсовых сил, в которых π-стэкингу отводится основная роль и которые перестраивают водородные связи внутри биологической молекулы.

Это означает, что меняется сила связи и происходит разрыв одних связей с образованием других. Адсорбция альбумина на поверхность нанотрубки предположительно происходит на обычные места (сайты) связывания этого белка за счет гидрофобного взаимодействия и π-стэкинга, о чем свидетельствуют структурные перестройки в БСА. А именно, это — тирозин та фенилаланин, аргинин и подобные ему по структуре аминокислоты

Ключевые слова: ДНК, бычий сывороточный альбумин (БСА), одностенные углеродные нанотрубки, SEIRA (Surface Enhanced Infrared Absorption — усиление инфракрасного поглощения металлической поверхностью) спектроскопия.

УДК 616.153

НА ПУТИ К СОЗДАНИЮ ПОРТАТИВНОЙ АВТОМАТИЧЕСКОЙ СИСТЕМЫ РЕГУЛИРОВАНИЯ ГЛЮКОЗЫ В КРОВИ

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Аннотация

НА ПУТИ К СОЗДАНИЮ ПОРТАТИВНОЙ АВТОМАТИЧЕСКОЙ СИСТЕМЫ РЕГУЛИРОВАНИЯ ГЛЮКОЗЫ В КРОВИ

И. Д. Войтович, В. М. Корсунский

Анализируются необходимость и возможности создания портативной автоматической системы регулирования концентрации глюкозы в крови (КГК) человека, которая бы эффективно дополняла или в некоторых звеньях заменяла естественные процессы регулирования, нарушенные в результате заболевания диабетом. Показано, что ныне основная проблема при создании такой системы состоит в разработке надёжного, неинвазивного, непрерывно действующего глюкосенсора. Основные трудности связаны с очень низкой средней концентрацией глюкозы в биоткани и её незначительным влиянием на оптические свойства, а также с физиологическими колебаниями уровня кровенаполнения биоткани. Приведен аналитический обзор разработок в данном направлении. Обращено внимание на то, что большинство предложенных до сих пор неинвазивных и малоинвазивных глюкосенсоров фактически измеряют концентрацию глюкозы, усредненную по всему объёму живой ткани, либо в тканевой жидкости, а задача корректного пересчета результатов измерений в КГК не решается. Высказано мнение о том, что современнный уровень техники обеспечивает все предпосылки для создания удобной портативной системы искусственного регулирования КГК.

Ключевые слова: диабет, концентрация глюкозы, глюкосенсоры, автоматизированная портативная система регулирования.

Анотація

НА ШЛЯХУ ДО СТВОРЕННЯ ПОРТАТИВНОЇ АВТОМАТИЧНОЇ СИСТЕМИ РЕГУЛЮВАННЯ ГЛЮКОЗИ В КРОВІ

І. Д. Войтович, В. М. Корсунський

Аналізуються необхідність і можливості створення портативної автоматичної системи регулювання концентрації глюкози в крові (КГК) людини, яка б ефективно доповнила або в деяких ланках замінила природні процеси регулювання, порушені в результаті захворювання на діабет. Показано, що зараз основна проблема при створенні такої системи полягає в розробці надійного, неінвазійного, неперервно діючого глюкосенсора. Її вирішенню заважають дуже низька середня концентрація глюкози та її незначний вплив на оптичні властивості біотканини, а також фізіологічні зміни рівня кровонаповнення біотканини.. Дано аналітичний огляд розробок у цьому напрямі. Звертається увага на те, що переважна більшість запропонованих неінвазійних і малоінвазійних глюкосенсорів фактично вимірює концентрацію глюкози, усереднену по всьому об'ємові живої тканини, або в тканинній рідині, а задача коректного перерахунку результатів вимірювань у КГК не вирішується. Висловлена думка про те, що сучасний рівень техніки забезпечує усі передумови для створення зручної портативної системи штучного регулювання КГК.

Ключові слова: діабет, концентрація глюкози, глюкосенсори, портативна система штучного регулювання.

Summary

TOWARDS DEVELOPMENT OF PORTABLE AUTOMATED SYSTEM FOR CONTROLLING OF GLUCOSE IN BLOOD

I. D. Voytovich, V. M. Korsunsky

Necessity and possibility of development of portable automated system for regulation of glucose in blood is analised. The system should supplement or replase in some links natural processes destroed by diabetes.It is showen that the kee issue of the system is the development of reliable noninvasive continuously operating glucosensor. Major reasons for essential difficulties with the sensors are given. Rather complete analitical survey of developing in this field is submitted. Attention is paid to the fact, that the absolute majority of nonivasive or semyinvasive glucosensors are measuring glucose concentration in everige volume of tissue. But there are no methods how to transfer the results of such measurements onto blood. The idea is stated, that modern level of technology creates all preconditions for development of convinient portable system for artificial regulation glucose concentration in blood.

Keywords: diabetes, glucose concentration, glucosensors, automated portable system of glucose regulation.

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SENSING THE NONLINEAR INTERACTION BETWEEN GLOBAL TELECONNECTION PATTERNS: MICROS TECHNOLOGY "GEOMATH"

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Abstract

SENSING THE NONLINEAR INTERACTION BETWEEN GLOBAL TELECONNECTION PATTERNS: MICROS TECHNOLOGY "GEOMATH"

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It is carried out the micros computer data processing technology for sensing the chaotic behavior in the global climate system of the Earth and the nonlinear interaction between teleconnection patterns, based on the using technical devices observation data and the joint wavelet analysis PC programs complex "GeoMath".

Key words: micros computer technology "GeoMath", wavelet analysis , sensing the nonlinear interaction between teleconnection patterns

Резюме

ДЕТЕКТУВАННЯ НЕЛІНІЙНОЇ ВЗАЄМОДІЇ ТЕЛЕКОННЕКЦІЙНИХ ПАТТЕРНІВ: МІКРОС ТЕХНОЛОГІЯ "GEOMATH"

О. В. Глушков, В. М. Хохлов, Ю. Я. Бунякова, Г. П. Препелица, А. А. Свинаренко, Т. О. Ценeнко

Розроблено мікрос технологію обробки данних і детектування нелінійної взаємодії телеконнекційних паттернів в земній атмосфері, яка базується на використанні данних супутникових та інших спостережень та ПК комплексу програм вейвлет аналізу "GeoMath".

Ключові слова: мікрос технологія "GeoMath", вейвлет аналіз, детектування нелінійної взаємодії телеконнекційних паттернів

Резюме

ДЕТЕКТИРОВАНИЕ НЕЛИНЕЙНОГО ВЗАИМОДЕЙСТВИЯ ТЕЛЕКОННЕКЦИОННЫХ ПАТТЕРНОВ: МИКРОС ТЕХНОЛОГИЯ “GEOMATH”

А. В. Глушков, В. Н. Хохлов, Ю. Я. Бунякова, Г. П. Препелица, А. А. Свинаренко, Т. А. Цененко

Разработана микрос технология обработки данных и детектирования нелинейного взаимодействия телеконнекционных паттернов в земной атмосфере, базирующаяся на использовании данных спутниковых и др. наблюдений и ПК комплексе программ вэйвлет анализа “GeoMath”.

Ключевые слова: микрос технология “GeoMath”, вэйвлет анализ, детектирование нелинейного взаимодействия телеконнекционных паттернов

УДК 006.022:006.058

АДАПТАЦІЯ СТАНДАРТУ IEEE 1451 ДЛЯ ЧАСТОТНИХ СЕНСОРІВ

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Анотація

АДАПТАЦІЯ СТАНДАРТУ IEEE 1451 ДЛЯ ЧАСТОТНИХ СЕНСОРІВ

С. Ю. Юриш

В статті описані розширення і адаптація стандарту IEEE 1451 для сенсорів частотно-часової групи. Показано, що при використанні одного універсального компонента — УПЧК-1 — будь-який існуючий частотний сенсор може бути перетворений в інтелектуальний з можливістю самоідентифікації і самоадаптації. Такий підхід до проектування IEEE 1451-сумісних сенсорів дає істотні переваги як виробникам, так і споживачам. Прогнозується збільшення ринку інтелектуальних сенсорів на 15-20 %.

Ключові слова: частотні сенсори, стандарт IEEE 1451, інтелектуальні сенсори, інтелектуальні перетворювачі, перетворювач частота-код

Abstract

IEEE 1451 STANDARD ADAPTATION FOR FREQUENCY OUTPUT SENSORS

S. Y. Yurish

An effort to simplify the IEEE 1451 standards family extension for adding smart, plug-and-play and self-adaptation capabilities to frequency output sensors is describe in the paper. It was shown that due to the use of one universal component — the universal frequency-to-digital converter (UFDC-1), any frequency output sensor can be transformed into a smart transducer compatible to the IEEE 1451 standard. This gives strong benefits to both: customer and manufacturers, increases the level of commercial adoption of the standard in industry and smart sensors market up to 15-20 %.

Key words: frequency output sensors, IEEE 1451, smart transducers, frequency-to-digital converter

Аннотация

АДАПТАЦИЯ СТАНДАРТА IEEE 1451 ДЛЯ ЧАСТОТНЫХ ДАТЧИКОВ

С. Ю. Юриш

В статье описаны расширение и адаптация стандарта IEEE 1451 для датчиков частотно-временной группы. Показано, что благодаря использованию одного универсального компонента — УПЧК-1 — любой существующий частотный датчик может быть преобразован в интеллектуальный с возможностью самоидентификации и самоадаптации. Такой подход к проектированию IEEE 1451-совместимых датчиков дает существенные преимущества как производителям, так и потребителям. Прогнозируется увеличение рынка интеллектуальных датчиков на 15-20 %.

Ключевые слова: частотные датчики, стандарт IEEE 1451, интеллектуальные датчики, интеллектуальные преобразователи, преобразователь частота-код

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УДК 544.225

МЕТАЛЛИЗАЦИЯ ХАЛЬКОГЕНИДОВ ЩЕЛОЧНОЗЕМЕЛЬНЫХ МЕТАЛЛОВ ПОД ДАВЛЕНИЕМ

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Аннотация

МЕТАЛЛИЗАЦИЯ ХАЛЬКОГЕНИДОВ ЩЕЛОЧНОЗЕМЕЛЬНЫХ МЕТАЛЛОВ ПОД ДАВЛЕНИЕМ

В. В. Поживатенко

Проведены оценочные расчеты давлений металлизации в халькогенидах щелочноземельных металлов, базирующиеся на приближении локальной плотности и использующие в качестве подгонки конструирование поправок в потенциал посредством электронной плотности, полученной в самосогласованном расчете в рамках приближения локальной плотности.

