ABSTRACTS of current literature on the platinum metals and their alloys

PROPERTIES

STM Investigation of the Adsorption and Temperature Dependent Reactions of Ethylene on Pt(111)

The adsorption and reactions of C2H4, adsorbed in UHV on Pt(111) were studied as a function of temperature by STM. The STM images at 160K show an ordered structure of adsorbed C2H4, which on annealing to 300K produces ethylidyne (C-CH2-) irreversibly. The ethylidyne on Pt(111) is not visible to STM at room temperature, but cooling allows the ethylidyne ordered structure to be observed. Annealing at >430K causes further dehydrogenation, leaving only C on the surface. Further annealing at >800K produces graphite islands, having several superstructures with lattice parameters of up to 22Å.

The Role of Defects in the Specific Adsorption of Anions on Pt(111)

The specific adsorption of anions from HCl and H2SO4 acids was studied on Pt(111) surfaces with two types of induced defects: a step-terrace structure and a random up-and-down stepped surface. All step defects lowered the work function of the surface in direct proportion to the step density, indicating a local dipole at the step with its positive end outward from the surface. The local work function at the step is lower at the step than at atomically flat terraces. The local potential at zero charge (pzc) is significantly increased on the addition of B and by rapid solidification processing. After rapid solidification by double anvil splat quenching with subsequent annealing at 650°C for 30 min, Pt42Co45B11 showed an Hc of 14 kOe. The magnetic hardening mechanism is a combination of inhibited magnetic domain nucleation and difficult reverse domain growth caused by the interaction of the magnetically anisotropic Co borides with the L12 Pt-Co matrix.

Scanning Tunneling Microscopy of Pt/Co Multilayers on Pt Buffer Layers

Systematic STM studies of the surface structure of Pt/Co multilayers sputter-deposited on various Pt buffer layer thicknesses showed that it evolved toward nanometer-scale crystallites with distinct, mostly six-sided polygonal grain boundaries with increasing Pt buffer layer thickness. It is concluded that improved (111) texture and the appearance of distinct grain boundaries contributed to the higher magnetic coercivity of the multilayer on a Pt buffer layer.

Hydrogen Adsorption on Cobalt/ Pt(110)(1 x 2) Surfaces

A thin Co overlayer on a Pt(110)(1x2) surface substantially modifies the adsorption energy of H2. A new state appears with an adsorption energy near 9 kcal/mol, which is lower than that usually observed on bulk Pt and bulk Co. At above one monolayer desorption conditions appear similar to those observed on bulk Co.

Observation of Inverse U-Shaped Profiles after Platinum Diffusion in Silicon

Studies of inverse U-shaped profiles of Pt in Si obtained after diffusion at 700°C were performed by deep level transient spectroscopy to determine the initial concentration of vacancies. The Pt profiles were called ‘inverse U-shaped profiles’ because in the bulk, a higher concentration of Pt was found than at the surface. Pt diffusion was found to offer, for the first time the possibility to check and improve process simulation models which are based on point defects.

Microstructural and Magnetic Characterization of Rapidly Solidified and Annealed Pt-Co-B Alloys

The intrinsic coercivity (Hc) of Pt-Co alloys significantly increased on the addition of B and by rapid solidification processing. After rapid solidification by double anvil splat quenching with subsequent annealing at 650°C for 30 min, Pt42Co45B11 showed an Hc as high as 14 kOe. The magnetic hardening mechanism is a combination of inhibited magnetic domain nucleation and difficult reverse domain growth caused by the interaction of the magnetically anisotropic Co borides with the L12 Pt-Co matrix.

Thermodynamics of the Uranium-Platinum Metals Systems

The thermodynamics of the systems: U-Pt, U-Pd, U-Rh, U-Ir, U-Os and U-Ru are critically assessed. The isothermal sections of the ternary U-Rh-F, U-Ru-F, U-Os-F and U-Ir-F systems were found, and the Gibbs energies of formation of URu4, U3Ru2, URu3, U2Ru3 and U2Ir are determined between 900 and 1200 K. Thermodynamic results of the intermetallic phases and the platinum rich solid solution regions are discussed.