Ключевые слова: халькогениды щелочноземельных металлов, приближение локальной плотности, сохраняющий норму псевдопотенциал, поправки самодействия.

Анотація

МЕТАЛІЗАЦІЯ ХАЛЬКОГЕНІДІВ ЛУЖНОЗЕМЕЛЬНИХ МЕТАЛІВ ПІД ТИСКОМ

В. В. Поживатенко

Проведено оціночні розрахунки тисків металізації у халькогенідах лужноземельних металів, які базуються на наближенні локальної густини і використовують у якості підгонки конструювання поправок в потенціал через електронну густину, яка одержана у самоузгодженому розрахунку в рамках наближення локальної густини

Ключові слова: халькогеніди лужноземельних металів, наближення локальної густини, зберігаючий норму псевдопотенціал, поправки самодії.

Abstract

THE METALLIZATION OF ALKALINE-EARTH CHALCOGENIDES UNDER PRESSURE

V. V. Pozhivatenko

Estimated calculation of pressure of metallization in alkaline-earth chalcogenides, based on local-density approximation and using as fit the construction of corrections in potential by means of the electronic density obtained in self-consistent calculation within the framework of local-density approximation are performed.

Key words: alkaline earth chalcogenides, local-density approximation, norm-conserving pseudopotential, self-interaction corrections.

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Electrochemical characterization and in vivo biocompatibility of a thick-film printed sensor for continuous in vivo monitoring

Voskerician, G. Chung-Chiun Liu Anderson, J.M.

On page(s): 1147- 1158

Abstract
This paper assessed the material biocompatibility and investigated the temporal modulation in electrochemical performance of printed thick-film electrochemical sensing devices (ESDs) that can serve as the basis of various enzymatic sensor in detecting an electrochemically potent species. The sensors were placed in phosphate buffered saline (PBS), human serum, or implanted subcutaneously in rats, free or in stainless steel cages. The exudate collection allowed the evaluation of inflammatory cell populations, up to 21 days. The ferrous/ferric redox electrode reactions were used to assess the electrode elements performance for up to 49 days. Following testing, scanning electron microscopy (SEM) evaluated cell surface adhesion, while fibrous capsules were examined by histology. It was determined that the exudates leukocyte concentration due to the presence of sensors was comparable to the empty cage controls. For the length of the study, the sensors functionality appeared not to be influenced by the in vivo environment, when tested ex vivo, without the surrounding fibrous capsule. Surface imaging (SEM) indicated temporal focal dissolution of the Ag/AgCl electrodes with no apparent local toxicity. We concluded that the ESDs were biocompatible and their ex vivo functionality was not lost when maintained in vivo for up to 49 days.

Surface plasmon resonance detection of metal ions: layer-by-layer assembly of polyelectrolyte sensing layers on a multichannel chip

Palumbo, M. Nagel, J. Petty, M.C.

On page(s): 1159- 1164

Abstract
A single-chip multichannel surface plasmon resonance sensor (SPR) has been used to detect metal ions in aqueous solutions. The equipment was designed around a commercial light-emitting diode and a CCD camera and incorporated no moving parts. The sensing materials were based on molecular architectures of polyelectrolyte films, deposited by the layer-by-layer self-assembly technique. Two bilayer architectures, poly(ethyleneimine) (PEI)/poly(ethylenealt-maleic acid) and PEI/poly(styrenesulfonate), were shown to produce different responses to solutions containing copper, nickel, and iron. The SPR equipment was able to measure concentrations of these metals down to levels of at least $2Ч10^{-5}$ M.

Array of opto-chemical sensors based on fiber-optic spectroscopy

Di Natale, C. Mignani, A.G. Paolesse, R. Macagnano, A. Mencaglia, A.A. Dapos Amico, A.

On page(s): 1165- 1174

Abstract
A compact, flexible platform for reading out the variation of the optical absorption spectra in the visible range in a number of sensing materials is illustrated in this paper. This apparatus is based on an integrated spectrophotometer, an array of suitably controlled LEDs, optical fibers to carry and collect light, and a mechanical arrangement that makes possible the measurement, in sequence, of up to 15 different sensing layers. The unit was tested with a number of metalloporphyrins, known for their outstanding sensorial and optical properties. Data were analyzed using a multiway chemometrics approach. In this regard, a methodology to investigate the properties of an array of chemical sensors is introduced. This approach allowed an evaluation of the role played in the array by each sensing material in each spectral region to be performed. The analysis revealed interesting insight into the classification properties of the sensor array and the interaction mechanisms of porphyrins. The set of metalloporphyrins showed a variety of interaction mechanisms, and the relation of these mechanisms to the structure of the metalloporphyrins was evidenced by an accurate interpretation of the loadings of the multiway analysis.

ATR-FTIR spectroscopic analysis of sorption of aqueous analytes into polymer coatings used with guided SH-SAW sensors

Jones, Y.K. Zhonghui Li Johnson, M.M. Josse, F. Hossenlopp, J.M.

On page(s): 1175- 1184

Abstract
Attenuated total internal reflectance Fourier transform infrared (ATR-FTIR) spectroscopy was used for the investigation of sorption of aqueous solutions of

analytes into polymer coatings. A series of simple model polymers, such as poly(dimethylsiloxane), poly(epichlorhydrin), and poly(isobutylene), and films and analytes, such as aqueous solutions of ethylbenzene, xylenes, toluene, and nitrobenzene, were used to evaluate the use of ATR-FTIR spectroscopy as a screening tool for sensor development. The ratios of integrated infrared absorption bands provided a simple and efficient method for predicting trends in partition coefficients. Responses of polymer-coated guided shear horizontal surface acoustic wave (SH-SAW) sensor platforms to the series of analytes, using polymer coatings with similar viscoelastic properties, were consistent with ATR-FTIR predictions. Guided SH-SAW sensor responses were linear in all cases with respect to analyte concentration in the tested range. Comparison of ATR-FTIR data with guided SH-SAW sensor data identifies cases where mass loading is not the dominant contribution to the response of the acoustic wave sensor. ATR-FTIR spectra of nitrobenzene, coupled with computational chemistry, provided additional insight into analyte/polymer interactions.

Micromachined silicon electrolytic conductivity probes with integrated temperature sensor
Dongming He Shannon, M.A. Miller, N.R.

On page(s): 1185- 1196

Abstract
Electrolytic conductivity measurements of fluids currently require sample volumes greater than a milliliter. Many applications would benefit from accurate measurements of nano- to microliter sample volumes. However, polarization and nonlinear electrode impedance effects, along with stray impedance and temperature effects, strongly affect measurements of the solution conductance for microliter and smaller sample volumes. MEMS-based silicon electrolytic conductivity probes, down to 100 μm wide, with integrated temperature sensors, have been designed and fabricated to overcome these effects. Several electrode configurations were tested: plain electrode pairs, electrode pairs plated with platinum black, plain four electrode sets, and four electrode sets plated with platinum black were investigated. The same accuracy as normal scale probes has been achieved with these sensors over almost three orders of magnitude in solution concentration and electrolytic conductivity ranges.

Core-referenced ratiometric fluorescent potassium ion sensors using self-assembled ultrathin films on europium nanoparticles
Brown, J.Q. McShane, M.J.

On page(s): 1197- 1205

Abstract
Nanoengineered fluorescent sensor coatings on colloidal carriers have been developed for use intracellularly. These nanosensors are fabricated via the electrostatic layer-by-layer self-assembly technique to form ultrathin polyelectrolyte films containing indicators on fluorescent nanoparticles. The fluorescent nanoparticle templates and the fluorescent indicator are chosen such that their optical properties are complementary, enabling the inert nanoparticle templates to serve as internal intensity references for the fluorescent probe. In this work, the potassium ion indicator, potassium-binding benzofuran isophthalate potassium-binding benzofuran isophthalate was immobilized within poly(styrene sulfonate)/poly(allylamine hydrochloride) films assembled on the surface of fluorescent europium nanoparticles. The indicator retains its sensitivity to potassium ions after immobilization within the films and exhibits sensitivity to increases in potassium concentration over a broad range. In addition, the sensors demonstrate excellent leaching stability, with less than 1% of loaded indicator leached after 14 days of wet storage. The core-referenced nanosensor scheme described here is a simple and elegant way to co-immobilize fluorescent indicator and intensity reference within a single nanoscale package, which may be deployed intracellularly; furthermore, the separation of fluorescent indicator from the cellular environment is attractive, as it may prevent complications due to use of liquid-phase fluorescent sensors intracellularly, such as cytotoxicity and probe compartmentalization.

Measurement of 5-eV atomic oxygen using carbon based films: preliminary results
White, C.B. Roberts, G.T. Chambers, A.R.

On page(s): 1206- 1213

Abstract
Carbon-based sensors have been developed to measure the atmospheric neutral atomic oxygen (AO) flux experienced by spacecraft in low Earth orbit. Thin- and thick-film carbon sensor elements were deposited onto an alumina substrate between thick-film gold tracks and silver palladium solder pads. AO flux is deduced by measuring resistance changes as the carbon film erodes and applying a simple theory. A wide range of responses were observed that are dependent on the deposition process and post deposition annealing. The deposition

methods used were dc magnetron sputtering, e-beam evaporation, and screen-printing. The sensors tested compare favorably with similar silver-based sensors that have been flown previously on small satellite missions with significant mass/power constraints.

A resonant accelerometer with two-stage microleverage mechanisms fabricated by SOI-MEMS technology
Su, S.X.P. Yang, H.S. Agogino, A.M.

On page(s): 1214- 1223

Abstract
We present the design, fabrication, and testing of a push-pull differential resonant accelerometer with double-ended-tuning-fork (DETF) as the inertial force sensor. The accelerometer is fabricated with the silicon-on-insulator microelectromechanical systems (MEMS) technology that bridges surface micromachining and bulk micromachining by integrating the 50-μm-thick high-aspect ratio MEMS structure with the standard circuit foundry process. Two DETF resonators serve as the force sensor measuring the acceleration through a frequency shift caused by the inertial force acting as axial loading. Two-stage microleverage mechanisms with an amplification factor of 80 are designed for force amplification to increase the overall sensitivity to 160 Hz/g, which is confirmed by the experimental value of 158 Hz/g. Trans-resistance amplifiers are designed and integrated on the same chip for output signal amplification and processing. The 50-/spl mu/m thickness of the high-aspect ratio MEMS structure has no effect on the amplification factor of the mechanism but contributes to a greater capacitance force; therefore, the resonator can be actuated by a much lower ac voltage comparing to the 2-μm-thick DETF resonators. The testing results agree with the designed sensitivity for static acceleration.

A novel thermal sensor concept for flow direction and flow velocity
Nam-Trung Nguyen

On page(s): 1224- 1234

Abstract
This paper presents a unified theory for different measurement concepts of a thermal flow sensor. Based on this theory, a new flow sensor concept is derived. The concept allows measuring both direction and velocity of a fluid flow with a heater and an array of temperature sensors. This paper first analyzes the two-dimensional (2-D) forced convection problem with a laminar flow. The two operation modes of a constant heating power and of a constant heater temperature are considered in the analytical model. A novel estimation algorithm was derived for the flow direction. Different methods for velocity measurement were presented: the hot-wire method, the calorimetric method, and the novel average-temperature method. The only geometric parameter of the sensor, the dimensionless position of the sensor array, is optimized based on the analytical results. Furthermore, the paper presents the experimental results of the sensor prototype. In order to verify the analytical model, an array of temperature sensors was used for recording the 2-D temperature profile around the heater. Temperature values are transferred to a computer by a multiplexer. A program running on a personal computer extracts the actual flow velocity and flow direction from the measured temperature data. This paper discusses different evaluation algorithms, which can be used for this sensor. A simple Gaussian estimator was derived for the direction measurement. This estimator provides the same accuracy as the analytical estimator. Velocity results of both the calorimetric concept and the novel average-temperature concept are also presented.

Noise of piezoelectric accelerometer with integral FET amplifier
Levinzon, F.A.

On page(s): 1235- 1242

Abstract
Since significant progress has been achieved in the development of low-noise piezoelectric (PE) accelerometers with integral FET amplifiers, detailed noise analysis of the system PE transducer-FET amplifier, and obtaining the engineering formula for its noise floor has become vital. As a result of this analysis, the formula for the noise floor of PE accelerometers in terms of acceleration spectral density is obtained at wide frequency band. Noise floor of the low-noise PE accelerometer comprising low-noise JFET charge amplifiers with some particular parameters of the PE transducer and the JFET amplifier was measured. The theoretical and experimental curves of the PE accelerometer's noise floor have a good correlation with each other at frequencies from 1 Hz to 10 kHz. The contribution of the different noise sources to the overall noise floor is shown. Those noise sources include the mechanical-thermal noise and electrical-thermal noise of the PE transducer and all main noise sources of FET amplifiers: the thermal noise voltage of the FET biasing resistor, the thermal noise of the series resistor between the PE transducer and the gate of the FET, the channel thermal noise voltage, the 1/f noise voltage, and the shot noise current in the gate circuit. At low frequencies, the f=50 Hz noise floor is determined mainly by the FET biasing resistor's thermal noise and the PE

transducer's electrical-thermal noise. At frequencies from about 50 Hz to about 1 kHz, the contribution of the PE transducer's electrical-thermal noise dominates over the amplifier's noise sources by a factor of less than 2. At frequencies above 1 kHz, noise floor is determined mainly by the JFET channel thermal noise and the PE transducer's electrical-thermal noise.

Analysis and optimization of a compliant mechanism-based digital force/weight sensor
Zheyao Wang Huan Hu

On page(s): 1243- 1250

Abstract
Digital force/weight sensors have some advantages over their analog counterparts. This paper describes the optimization and implementation of a novel digital force/weight sensor that uses a thickness-shear quartz crystal resonator (QCR) and a unique compliant mechanism. The compliant mechanism consists of eight flexure hinges and is used to fix the sensitive QCR and transfer the measured force. Advantages of such a sensor include inherent digital output, high resolution, high reliability, and low cost. Due to the complex structure and the multivariables of the compliant mechanism, conventional trial methods are inefficient in determining the dimensions. To solve this problem, an optimization method has been developed by employing rigid-body model, finite element method, and nonlinear programming techniques. Experimental results show that it is more efficient than trial methods in optimizing complex compliant mechanism-based sensors. This method can be used as a generic method for optimizing force sensors using compliant mechanisms, to obtain the desired specifications.

Sensitivity, noise, and resolution in QCM sensors in liquid media
Rodriguez-Pardo, L. Rodriguez, J.F. Gabrielli, C. Perrot, H. Brendel, R.

On page(s): 1251- 1257

Abstract
The use of quartz-crystal oscillators as high-sensitivity microbalance sensors is limited by the frequency noise present in the circuit. To characterize the behavior of the sensors, it is not enough to determine their experimental sensitivity, but, rather, it is essential to study the frequency fluctuations in order to establish the sensor resolution. This is fundamental in the case of oscillators for damping media, because the level of noise rises due to the strong decline of the quality factor of the resonator. In this paper, a comparative study of noise and resolution is presented with respect to the frequency and the quality factor. The study has been made using four oscillators designed to be used in quartz-crystal microbalance sensors in damping media. The four circuits have been designed at increasing frequencies in order to improve the sensitivity or frequency change per unit of measurand. Also, the present theoretical resolution limit or best resolution achievable with a microbalance oscillator using an AT resonator is determined, since this does not depend on frequency. However, when operating in liquid, the damping of the resonator makes the resolution diminish due to a worsening of the quality factor. The relationship between the resolution limit and the frequency and characteristics of the liquid medium is determined. The resolution worsens when the density and viscosity of the liquid is increased. However, in this case, an increase in frequency implies a small increase in resolution. Therefore, we find that when working below the maximum quality factor, for similar values, the resolution can be improved by elevating the work frequency.

Anisotropic magnetoresistive model for saturated sensor elements
Haji-Sheikh, M.J. Morales, G. Altuncevahir, B. Koymen, A.R.

On page(s): 1258- 1263

Abstract
Presented is a model that predicts the resistive behavior of an anisotropic magnetoresistive (AMR) sensor element in magnetic saturation. Both the experimental data and the model concur with a high degree of accuracy. The model builds on the work of other investigators and it is shown to track the behavior of actual magnetoresistive elements. This paper shows that, with a minor modification to previous models, the resistor should and can be divided into isotropic and magnetically affected components that can give some new insights into the AMR effect. With this model, one can extract the parameters that have magnetic effects from the ones that are independent of the magnetic effects.

Excitation and temperature stability of PCB fluxgate sensor
Tipek, A. Oapos Donnell, T. Ripka, P. Kubik, J.

On page(s): 1264- 1269

Abstract
Printed circuit board (PCB) integrated inductors have been adapted for operation as fluxgate sensors. A ring core is made from an electrodeposited permalloy thin film and is sandwiched between the layers of the PCB.

The sensor excitation winding is also integrated into the PCB design. The pick-up coil is wound around the frame of the PCB core. Different types of current excitation waveforms with tuned and nontuned pick-up coils were used. The achieved sensitivities for 60 turns of tuned/nontuned pick-up coil, a sinusoidal waveform excitation current of Irms=300 mA, and an excitation frequency of 150 kHz were 13100/1800 V/T. The achieved sensitivity for pulse excitation (Ipeak-peak=900 mA, Irms=184 mA, duty 20%) was 2100 V/T. Noise power density for pulse excitation was 1.2 nTrmsvHz@1 Hz, noise rms value from 10 mHz to 10 Hz was 3.3 nT. A perming error of 1 μT was measured for a wide range of excitation currents.

Development and application of millimeter wave radar sensors for underground mining
Brooker, G.M. Scheding, S. Bishop, M.V. Hennessy, R.C.

On page(s): 1270- 1280

Abstract
This paper defines the issues that are required for the development of a successful underground range measurement sensor. It considers various options, including laser and sonar implementations, before focusing on a millimeter-wave frequency modulated continuous wave radar. The implementations of radar sensors for simple ranging and three-dimensional cavity profiling are then discussed before some data obtained in underground mines is presented to verify the radar performance through thick dust and vapor.

Complex permittivity and moisture measurements of oil palm fruits using an open-ended coaxial sensor
Abbas, Z. You Kok Yeow Shaari, A.H. Khalid, K. Hassan, J. Saion, E.

On page(s): 1281- 1287

Abstract
An open-ended coaxial sensor for the determination of complex permittivity and moisture content of oil palm fruits is presented in this paper. The measurement system consisting of the sensor and a PC-controlled vector network analyzer have been tested successfully on a range of oil palm fruits of various degrees of ripeness. The initial values of the complex permittivity were estimated using the admittance model of the sensor. The amount of moisture content was found by matching the values of permittivity from the quasistatic model with the permittivity of a dielectric mixture model using the moisture content values obtained from the standard oven drying method.

Thinned fiber Bragg gratings as refractive index sensors
Iadicicco, A. Cusano, A. Campopiano, S. Cutolo, A. Giordano, M.

On page(s): 1288- 1295

Abstract
In this work, highly sensitive refractive index measurements have been experimentally demonstrated by using thinned fiber Bragg grating (FBG) sensors. When the cladding diameter is reduced, significant changes in the effective refractive index occur due to surrounding medium refractive index modifications, leading to Bragg wavelength shifts. Uniformly thinned FBGs have been obtained by using wet chemical etching in hydrofluoric acid solutions. In order to prove sensor sensitivity, experimental tests have been carried out by using glycerine solutions with well-known refractive indices. Obtained results agree well with the numerical analysis carried out by using the three-layer fiber model. If the cladding layer is completely removed, resolutions of □10^{-5} and □10^{-4} for the outer refractive index around 1.450 and 1.333, respectively, are possible. Finally, a novel approach based on the selective etching along the grating region has been analyzed, leading to high-sensitivity refractive index sensors based on intensity measurements.

A CMOS sensor optimized for laser spot-position detection
De Nisi, F. Comper, F. Gonzo, L. Gottardi, M. Stoppa, D. Simoni, A. Beraldin, J.-A.