The Effect of Hydriding on the Physical Structure of Palladium and on the Release of Contained Tritium


The behaviour of T released from a contaminated Pd cathode was compared with the pattern found in cells which were claimed to produce T by cold fusion. Void space is produced in Pd when subjected to H absorption and desorption cycles. This void space can produce channels through which H can be lost from the cathode, thus reducing the H concentration. This effect is influenced by impurities, the electrode shape, charging rate, the H concentration achieved and the length of time of maximum concentration.

Formation of Decagonal Quasicrystal in the Al-Pd-Mn System and Its Structure


Studies of formation of a decagonal quasicrystal in Al$_x$Pd$_{9-x}$Mn$_{0.7}$ alloys ($x=8–20$) showed that the decagonal quasicrystal was formed as a coexisting phase with an icosahedral phase in the composition range of $x=10–15$, and as a single phase at a composition of $x$ about 20. It is proposed that the structure of Al-Pd-Mn decagonal quasicrystal may be interpreted as a tiling formed by atom cluster linkages.

Effect of Ordering Processes on Electrical and Magnetic Properties of Pd$_{0.40}Cu_{1-x}$ Alloy ($0.40 \leq x \leq 0.48$)


Studies of transformation of crystal structure, electrical resistance and magnetic susceptibility of Pd$_{0.40}Cu_{1-x}$ alloys with $x=0.40–0.48$ were performed under homogeneous conditions near to the stoichiometric region at 300–1200K. The results showed that ordering was accompanied by compression of the crystal lattice, and by sharp changes in electrical resistivity and diamagnetic susceptibility. The results were evaluated on the basis of density state in ordered and disordered alloys.

Constitutional Studies of Molybdenum-Palladium Alloys Using Ultra-Rapidly Solidified Samples


Studies of phase relationships in the Mo-Pd system at 880–1100°C were performed using ultra-rapidly solidified samples. The finely divided microstructures produced by this technique were found to achieve equilibrium on annealing more rapidly than conventionally prepared materials. The solubility limits of the Pd-rich and Mo-rich terminal solid solutions were established.

Hydrogen Induced Ordering in Palladium-Rich Pd-Mn Alloys


Hydrogen-induced formation of an L1$_1$ ordered structure from an $\alpha$-L1$_2$ (Ag$_5$Mg-type) structure was observed in the presence of H$_2$ at a pressure of 5.0 MPa at 726K in the $\alpha$-phase of rapidly quenched alloys of Pd-Mn alloys containing 12.5–31.0 at.% Mn. In Pd–29.0 at.% Mn and Pd–31.0 at.% Mn alloys the $\beta_1$-L1$_1$ ($M=2$) structure transforms under the effect of H$_2$ into the $\beta_1$-L1$_1$ ($M=4$) structure, where the domain size increases from $M=2$ to $M=4$.


The Pd activities of 12Pd-Nb alloys, with compositions from 60Pd40Nb to 97Pd3Nb, were determined experimentally with a twin-chamber Knudsen cell mass spectrometer at 1450–1750 K. The results showed a strong interaction in the solid state between the Pd and the Nb atoms.

Effect of Soluted Hydrogen on the Mechanical Properties of Palladium-Rhodium Alloys


Studies of structural changes and physico-mechanical properties of Pd-Rh alloys containing up to 25 at.% Rh were performed during H implantation in the alloy. The results showed that the mechanism of property changes in the Pd-Rh-H system can be characterised both for Pd alloys containing monovalent noble metals, and for these alloys containing transition elements. Depending on the concentration of the soluted H and on the phase compositions in the Pd-Rh alloys, the observed effects were either a simultaneous rise in their stability and ductility, or their sudden embrittlement.