On page(s): 1296- 1304

Abstract
An optical sensor architecture optimized for flying-spot, triangulation-based, three-dimensional (3-D) laser scanners will be presented. The architecture implements a spot-position detection algorithm based on a two-step procedure that allows for improved dynamic range and readout speed. The sensor, which contains two linear arrays of pixels, analog readout channels, and digital signal preprocessing circuitry, has been fabricated in 0.6-μm CMOS double-poly triple-metal technology and measures 8.17Ч5.67 mm^2. Pixel size and shape have been selected for reducing the effect of laser speckle and for the possibility of measuring color in a multiwavelength 3-D scanner. Electrooptical test results confirm the sensor behavior as expected from simulations on a dynamic range of 80 dB and exhibits a maximum speed of 50-k voxel/s.

A monolithic optical phase-shift detector on silicon
Arguel, P. Valentin, J. Fourment, S. Lozes-Dupuy, F. Sarrabayrouse, G. Bonnefont, S. Jourlin, Y. Reynaud, S. Destouches, N. Tishchenko, A.V. Jay, J.

On page(s): 1305- 1309

Abstract
A novel monolithically integrated device used as an optical phase-shift detector is presented. It consists of a diffraction grating etched at the surface of a p-n photodiode fabricated by a process compatible with a standard silicon CMOS technology. When two coherent light beams are collimated toward the surface of the device, the detected optical power generates a current depending on the relative phase between the two incident beams. The operating principle of this detector and the results obtained by finite-difference time-domain modeling are presented. The fabrication process of the first devices is described and the experimental validation of the concept is demonstrated.

Curved elastic beam with opposed fiber-Bragg gratings for measurement of large displacements with temperature compensation
Falciai, R. Trono, C.

On page(s): 1310- 1314

Abstract
In this paper, a temperature-compensated configuration for extending the working range of fiber-Bragg grating (FBG) strain sensors has been proposed. This technique consists of the application of two FBGs to the opposite surfaces of a straight elastic beam which was bent in a horizontal direction. The difference of the two FBGs' wavelengths depends on the beam curvature, while the mean value is taken in order to compensate for the temperature effects. The sensor proposed is less fragile than the bare fiber and seems particularly suited as large displacement sensor, and for structures in which it is impossible to affix the bare fiber, such as breaks or separate elements.

An integrated fluorescence array as a platform for lab-on-a-chip technology using multimode interference splitters
Cleary, A. Garcia-Blanco, S. Glidle, A. Aitchison, J.S. Laybourn, P. Cooper, J.M.

On page(s): 1315- 1320

Abstract
We present the design and fabrication of 1-to-N multimode interference (MMI) splitters, suitable for use in integrated optical fluorescence array sensing, with particular applications in lab-on-a-chip (micro-TAS) technologies. Electron beam irradiation of germanium-doped flame hydrolysis deposited silica was used to define the MMI waveguide regions. The splitters were integrated with microfluidic channels to form direct-excitation fluorescence sensor chips for use at visible wavelengths. Characterization of the waveguides shows that predictable splitting ratios can be achieved. Two devices are presented: a 1Ч2 splitter integrated with one analytical chamber and a 1Ч4 array device for multipoint excitation. A photomultiplier tube was used to assess the analytical performance of the chip, in response to standard aliquots of fluorophore (31 nM to 1.25 μM).

An optical device for measuring bending strain to 5000 microstrain and compatible with optical fiber installations
Crisman, E.E. Derov, J.S. Barchard, G.J. Gregory, O.J. Euler, W.B.

On page(s): 1321- 1326

Abstract
An optical sensor is described which can be attached to a structure and used as a gage for measuring bending strain. This device can be adjusted to maximize the gage factor for predetermined strain ranges. The sensor consists of glass capillaries coated on the outer surfaces with an optical absorbing layer followed by a reflecting layer. A mechanical strengthening layer can be included to extend the range of strain response. A source laser beam from an optical fiber is injected into one end of the gage. The light remaining in the beam after traveling through the gage is collected via another optical fiber. The optically active layer is adjusted during manufacture to provide a predetermined gage factor. For a given thickness of the absorber layer, the detected light is proportional to the amount of bending. Thus, by rigidly affixing the sensor to a structural member, the strain experienced by the member can be monitored.

Fiber Bragg grating flow sensors powered by in-fiber light
Cashdollar, L.J. Chen, K.P.

On page(s): 1327- 1331

Abstract
This paper presents an active fiber Bragg grating temperature and flow sensor based on self-heated optical hot wire anemometry. The grating sensors are directly powered by optical energy carried by optical fibers. In-

fiber diode laser light at 910 nm was leaked out from the fiber and absorbed by the surrounding metallic coating to raise the temperature and change the background refractive index distribution of the gratings. When the diode laser is turned off, the grating is used as a temperature sensor. When the diode laser is turned on, the resonance wavelength and spectral width change of the self-heated grating sensor is used to measure the gas flow velocity. The grating flow sensors have been experimentally evaluated for different grating length and input laser power. The grating flow sensors have demonstrated a 0.35- m/s sensitivity for nitrogen flow at atmosphere pressure.

Enhancement in sensitivity for fiber-optic torsion sensors
Basilio-Sanchez, G. Hernandez-Cordero, J.

On page(s): 1332- 1337

Abstract
We demonstrate a simple fiber-optic torsion sensor with enhanced sensitivity. The sensor is based on the combination of a Malus and a Fabry-Perot (MFP) interferometer and allows for the sensitive detection of changes in the polarization of the guided beam due to torsion applied to the fiber. The basic idea behind this optical arrangement is to enhance the sensitivity for the measurements of intracavity anisotropies due to multiple passes of the beam through the sensing area. Theoretical analysis based on Jones calculus for a fiber-optic MFP interferometer shows that small twists in the fiber can be monitored through variations on the transmission of the arrangement. Experimental results with a hybrid MFP arrangement of bulk optical components and optical fibers show that, compared to single-pass polarimeter measurements, an enhancement in sensitivity up to 116 can be effectively achieved.

Fluctuation-enhanced multiple-gas sensing by commercial Taguchi sensors
Solis, J.L. Seeton, G.E. Yingfeng Li Kish, L.B.

On page(s): 1338- 1345

Abstract
This study is carried out to investigate and demonstrate the possibility of practical applications of commercial Taguchi gas sensors for fluctuation-enhanced chemical sensing of multiple gases. The stochastic resistance fluctuations of the sensors were studied during the burning-in process and during exposure to different gases at different temperatures. The analysis of resistance fluctuations in the gas sensors during and after exposure to gases indicates a strongly enhanced sensitivity and selectivity.

An impedance microsensor with coplanar electrodes and vertical sensing apertures
Hui Tang Yuanfang Gao

On page(s): 1346- 1352

Abstract
An impedance microsensor with coplanar electrodes and a vertical sensing aperture is presented for detecting single particles/cells. The sensing mechanism utilizes gating electrodes patterned in a plane perpendicular to the fluidic flow to minimize coincidence due to multiple particles. The design was implemented by integrating gating microelectrodes across the entrance of an orifice anisotropically etched into a silicon substrate. Through holes in diameters of 20, 60, and 100 μm were made on a single device. The microsensor was tested by detecting microbeads 45 μm in diameter suspended in 0.9% saline solution using AC excitation of 500 kHz. For comparison, a larger version made on a printed circuit board was also tested on microbeads 367 and 867 μm in diameter using an excitation frequency of 50 KHz. The impedance change across the gating electrodes due to passage of particles through the sensing apertures was converted into electrical pulses using an interfacing system including demodulation and signal processing circuitry and acquired into a LabView program for automatic pulse detection and analysis. Preliminary results on detection of microbeads indicate that the sensing mechanism is capable of detecting passing particles, and the pulse amplitude distribution correlates with the size of beads.

An oversampled capacitance-to-voltage converter IC with application to time-domain characterization of MEMS resonators
Lei, S. Zorman, C.A. Garverick, S.L.

On page(s): 1353- 1361

Abstract
This paper reports the first electronic circuit used to measure the motion of a microelectromechanical systems (MEMS) resonator in the time domain. The measurement of the shuttle position is made using a capacitance-to-voltage converter IC that has been developed by combining correlated double sampling with delta modulation in a fully differential circuit topology. This oversampling circuit may be adjusted to trade bandwidth (sample rate) for resolution, while reference levels may be adjusted to set the desired sensitivity to accommodate a large range of capacitive sensor in-

terface applications. The IC was fabricated using an inexpensive, 1.5-μm, double-metal, double-polysilicon CMOS technology, and test results demonstrate a resolution of 170 aF for a signal bandwidth of 3 kHz, a 68-dB dynamic range, and nonlinearity less than 0.16%. The converter IC was used to characterize a comb-drive, SiC lateral MEMS resonator by time-domain measurement of its shuttle-comb capacitance. Resonant frequency was found to be 16.6 kHz, independent of operating pressure, but quality factor varied from 51 at 760-Torr pressure to 6900 at 175 mTorr. The ability to accurately characterize the SiC resonator shows that the packaging approach used in this study is sufficient to interface capacitive-based MEMS devices with Si ICs in cases where on-chip integration is not feasible or possible.

Measurement and comparison of potentiometric selectivity coefficients of urea biosensors based on ammonium ion-selective electrodes
Nien Hsuan Chou Jung Chuan Chou Tai Ping Sun Shen Kan Hsiung

On page(s): 1362- 1368

Abstract
This study analyzes the selectivity of a potentiometric urea biosensor prepared by immobilizing of urease directly onto the surface of an ammonium ion-selective electrode. In this investigation, using the entrapment method, the urease enzyme was immobilized onto the carboxylated polyvinylchloride (PVC-COOH) membrane surface of an ion-selective electrode containing nonactin as an ionophore and a tin oxide (SnO/sub 2/) thin film. To describe the characteristics of the selectivity of urea biosensors based on ammonium ion-selective electrodes, the determinations of potentiometric selectivity coefficients ($K^{pot}_{i,j}$) of the urea biosensor in different univalent interfering ions were presented in a sample solution of pH 7.5. Using the separate solution method and fixed interference method (FIM) for determining selectivity coefficients, this investigation considers and discusses the influence of the urea biosensors preference on the primary ions relative to interfering ions of the same charge number. The observation results indicate that FIM is the proper method for calculating the selectivity coefficients of the ammonium ISE-based urea biosensors.

Optimized temperature modulation of micro-hotplate gas sensors through pseudorandom binary sequences
Vergara, A. Llobet, E. Brezmes, J. Vilanova, X. Ivanov, P. Gracia, I. Cane, C. Correig, X.