Mechanical Alloying of the Pd-Si System in Controlled Conditions of Energy Transfer


The composition Pd$_x$Si$_{3-x}$ was milled, starting from pure elemental powders, in different milling conditions, and the mechanical alloying process was followed by X-ray and differential scanning calorimetry measurements. For high levels of energy transfer the system evolves towards the formation of the intermetallic Pd$_2$Si. At lower levels of energy transfer, formation of a stable intermetallic phase was hindered and the product was a fully amorphous phase.
Thermal Stability and Phase Studies of Crystalline Zr,Pd Hydrides


Studies of the crystalline metal hydrides Zr,PdH_x for x<2.0 showed that they underwent an endothermic reaction above 800K, and decomposed to ZrH_x, Zr and Pd on further heating. When the crystalline hydride has x>3.0, it undergoes abrupt endothermic transitions around 550K (+50K) which leads to the formation of lower H content ternary hydrides. Upon further heating above 800K, the ternary hydrides go through more endothermic reactions forming a mixture of phases that includes ZrPd, ZrH, and ZrO.

Investigations of Rh-Based Multilayers for Soft X-Ray Applications by High-Resolution Electron Microscopy


A series of Rh-based multilayers was developed for soft X-ray applications by using ‘trilayer’ structures and low density B,C spacing material. The microstructure of the multilayers was studied and compared with those of W- and Ni-based multilayers. Rh crystals with f.c.c. structure but with different preferred orientations were identified in Rh-based layers. High reflectivity and selectivity for X-ray mirrors was obtained in the case of W/Rh/C multilayers due to significant improvement in their microstructure, especially the interface roughness.

Magnetic Properties of U(Ru_x,Rh_y) Si_2 Single Crystals (0 < x < 1)


The temperature dependence of the non-linear susceptibility of URu_x Si_2 was studied in order to determine properties of the phase transition at 17.5 K. Various magnetic phases of U(Ru_x,Rh_y) Si_2 were studied as a function of x by means of specific heat, susceptibility, and neutron scattering methods. Two successive phase transition occurred when x=0.3.

Electrical Conductivity of BaRuO_3 Ceramics


BaRuO_3 and Ba_xK_yRuO_3 ceramics contain a mixture of 4H and 9R polytypes whose volume fraction depends on quenching temperature and the concentration of K dopant. Both polytypes have a room temperature resistivity of ~10 mΩcm, but with opposite signs for the temperature coefficient. The negative temperature coefficient for the 9R polytype is ascribed to localisation effects arising from the existence of two distinct crystallographic Ru sites.

CHEMICAL COMPOUNDS

Ligand-Stabilized Bimetallic Colloids Identified by HRTEM and EDX


The synthesis of ligand-stabilised bimetallic colloids and the identification of their shell structures is described. Au colloids of diameter 18 nm were covered by Pt or Pd shells, when aqueous solutions of the colloids is added to a solution of H_2PtCl_6 or H_2PdCl_6 and H_2NOH, stabilising the particles formed with p-H_2NC,H SO_3Na. Uniform heterogeneous Au/ Pt agglomerates of a Au core surrounded by Pt crystals of ~5 nm, with two kinds of intergranular structures are found. For AuPd a homogeneous system of Pd and Au solid solutions is formed. The sequence of metals can also be reversed, so that 15 nm Pd colloids can be prepared and coated with Au.

Metallic Properties in the Series K,Pd(II)H_y, Na,Pd(0)H_2 and Li,Pd(0)H_2 Correlated with the Stabilization of a Formally Zero-Valent Palladium-Hydrogen Complex


New hydrides, Li,PdH_2, and K,PdH_x, were compared with Na,PdH_2. The Li,PdH_2 and Na,PdH_2 were found to be metals and their structures were characterised by linear, formally zero-valent PdH complex in an alkali atom framework. The Pd-H bond lengths was 1.68 Å. In K,PdH_x, with the Na,PtH_2-type structure, the larger and more electropositive K atom allows a four-co-ordinated d^2 square planar Pd complex to be formed. The Pd-H bond length was 1.63 Å. The electrons were localised and K,PdH_2 was a yellow-green non-conducting powder.

N-Bonded TCNQ in Stacked Dimeric Systems. Synthesis and Crystal Structure of [Ru(PPh_3)_2(TCNQ)]_2, [TCNQ=7,7,8,8-tetracyanoquinodimethane]


The reaction of RuCl_3(CO),(PPh_3) with AgBF_4 in tetrahydrofuran (thf) resulted in the formation of [Ru(CO)_2(PPh_3),(thf)](BF_4), which further reacted with PPh_3 in CH_2Cl_2 and LiTCNQ in MeOH yielded purple crystals of [Ru(PPh_3)_2(TCNQ)]_2. The crystal structure of this compound showed a tetrahedral environment of the Ru atom with the TCNQ molecule co-ordinated via N. All the TCNQ units act as bridges bonding two Ru atoms via opposite nitrile groups which gives rise to dimers [Ru(PPh_3)_2(TCNQ)]_2.
ELECTROCHEMISTRY

Electrochemistry at Platinum Single Crystal Surfaces in Acidic Media: Hydrogen and Oxygen Adsorption
A review of the adsorption properties of H2 and O2 at the Pt/h2O solution interface, and their dependence on the crystalline surface structure of the Pt electrode is presented. Unusual adsorption states are seen on (111) and (100) oriented electrodes, which appear to be controlled by two-dimensional long range order. Studies on the Pt(hk)/solution system are examined; these include the electrochemical behaviour of stepped surfaces, surface reconstruction in solution, size of the ordered domains and the characterisation of point defects and ordered defects. (75 Refs.)

In situ Infrared Studies of Glucose Oxidation on Platinum in an Alkaline Medium
The oxidation of α(-)-glucose on a Pt electrode in 0.1 M NaOH was investigated in situ FTIR-absorption spectroscopy in the range -0.76 to +0.46 V vs. Hg/HgO, OH-. The surface adsorbates involved linear CO and bridged CO. The linear CO persisted on Pt in the entire potential range, with gradual shifts to higher frequencies, of -70 /cm/V, while the bridged CO disappeared as the electrode potential reached -0.05 V. The oxidation products were carboxylic acid and CO2. A potential excursion up to +0.46 V caused a pH swing of >8 in the spectroelectrochemical thin layer, due to glucose oxidation.

Structural Effects in Electrocatalysis. Ethylene Glycol Oxidation on Platinum Single-Crystal Surfaces
The oxidation of ethylene glycol (EG) was studied on Pt single crystal surfaces in 0.1 M NaOH. Strong structural dependence of the reaction kinetics occurred for all 12 orientations investigated. The onset of the reaction occurs in the sequence Pt(110)>Pt(100)~Pt(111). The peaks of the voltammery curves for the low-index planes decrease in the order (111)> (110)> (100). Either the (111) or the (100) oriented steps cause a decrease in the activity of the (111) plane. Surfaces near the (100) plane have higher activity than Pt(111). The (111) oriented steps in the Pt(110) plane increased the activity, while the (100) oriented steps decreased it. PtOH layer formation and onset of EG oxidation occurred together, showing the reaction involves interaction of the adsorbed and dehydrogenated EG with Pt(OH)ad.

Platinum Electro catalysts Applied to Carbon Fibres
Studies were performed of Pt/C fibre catalysts prepared by impregnation of C fibres by H2PtCl6 solution or by electrochemical deposition of Pt on C fibres from the analogue solution at 0.2 V. The results showed that Pt/C fibre catalysts prepared by electrochemical deposition have greater dispersion than those obtained by impregnation. It is suggested that two types of polarisation processes with different rates occur on the catalyst surfaces.