On page(s): 1369- 1378

Abstract
In recent years, modulating the working temperature of metal-oxide gas sensors has been one of the most widely used methods to enhance sensor selectivity. When the working temperature of a gas sensor is modulated, the kinetics of the gas-sensor interaction are altered, and this leads to characteristic response patterns. Many works have shown that it is possible to identify and determine the concentration of gases in simple mixtures, even using a single temperature-modulated metal-oxide gas sensor. However, the selection of the frequencies used to modulate temperature remains an empirical process. In this paper, we introduce a method, borrowed from the field-of-system identification, to systematically determine the optimal set of modulating frequencies to solve a given gas-analysis application. The method consists of using maximum-length pseudorandom binary sequences to modulate the working temperature of metal-oxide gas sensors. Since these signals have a flat power spectrum (i.e., like white noise) in a wide frequency range, an estimate of the impulse response of each gas-sensor pair can be computed by the cross correlation of the excitatory and response sequences. Studying the impulse response estimates, the set of modulating frequencies that are useful to discriminate between different gases and to estimate gas concentration, is obtained in a systematic way. The method is demonstrated with tungsten oxide micro-hotplate gas sensors applied to detect ammonia, nitrogen dioxide, and their binary mixtures at different concentrations. It is shown that it is possible to find temperature-modulating frequencies to obtain high gas identification and quantification rates (95.55% and 100%, respectively).

A Novel У–Д Pulsed Digital Oscillator (PDO) for MEMS
Dominguez, M. Pons-Nin, J. Ricart, J. Bermejo, A. FigueraSCosta, E.

On page(s): 1379- 1388

Abstract
A novel digital oscillator topology for microelectromechanical systems (MEMS) based on bandpass sigma–delta modulation is presented. Short pulses of force of the same amplitude maintain the oscillation and the associated bit-stream output serves to know the oscillation frequency which, for low mechanical losses, is very close to the natural frequency of the MEMS reso-

nator. Position-sensing requirements are extremely simplified because, at each sampling time, it is only necessary to know whether the resonator position is above or below the steady-state position. Continuous-time simulations are presented showing the behavior of the oscillator for different sampling frequencies and mechanical damping losses. Experimental results from an oscillator using a MEMS resonator with thermoelectric actuation and piezoresitive position sensing are presented. It is concluded that the quality of the oscillator response depends on the resonator damping losses and on the sampling frequency. The experimental results agree with the analytical and simulation results.

Silicon-carbide MESFET-based 400°C MEMS sensing and data telemetry
Run Wang Ko, W.H. Young, D.J.

On page(s): 1389- 1394

Abstract
A prototype high-temperature silicon-carbide (SiC) MESFET-based microelectromechanical systems (MEMS) sensing and date telemetry module is reported for harsh environment applications. The module employs a MEMS silicon capacitive pressure sensor performing pressure to frequency conversion and an on-board spiral loop serving as an inductor for the LC resonator and also as a telemetry antenna. The system demonstrates a high-temperature performance up to 400°C, limited by the SiC MESFET characteristics, and achieves a telemetry distance of 1m.

A microphone array system for multimedia applications with near-field signal targets
Yahong Rosa Zheng Goubran, R.A. El-Tanany, M. Hongchi Shi

On page(s): 1395- 1406

Abstract
A microphone array beamforming system is proposed for multimedia communication applications using four sets of small planar arrays mounted on a computer monitor. A new virtual array approach is employed such that the original signals received by the array elements are weighted and delayed to synthesize a large, nonuniformly spaced, harmonically nested virtual array covering the frequency band [50, 7000] Hz of the wideband telephony. Subband multirate processing and near-field beamforming techniques are then used jointly by the nested virtual array to improve the performances in reverberant environments. A new beamforming algorithm is also proposed using a broadband near-field spherically isotropic noise model for array optimization. The near-field noise model assumes a large number of broadband random noises uniformly distributed over a sphere with a finite radius in contrast to the conventional far-field isotropic noise model which has an infinite radius. The radius of the noise model, thus, adds a design parameter in addition to its power for tradeoffs between performance and robustness. It is shown that the near-field beamformers designed by the new algorithm can achieve more than 8-dB reverberation suppression while maintaining sufficient robustness against background noises and signal location errors. Computer simulations and real room experiments also show that the proposed array beamforming system reduces beampattern variations for broadband signals, obtains strong noise and reverberation suppression, and improves the sound quality for near-field targets.

Design of a system that uses optical-fiber sensors and neural networks to control a large-scale industrial oven by monitoring the food quality online
Oapos Farrell, M. Lewis, E. Flanagan, C. Lyons, W.B. Jackman, N.

On page(s): 1407- 1420

Abstract
An optical-fiber sensor-based system has been designed to assist in the controlling of a large-scale industrial by monitoring the color of the food product being cooked. The system monitors the color of the food as it cooks by examining the reflected visible light, from the surface and/or core of the cooked product. A trained backpropagation neural network acts as a classifier and is used to interpret the extent to which each product is cooked with regard to the aesthetics of the food. Principal component analysis is also included before the neural network as a method of feature extraction. This is implemented using Karhunen-Loeve decomposition. A wide range of food products have been examined and accurately classified, demonstrating the versatility and repeatability of the system over time. These products include minced beef burgers and steamed chicken fillets.

Noniterative algorithms for electrical resistivity imaging applied to subsurface local anomalies
Gasulla, M. Pallas-Areny, R.

On page(s): 1421- 1432

Abstract
In this paper, we compare five noniterative (one-step) algorithms for two-dimensional electrical resistivity imaging applied to the location of subsurface local

anomalies. Here, we analyze the performance of two backprojection algorithms and three algorithms based on a least-squares criterion. These five algorithms can also be adapted for process and medical tomography. Algorithm performance is first assessed from synthetic data derived from an analytical solution. We show that least-squares-based algorithms outperform backprojection algorithms in all situations considered. One of the least-squares algorithms was further validated with experimental measurements involving spherical objects immersed into a water tank. Data were obtained using a 16-electrode linear array and a computer-controlled data-acquisition system. A reference measurement before immersing the objects into the water tank reduced errors in the reconstructed image attributable to the uncertain electrode position and the finite dimensions of the tank. Images deteriorated for deeper objects, but neglecting measurements with the smallest signal-to-noise ratio improved the results.

Fast and robust gas identification system using an integrated gas sensor technology and Gaussian mixture models
Brahim-Belhouari, S. Bermak, A. Minghua Shi Chan, P.C.H.

On page(s): 1433- 1444

Abstract
Among the most serious limitations facing the success of future consumer gas identification systems are the drift problem and the real-time detection due to the slow response of most of today's gas sensors. This paper shows that the combination of an integrated sensor array and a Gaussian mixture model permits success in gas identification problems. An integrated sensor array has been designed with the aim of combustion gases identification. Our identification system is able to quickly recognize gases with more than 96% accuracy. Robust detection is introduced through a drift counteraction approach based on extending the training data set using a simulated drift.

Feasibility of spread spectrum sensors for location of arcs on live wires
Furse, C. Smith, P. Safavi, M. Chet Lo

On page(s): 1445- 1450

Abstract
Spread spectrum methods are an important emerging class of sensors that have the potential to locate small, intermittent faults on energized aircraft power circuit wires. Previous work has demonstrated the use of these methods for hard faults (open and short circuits). This paper extends that work to the location of typical intermittent faults that plague aircraft maintainers. Test results on 200-ft-long realistic aircraft wires demonstrate the feasibility of these techniques to locate both wet and dry arcs while the system is powered with 400-Hz 115-V ac power running a variety of aircraft lighting loads. The capability of the system to function with either the aircraft structure or a paired wire as the return path to ground is demonstrated. These results indicate that spread spectrum methods have significant promise for locating intermittent faults on wires as they occur in flight or other modes of operation, such as landing and takeoff, taxiing, and other critical times when possible vibration, etc., may cause intermittent faults.

Dynamic MEMS-based photonic bandgap filter
Trimm, R.H. Tuck, E.J. Tuck, G. Buncick, M.C. Kranz, M. Reiner, P. Temmen, M.G. Ashley, P.R.

On page(s): 1451- 1461

Abstract
This paper presents the development of an integrated fast filtering system using a photonic band gap (PBG) filter and a microelectromechanical systems (MEMS) actuator. The actuator varies the air-gap thickness between two PBG stacks to vary the optical transmission of the stack. The switch is a fast, reliable, electrically driven filter that can be fully integrated with current focal plane array technologies. The filter has been developed to have "on" and "off" states in the 3-5-μm wavelength range. The device can be easily tailored for use in other wavebands. It can be stacked to increase the on/off contrast. This MEMS/PBG filter can be hybridized into existing optical system designs, and it can also be integrated into new optical system designs.

Simultaneous measurement of strain (to 2000 με) and temperature (to 600°C) using a combined Sb-Er-Ge-codoped fiber-fluorescence and grating-based technique
Pal, S. Yonghang Shen Mandal, J. Tong Sun Grattan, K.T.V.

On page(s): 1462- 1468

Abstract
An optical fiber-based sensing scheme for the simultaneous measurement of strain and temperature over a wider range has been demonstrated by writing a grating with very high reflectivity in a 10-cm-long specially fabricated antimony-erbium-germanium (Sb-Er-Ge)-doped silica fiber. The scheme exploits the grating sensitivity to both strain and temperature in association

with the temperature-dependent peak power ratio of the two fluorescence peaks around 1535 and 1552 nm of the amplified spontaneous emission due to $^4I_{13/2}$?$^4I_{15/2}$ transition arising from the presence of erbium ions in the fiber core, using a 980-nm laser diode as a pumping source. The sensor created using this fiber can be used for the simultaneous measurement of strain and temperature over the wide ranges of 0-2000 με and 20°C-600°C, with root-mean-square errors of 36 με and 2.8°C, respectively.

Analysis of spread spectrum time domain reflectometry for wire fault location
Smith, P. Furse, C. Gunther, J.

On page(s): 1469- 1478

Abstract
Spread spectrum time domain reflectometry (SSTDR) and sequence time domain reflectometry have been demonstrated to be effective technologies for locating intermittent faults on aircraft wires carrying typical signals in flight. This paper examines the parameters that control the accuracy, latency, and signal to noise ratio for these methods. Both test methods are shown to be effective for wires carrying ACpower signals, and SSTDR is shown to be particularly effective at testing wires carrying digital signals such as Mil-Std 1553 data. Results are demonstrated for both controlled and uncontrolled impedance cables. The low test signal levels and high noise immunity of these test methods make them well suited to test for intermittent wiring failures such as open circuits, short circuits, and arcs on cables in aircraft in flight.

Mixed-signal reflectometer for location of faults on aging wiring
Tsai, P. Chet Lo You Chung Chung Furse, C.

On page(s): 1479- 1482

Abstract
Location of faults on aging cables is of great interest to maintainers of aircraft, cars, power distribution systems, communication systems, etc. One class of methods for locating faults is frequency domain reflectometry (FDR), using sine waves as the forcing function. A new frequency domain method called mixed-signal reflectometry (MSR) is described in this paper and compared to data from phase detection FDR (PDFDR) methods. The MSR is less expensive and smaller than the PDFDR and has very similar performance. A prototype system using the 100-200-MHz bandwidth with 256 40-kHz steps is shown to have a resolution of about 10 cm, very similar to a PDFDR in the same frequency band.

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Configurable electrodes for capacitive-type sensors and chemical sensors
Kummer, A.M. Hierlemann, A.

On page(s): 3- 10

Abstract
This paper describes a novel design for capacitive sensors or chemical sensors, which features configurable interdigitated electrodes: The electrode spacing can be varied by means of switches on the CMOS chip. This new design allows for performing two capacitive measurements with one single-sensor capacitor so that the number of sensors required to acquire a certain amount of information can be significantly reduced. The use of the same sensor and the same polymer layer for two measurements at a different electrode periodicity provides a better signal quality for the difference signal since detrimental influences, such as humidity and sensor drift, are similar for both electrode configurations and are strongly correlated. Such high signal quality is required for, e.g., the successful recognition of n-octane in the presence of tenfold larger background signals of humidity or, in general, for the determination of low analyte concentrations in humid air. The baseline drift in the concentration predictions based on the differential signal from the two electrode configurations was an order of magnitude lower than that for uncorrelated signals produced by two separate interdigitated capacitors on the same chip. Since the number of required sensors is reduced and, owing to the differential readout of two electrode configurations, reference capacitors are no longer necessary, the overall chip size and/or the number of sensor chips and, consequently, costs can be considerably reduced.

Microfabricated needle-type sensors for pO_2, pCO_2, and pH
Xiaowen Wang Suzuki, H. Hayashi, K. Kaneko, T. Sunagawa, K.

On page(s): 11- 18

Abstract
In order to conduct in vivo continuous monitoring of blood gas levels, very thin disposable pO_2, pCO_2, and pH sensors, which could be incorporated into a syringe needle or a catheter, were microfabricated. Electrode

patterns were formed on a polyimide substrate and stacked with intervening polyimide insulating layers. An electrolyte layer was formed, which was covered with a silicone rubber gas-permeable membrane or a passivating layer. The most critical part of the sensor was a Ag-AgCl reference electrode with a pinhole structure. Because of the structure and novel operational mode of the reference electrode, its potential stabilized immediately, and reproducible responses were realized for the respective sensors. Performance characterization revealed clear responses and linear calibration plots in the ranges of partial pressures or pH of physiological levels. No significant damages or changes in the performance of the sensors were observed after ethylene oxide sterilization.

Low-concentration NO_2 detection with an adsorption porous silicon FET
Barillaro, G. Diligenti, A. Nannini, A. Strambini, L.M. Comini, E. Sberveglieri, G.

On page(s): 19- 23

Abstract
Adsorption porous silicon FET (APSFET) is a porous silicon (PS)-based device constituted of a FET structure with a porous adsorbing layer between drain and source. Adsorbed gas molecules in the porous layer induce an inverted channel in the crystalline silicon under the PS itself. The mobile charge per unit area in the channel depends on the molecular gas concentrations in the sensing layer so that adsorbed gas molecules play a role similar to the charge on the gate of a FET. In this work, NO_2 detection by using the APSFET is demonstrated for the first time. NO_2 concentration as low as 100 ppb was detected. Devices with both as-grown and oxidized PS layers were fabricated and compared in order to investigate the effect of a low-temperature thermal oxidation on the electrical performances of the sensor. Nonoxidized sensors show a high sensitivity only for fresh devices, which reduces with the aging of the sample. Oxidation of the PS layer improves the electrical performance of sensors, in terms of stability, recovery time, and interference with the relative humidity level, keeping the high sensitivity to nitrogen dioxide.

Impact of morphology on high-speed humidity sensor performance
Steele, J.J. Gospodyn, J.P. Sit, J.C. Brett, M.J.

On page(s): 24- 27

Abstract
Capacitive-based humidity sensors were fabricated using unique nanostructured aluminum-oxide thin films. These sensors exhibited extremely fast desorption response times as short as 42 ms. In this paper, we present the effects of varying the thin-film porosity on sensor performance. Specifically, we look at the capacitive response and the desorption response time of the sensors. It was found that increased porosity tends to decrease the desorption response time and increase the relative humidity where the devices become sensitive.

Optimization of inertial micropower Generators for human walking motion
von Buren, T. Mitcheson, P.D. Green, T.C. Yeatman, E.M. Holmes, A.S. Troster, G.

On page(s): 28- 38

Abstract
Micropower generators, which have applications in distributed sensing, have previously been classified into architectures and analyzed for sinusoidal driving motions. However, under many practical operating conditions, the driving motion will not be sinusoidal. In this paper, we present a comparison of the simulated performance of optimized configurations of the different architectures using measured acceleration data from walking motion gathered from human subjects. The sensitivity of generator performance to variations in generator parameters is investigated, with a 20% change in generator parameters causing between a 3% and 80% drop in generator power output, depending upon generator architecture and operating condition. Based on the results of this investigation, microgenerator design guidelines are provided. The Coulomb-force parametric generator is the recommended architecture for generators with internal displacement amplitude limits of less than ~0.5 mm and the velocity-damped resonant generator is the recommended architecture when the internal displacement amplitude can exceed ~0.5 mm, depending upon the exact operating conditions. Maximum power densities for human powered motion vary between 8.7 and 2100 $\mu W/cm^3$, depending upon generator size and the location of the body on which it is mounted.

Design optimization and implementation of a micro-gravity capacitive HARPSS accelerometer
Monajemi, P. Ayazi, F.

On page(s): 39- 46

Abstract
This paper reports on the design optimization and implementation of a lateral capacitive accelerometer with high sensitivity and micro-g resolution, fabricated through the high-aspect ratio polysilicon and single-

crystal silicon process on regular silicon wafers. A new implementation of vertical corrugation in silicon electrodes is developed to reduce the mechanical noise equivalent acceleration of the sensor. The predicted effect of corrugation on thermomechanical noise and also on static sensitivity is verified using ANSYS steady-state thermal simulation and FEMLAB linear stationary electrostatics analysis, respectively. The number of corrugated electrodes and the sense gap spacing is optimized to minimize the system (sensor + circuit) noise floor, while satisfying process and electronics limits. The open-loop differential sensitivity of a 60-мм-thick prototype accelerometer is measured to be 0.25 V/g equivalent to 4.5 pF/g over a 1-g range. The estimated total noise equivalent acceleration of the system (sensor + circuit) is 0.95 мg/?Hz in atmosphere.

Passive charge modulation for a wireless pressure sensor
Theurer, C.B. Li Zhang Kazmer, D.O. Gao, R.X. Jackson, R.W.

On page(s): 47- 54

Abstract
A wireless pressure sensor is described for use in a high-pressure manufacturing process with three major subsystems: energy conversion by a stack of piezoelectric disks, energy measurement and control by a threshold modulator, and ultrasonic signal transmission by a piezoelectric transmitter. The second system, the threshold modulator, is the focus of this paper. The charge, proportional to pressure, on a capacitive element is measured and controlled through the use of a two-transistor modulator. Standard NPN and PNP transistors are used to passively control the flow of charge between a piezoelectric stack and an ultrasonic transmitter. The basis for the design is discussed, from which a simulation is developed and compared to a bench top prototype. The results of this comparison indicate the appropriateness of the assumptions used to produce an analytical model of the design and the limiting conditions under which the modulator will effectively measure charge. Finally, the prototype device is optimized with respect to sensitivity, gain, and operating range for use in real-time process monitoring and control.

High-temperature piezoelectric film ultrasonic transducers by a sol-gel spray technique and their application to process monitoring of polymer injection molding
Kobayashi, M. Ono, Y. Cheng-Kuei Jen Chin-Chi Cheng

On page(s): 55- 62

Abstract
Thick-film (90 мм) piezoelectric ceramic high-temperature ultrasonic transducers (HTUTs) have been successfully deposited on metallic substrates by a sol-gel spray technique. The gel is composed of fine powders of bismuth titanate dispersed in a lead-zirconate-titanate solution. The films with desired thickness have been obtained through multilayer coating approach. Piezoelectricity is achieved using the corona discharge poling method. The center frequencies of ultrasonic signals generated by these HTUTs are around 10 MHz and their signal-to-noise ratio (SNR) is more than 30 dB in pulse-echo mode at 500 °C. The main advantages of these new HTUTs are that they 1) are applicable at temperatures higher than 500 °C, 2) are miniature, 3) can be coated on flat and curved surfaces, 4) do not need ultrasonic couplant, 5) can be operated at low and medium megahertz frequency range with sufficient frequency bandwidth, and 6) have sufficient piezoelectric strength and SNR. The ability of the HTUTs to monitor the polymer injection molding process in real-time at the mold insert of the machine is demonstrated.

Tilt sensor with FBG technology and matched FBG demodulating method
Bao-Jin Peng Yong Zhao Yan Zhao Jian Yang

On page(s): 63- 66

Abstract
A tilt measurement structure and signal detection method is proposed based on a self-demodulated fiber-Bragg grating (FBG) sensor, which consists of a couple of matched FBGs and a cantilever-based pendulum clinometer. Compared by the typical matched FBGs demodulating method, of which a sensing FBG and a demodulating filter FBG is placed separately, both matched FBGs of this tilt sensor are attached on the upper and lower surface of only one single pendulum-type cantilever element for simultaneous sensing and demodulating. So the received light power will change due to the split of the two reflected spectrum of FBGs, which is corresponding to the tilt angle. In addition, the cross-sensitivity effect of the FBG-based sensor is automatically solved due to a differential signal process method. Experimental results indicate the feasibility of the proposed idea.

Experimental modal analysis of an aircraft model wing by embedded fiber Bragg grating sensors
Cusano, A. Capoluongo, P. Campopiano, S. Cutolo, A. Giordano, M. Felli, F. Paolozzi, A. Caponero, M.

On page(s): 67- 77

Abstract
A critical issue in practical structural health monitoring is related to the capability of proper sensing systems integrated within the host structures to detect, identify, and localize damage generation. To this aim, many techniques have been proposed involving dynamic measurements such as modal analysis, acoustic emission, and ultrasonics. This paper relies on the use of embedded fiber Bragg grating sensors for performing an experimental modal analysis on a wing of an aircraft model. Time domain response of the embedded fiber-optic sensors induced by hammer impacts were acquired and transformed into the frequency domain. Using a classical technique based on the frequency transfer function, the first displacement and strain mode shapes of the wing have been retrieved in terms of natural frequencies and amplitudes. Experimental results confirm the excellent performances of this class of sensing devices to determine the modal behavior within complex structures compared with conventional accelerometer-based detection systems.

MEMS sensors to resolve spatial variations in shear stress in a 3-D blood vessel bifurcation model
Rouhanizadeh, M. Soundararajan, G. Lo, R. Arcas, D. Browand, F.K. Hsiai, T.K.

On page(s): 78- 88

Abstract
Coronary artery disease (CAD) preferentially develops at the arterial branching points or bifurcations. Hemodynamics, particularly wall shear stress, plays an important role in regulating the development of CAD. The advent of the microelectromechanical systems (MEMS) sensor provides a potential entry point to overcome the difficulty in measuring temporal and spatial variations in shear stress. We, hereby, demonstrate the application of a MEMS sensor to resolve circumferential variations in shear stress using a three-dimensional symmetric bifurcation model. Reynolds numbers ranging from 1.34 to 6.7 were chosen to simulate flow at the microcirculation level. At these low Reynolds numbers, the wall shear stress was highest at the divider of bifurcation, and relaxed to a lower value downstream from the bifurcation. Skin friction coefficient values (C_f), defined as local wall shear stress normalized by the upstream dynamic pressure, varied circumferentially by a factor of 2 or more from the medial wall at the divider to the lateral wall of bifurcation. These experimental skin friction coefficients at various positions were in close agreement with values derived from the Navier-Stokes solution.

The derivation and validation of the practical operating equation for electromagnetic flowmeters: case of having an electrolytic conductor flowing through
Maalouf, A.I.

On page(s): 89- 96

Abstract
In this paper, the practical operating equation for the electromagnetic flowmeter is derived for the case of having a circular pipe with an electrolytic conductor flowing through. It is assumed further that the magnetic field is uniform and the velocity profile is axisymmetric (assuming nonconducting walls). The derivation was done before by many authors to whom the author refer to in this paper, but the approach provided here is comprehensive and simple. To add to that, the solution for the electromagnetic flowmeter's operating equation illustrated in this paper is new and is provided using very simple mathematical concepts, eliminating the complexity of solutions provided by other authors in the past. In the end, the practical operating equation derived was validated using a new approach based on the finite element analysis and the moving stream method to estimate the error resulting from using this operating equation with the assumptions of having a uniform magnetic field and an axisymmetric velocity profile, which are difficult to achieve in practice. This error can be used in a dry calibration to estimate the error caused by variable flow characteristics.

A micromachined wide-bandwidth magnetic field sensor based on all-PMMA electron tunneling transducer
Jing Wang Wei Xue Seetala, N.V. Xueyuan Nie Meletis, E.I. Tianhong Cui

On page(s): 97- 105

Abstract
All-PMMA-based tunneling magnetic sensors were fabricated by hot embossing replication with silicon templates. The silicon templates had smooth surfaces, positive profiles, and pyramid-like pits with a high aspect ratio. With this fast (20 min), simple (one-step), and repeatable method, the all-PMMA tunneling sensor platform yielded sharp tunneling tips with 75 мм in baseline and 50 мм in depth. The sensors were assembled and fixed with measurement circuits, after their electrodes were patterned with modified photolithography and Co film was deposited with e-beam

evaporation. A natural frequency response of 1.3 kHz was observed, and a tunneling barrier height of 0.713 eV was tested. Due to the quadratic relation between magnetic force and the field, the sensor field response ($7.0Ч10^{6}$ V/T^{2}) was also quadratic. The noise voltage at 1 kHz is 0.2 mV, corresponding to a magnet field of $0.46Ч10^{-6}$ T. The bandwidth of this sensor is 18 kHz. This new type of sensor platform is promising for the next generation of microsensing applications.

Temperature stable Hall effect sensors
Partin, D.L. Heremans, J.P. Schroeder, T. Thrush, C.M. Flores-Mena, L.A.

On page(s): 106- 110

Abstract
Magnetic field sensors are needed for high-accuracy position, angle, force, strain, torque, and current flow measurements. Molecular beam epitaxy was used to grow tellurium-doped indium-gallium antimonide thin films. Hall effect sensors made from these films have been studied for their magnetic sensitivity and thermal stability. For a range of alloy composition near $In_{0.8}Ga_{0.2}Sb$ and n-type doping levels near $2Ч10^{17}$ cm^{-3}, high magnetic sensitivity from -40°C to +200°C was found with a resolution of better than ±0.5% over the entire temperature range.

Chirped fiber-Bragg grating as self-temperature referenced strain sensor in nonisothermal thermoset processing
Cusano, A. Capoluongo, P. Cutolo, A. Giordano, M.

On page(s): 111- 117

Abstract
A partially embedded chirped fiber-Bragg grating (FBG) has been used to monitor the strain build up during nonisothermal curing of a model thermoset resin. The particular feature of the spectrum of a linearly chirped and strongly apodized FBG to encode position along the sensor has been used to simultaneously measure temperature and strain during the cure cycle of an epoxy-based polymer. In particular, the embedded part of the grating allows the monitoring of temperature and processing strain while the rest of the sensor is sensible to temperature variation only. A new self-temperature referenced sensor system has been successfully tested in an operative condition where usually thermomechanical loading are simultaneously active. The onset and progression of gelification, as well as the residual processing strain, have been experimentally measured.

Theoretical approach to CMOS APS PSF and MTF modeling — evaluation
Grois, D. Shcherback, I. Danov, T. Yadid-Pecht, O.

On page(s): 118- 124

Abstract
In this work, a fully theoretical CMOS active pixel sensor (APS) modulation transfer function model is formulated, evaluated, and compared with practical results. The model is based on a two-dimensional diffusion equation solution and covers the symmetrical photocarriers diffusion effect together with the impact of the pixel active area geometrical shape. Thorough scanning results obtained by means of a unique submicron scanning system (the S-cube system) from various APS chips, implemented in a standard CMOS 0.35-мм technology, are compared with our theoretical predictions. The agreement of the presented comparison results indicates that for any potential active area shape, an analytical reliable estimate of image performance is possible.

Capacitive transducers with curved electrodes
McIntosh, R.B. Mauger, P.E. Patterson, S.R.

On page(s): 125- 138

Abstract
The design, performance, and potential applications are described for capacitive transducers with curved electrodes. A curved electrode governs the deflection of a compliant electrode under applied stress. A dielectric film on one electrode provides a variable region of fixed electrode spacing. The sensitivity and linear dynamic range of the transducers are higher and wider than devices with parallel electrodes. An electrical advantage is obtained from the permittivity of the dielectric film and a mechanical advantage from its thinness. Transducers have been constructed with silicon diaphragms that bend and polymer membranes that stretch in response to uniform pressure. The silicon sensors measured dynamic pressure changes over a linear range of 125 dB. An 885% change in capacitance was obtained for a sensor with a thin silicon diaphragm. Sensors with polycarbonate membranes demonstrated the ability of a low-cost transducer to measure pressure, fluid flow, displacement, and tilt. An active capacitive bridge circuit was developed to linearly measure capacitance changes up to 1000% and to control electrostatic actuators by force-balanced feedback. Methods and materials to construct microscale transducers are discussed along with the performance limitations of electrostatic actuation.

Temperature feedback control for improving the stability of a semiconductor-metal-oxide (SMO) gas sensor

Jian-Wei Gong Quan-Fang Chen Ming-Ren
Lian Nen-Chin Liu Daoust, C.

On page(s): 139- 145

Abstract
Stability is a major concern of semiconductor-metal-oxide (SMO) gas sensors in practical applications, as they may cause false alarm problems. Ambient temperature is a major factor affecting the SMO gas sensor's stability. In this paper, we use a novel way to improve temperature stability of SMO (tin oxide) gas sensors by applying a temperature feedback control circuits which are compatible with our microelectromechanical systems sensor fabrication. A built-in platinum temperature sensor can precisely detect the sensor's working temperature. It provides feedback information to compensate the microheater's current to maintain the sensor's working temperature constant, regardless of ambient temperature change. Test results showed that, with this approach, significant improvement of stability has been achieved compared to SMO gas sensors without temperature compensation under the same ambient variation. The algorithm is realized through a hardware circuit, whose advantages include real time, large feedback gain, and low cost.

Room-temperature gas-sensing ability of PtSi/porous Si Schottky junctions

Raissi, F. Mirzakuchaki, S. Jalili, H.M. Erfanian,
A. Dept. of Electr. Eng., K. N.

On page(s): 146- 150

Abstract
Gas-sensing ability of n-type PtSi/porous Si Schottky junctions is investigated at room temperature. These junctions exhibit a breakdown-type current-voltage (*I-V*) curve at low reverse bias voltages (5-15 V) due to very large electric fringing fields (10^5-10^6 V/cm) developed at the sharp edges and the bottom of the pores. Experimental results for selected gases are presented. Gases with inherent dipole moments tend to decrease the breakdown voltage. Gases without dipole moments do not affect the *I-V* curve directly, but they can replace gas content inside the pores and decrease the dipole moment of the ambient gas, which results in an increase in breakdown voltage. Based on these experiments, the possible application of this structure as a gas sensor at room temperature is discussed.

Numerical and experimental analysis of enzymatic reaction in electrochemical sensors: electrochemical enzymatic analysis

Barak-Shinar, D. Rosenfeld, M. Rishpon,
J. Neufeld, T. Abboud, S.

On page(s): 151- 159

Abstract
The research examines, numerically and experimentally, the identification of substrate concentration in amperometric electrochemical flow cells. Three-dimensional numerical simulations have been preformed for predicting the mass transfer processes in the vicinity of the electrochemical cell using a realistic geometrical model. The experimental procedure included the fixed enzyme в-galactosidase and the injected substrate, para-aminophenyl в-D-galactopyranoside. For the optimization of the inlet flow rate, simulations and experiments have been preformed using flow rates between 0.05-250 мl/min with an identical substrate concentration. The numerical simulation results were used to evaluate the species concentration distribution in the vicinity of the electrochemical cell for predicting the electric current through the electrode. Different substrate concentrations applied and ranged between 0.05-1.125 mg/ml at a chosen flow rate of 50 мl/min. A good agreement was found between the numerical and the experimental electric current evolution values, especially for the higher substrate concentrations. The correlation coefficient was 0.98 in the higher substrate concentrations. A linear relationship was obtained between the inlet substrate concentration and the steady-state electric current for both the numerical and the experimental results. Once this linear relationship is established, the inlet substrate concentration based on the electric current through the electrode can be established.

Exact extraction of piezoresistance coefficient using flat membrane

Gniazdowski, Z.

On page(s): 160- 165

Abstract
The method for the extraction of piezoresistance coefficients with the use of a flat membrane as a test structure is considered. The necessary and sufficient conditions and conditioning of the extraction problem are examined as a problem of a correct test structure. For the given condition number, the number of the error propagation of the input data is considered.

Acoustic self-localization in a distributed sensor network

Frampton, K.D.

On page(s): 166- 172

Abstract

The purpose of this paper is to present a technique for determining the coordinate locations of nodes in a distributed sensor network. This technique is based on the time difference of arrival (TDOA) of acoustic signals. In this scheme, several sound sources of known locations transmit while each node in the sensor network records the wave front time-of-arrival. Data from the nodes are transmitted to a central processor and the nonlinear TDOA equations are solved. Computational simulation results are presented in order to quantify the solution behavior and its sensitivity to likely error sources. Results based on experimentally collected data are also presented in order to demonstrate the potential for this approach in solving the self-localization problem.

Identification of typical wine aromas by means of an electronic nose

Lozano, J. Santos, J.P. Aleixandre, M. Sayago, I. Gutierrez, J. Horrillo, M.C.

On page(s): 173- 178

Abstract

In the field of electronic noses (e-noses), it is not very usual to find many applications to wine detection. Most of them are related to the discrimination of wines in order to prevent their illegal adulteration and detection of off-odors, but their objective is not the identification of wine aromas. In this paper, an application of an e-nose for the identification of typical aromatic compounds present in white and red wines is shown. The descriptors of these compounds are fruity, floral, herbaceous, vegetative, spicy, smoky, and microbiological, and they are responsible for the usual aromas in wines; concentrations differ from 2-8Ч the threshold concentration humans can smell. Some of the measured aromas are pear, apple, peach, coconut, rose, geranium, cut green grass, mint, vanilla, clove, almond, toast, wood, and butter. Principal component analysis and linear discriminant analysis show that datasets of these groups of compounds are clearly separated, and a comparison among several types of artificial neural networks has been also performed. The results confirm that the system has good performance in the classification of typical red and white wine aromas.

An ultrasonic obstacle detector based on phase beamforming principles

Strakowski, M.R. Kosmowski, B.B. Kowalik, R. Wierzba, P.

On page(s): 179- 186

Abstract

A prototype of an ultrasonic obstacle detector developed as a part of a navigation system for blind and visually impaired people is presented. The detector, which employs a single ultrasound source and an array of microphones, determines the distance to the obstacle by measuring time between sending the pulse and receiving the reflected signal. Using the phase beamforming technique, borrowed from hydroacoustics, to process the output signals of microphones, it determines also the direction from which the reflected signal is received, thereby locating the obstacle. The obstacle detector was subjected to a series of tests in order to verify its design and to assess its ability to detect a broad range of obstacles. Presented test results show that most obstacles can be detected and recognized, and that the tested obstacle detector provides complete coverage of the safety zone in front of the user.

A multichannel, wireless telemetric microsystem for small animal studies

Chung-Chiun Liu Oapos Connor, E. Strohl, K.P.

On page(s): 187- 202

Abstract

Conventional means of collecting biophysiological parameters in small animals often involve cumbersome direct wiring and/or restraint of the animal. At present, there is no system for very small animals that can provide multichannel monitoring of biopotentials without restraining the animal or small enough in size or light enough in weight for studies with smaller animals. For larger animals, such as monkeys or larger rodents, systems have been proposed where the transmitter of the system has dimensions such as 2.5Ч2.5Ч1.3 cm^3 and the weight is 9 g; this is far too high for smaller animals. Also, the battery life of that system is relatively short (~10 h). In this study, a multichannel wireless telemetric microsystem for biopotential monitoring in small animals, such as mice or rats, has been designed, fabricated, and evaluated. This microsystem has four input channels with one calibration channel. There are 8 channels on the chip, of which five, the four electroencephalogram (EEG)/electromyogram (EMG) channels, and the calibration channel, are now in use. The system can also be expanded to more than eight input channels, if desired. In that case, a larger ASIC chip and larger circuit substrate might be required, depending on the type of biopotentials being measured. The

amount of ASIC and circuit substrate space consumption is larger for biopotentials such as EEG or EMG than for others such as temperature or pressure. However, the same clocking-demodulation system could be retained up to ~128 channels. The multichannel telemetric chip for the present embodiment is approximately 2Ч2 mm, and the overall size of the microsystem is approximately 10Ч10Ч5 mm, including the enclosure package and battery, with a total weight of 1 g. The power consumed by this four-channel version, where two channels are EEG and two are EMG, is ~0.41 mW, and the fabrication process is AMI_ABN. There is a magnetic on/off provision. The microsystem has been used to monitor EEG, Theta activity, and nuchal EMG in mice with excellent results. This wireless telemetric microsystem can be effectively used to record multiple biopotentials from freely moving small animals. This platform microsyste- m can be extended to include other physiological parameters, such as temperature, pressure, and biological parameters.

Localization of object edges in arbitrary spatial positions based on ultrasonic data
Krammer, P. Schweinzer, H.

On page(s): 203- 210

Abstract
In mobile robotics, ultrasonic sensors became standard devices for collision avoiding. Moreover, their applicability for map building and navigation has exploited in recent years. Although three-dimensional (3-D) map building methods arose in recent years, most methods are concentrated on two-dimensional data representation. In this work, a new method for 3-D localization of object edges in arbitrary spatial positions and orientation is presented. With the help of a 3-D map of geometric modeled object edges, a high flexibility in the application of ongoing measurement values for the continuous correction of the robots' odometric drift can be achieved. The main problems with the practical application of this method are the statistical and distance-dependant behavior of conventional ultrasonic sensors, especially at the border of the sound lobe where the accuracy of the sensors normally decreases. Therefore, ways to improve the sensor accuracy for modeling and position measurement by enhancing sensor performance are shown. Finally, this paper includes an outlook on specialized sensors, applying sophisticated signal processing methods, especially suited for the localization method presented in this work.

Prototype silicon micropower supply for sensors
Singh, P. Kaneria, S. Anugonda, V.S. Chen, H.M. Wang, X.Q. Reisner, D.E. LaFollette, R.M.

On page(s): 211- 222

Abstract
Miniature, remote, autonomous sensors generally have a relatively large power supply compared to the size of the sensor and sensor conditioning electronic circuitry. An integrated micropower supply made in a silicon wafer offers the prospect of shrinking the power supply size down to the size of the sensor and conditioning circuitry. In this paper, we describe a prototype silicon micropower supply comprising a nickel-zinc microbattery integrated in a silicon wafer interfaced to a miniature silicon solar array via an adaptable charge controller that can optimally supply charging current from the miniature solar array to the microbattery. Details of each of the subsystems are described together with test results on a multichip, hybrid implementation of an all-silicon, miniature power supply.

Artificial odor discrimination system using multiple quartz resonator sensors and various neural networks for recognizing fragrance mixtures
Jatmiko, W. Fukuda, T. Arai, F. Kusumoputro, B.

On page(s): 223- 233

Abstract
An electronic odor discrimination system had been developed by using four quartz resonator-sensitive membranes basic-resonance frequencies at 10 MHz as a sensor and analyzed the measurement data through a back propagation (BP) as the pattern recognition system. The developed system showed high recognition probability to discriminate various single odors to its high generality properties; however, the system had a limitation in recognizing the fragrances mixture. This system also had other disadvantages, such as classifying the unknown category of odor as the known category of odor. In order to improve the performance of the proposed system, development of the sensor and other neural networks (NNs) are being sought. This paper explains the improvement of the capability of that system. In this experiment, the improvement is conducted not only by replacing the last hardware system from four quartz resonator-basic resonance frequencies at 10 MHz with new 16 quartz resonator-basic resonance frequencies at 20 MHz, but also by replacing the pattern classifier from BP NNs with the variance of BP, probabilistic NNs, and fuzzy-neuro learning vector quantization (FNLVQ). Matrix similarity analysis (MSA) is then proposed to increase the accuracy of the FNLVQ, to become FNLVQ-MSA

neural systems in determining the best exemplar vector, for speeding up its convergence. The purpose of the recent study is to construct a new artificial odor discrimination system for recognizing the fragrance mixtures, in addition to recognizing the unknown fragrance mixtures. The use of new sensing systems and FNLVQ-MSA has produced higher capability, compared to the previously mentioned system.

ВИМОГИ ДО ОФОРМЛЕННЯ СТАТЕЙ У ЖУРНАЛ. ІНФОРМАЦІЯ ДЛЯ АВТОРІВ.

Журнал "**Сенсорна електроніка і мікросистемні технології**" публікує статті, короткі повідомлення, листи до Редакції, а також коментарі, що містять результати фундаментальних і прикладних досліджень, за наступними напрямками:

1. Фізичні, хімічні та інші явища, на основі яких можуть бути створені сенсори.
2. Проектування і математичне моделювання сенсорів.
3. Сенсори фізичних величин.
4. Оптичні, оптоелектронні і радіаційні сенсори.
5. Акустоелектронні сенсори.
6. Хімічні сенсори.
7. Біосенсори.
8. Матеріали для сенсорів.
9. Технологія виробництва сенсорів.
10. Сенсори та інформаційні системи.
11. Деградація, метрологія і сертифікація сенсорів.
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1. Берестовский В.Б., Лифшиц Е.М., Питаевский Л.П., Квантовая электродинамика. — М.: Наука, 1984. — 430 с.

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