Oxidation of Sulfur Dioxide in Sulfur-Modified Platinum-Graphite Packed Bed Electrodes
The oxidation of dissolved SO2 at Pt supported in porous graphite sheet electrodes was studied at 450–750 mV (RHE) using various Pt loadings and SO2 concentrations. Controlled reductive pretreatment of the electrodes in the presence of SO2 was found to produce catalytic effects which resulted in enhanced steady-state oxidation currents due to formation of a S-modified Pt surface. In hybrid cells with fuel cell type O2 gas diffusion cathodes operating in the electrogenerative mode, the pretreated Pt-graphite anodes were used to oxidise 3–500 mM SO2 in 3M H2SO4.

Irreversible Adsorption of Chlorophyll on an Amalgamated Platinum Electrode in Aprotic Solvents
Studies of adsorption of chlorophyll on an amalgamated Pt electrode in various aprotic solvents were performed under controlled potentials. The adsorption of chlorophyll was stable and it could only desorb with the surface held under a significant negative potential. The adsorption was affected by the amount of adsorption substance and on its concentration in solution, and also by the adsorption conditions.

Investigations of the O2 Reduction Reaction at the Platinum/Nafion Interface Using a Solid-State Electrochemical Cell
The processes occurring at the Pt/Nafion interface in the absence of a contacting electrolyte phase was investigated in an electrochemical cell to determine such conditions in a SPE fuel cell. From cyclic voltammetric measurements the purity of the Nafion and the roughness factor of the electrode were found.
Characteristics of a Rechargeable Cell Constructed by Coupling Na$_{x-y}$WO$_3$ and Na$_{1-x}$Pd$_2$O$_4$


The electrochemical behaviour of NaPd$_2$O$_4$ and Na$_x$WO$_3$ was investigated in 0.5 M H$_2$SO$_4$ at 25°C. A Na depleted surface layer can be formed on the electrode surface of NaPd$_2$O$_4$ by anodic pre-polarisation, and this surface layer absorbs or desorbs H$^+$ reversibly at ~1.0 V vs. SHE. A new type of rechargeable cell with a long cyclability can thus be constructed by coupling Na$_{x-y}$WO$_3$ and Na$_{1-x}$Pd$_2$O$_4$ in an acidic solution.

Adsorption of Nitroethane on Rh-Ru Catalytic Systems


The adsorption of nitroethane was studied on skeletal Rh-Ru catalysts containing 5, 10, 20, 50, 60, 90 and 95 at.% Ru which had preliminary pretreatment under various conditions. At 40–60°C, a decrease of stationary potential was observed with nitroethane adsorption. It was explained by an increase in temperature in H$_2$SO$_4$, resulting in the formation of active electrochemical phases, which affect the potential. A maximum rise of potential of 10 mV was found on Rh in ethylamine.

PHOTOCONVERSION

Photoinduced Dissociation and Desorption of N$_2$O on a Pt(111) Surface


N$_2$O adsorbed on a Pt(111) surface was irradiated by UV light, and the photochemistry was studied by XPS, UPS and TPD. Upon irradiation at 50K, adsorbed N$_2$O undergoes dissociation and desorption. Photon energies >4.35 eV are required. The cross section is in the range 10$^{-16}$–10$^{-18}$ cm$^2$. This is the first UV photon-driven chemistry in this system.

Photocatalytic Hydrogen Production with Semiconductor Particulate Systems: An Effort to Enhance the Efficiency


H$_2$ production in visible light (437 nm) with the following semiconductor particulate systems, Ag(I)/WO$_3$, Fe(III)/WO$_3$, and Cr(III)/WO$_3$, and mixed semiconductors, WO$_3$-Pt/CdS and WO$_3$-CdS was studied in the presence of an electron relay, methylviologen, MV$^{2+}$. Pt loaded CdS powders mixed with WO$_3$, powders (WO$_3$-Pt/CdS) showed a notable enhancement in the photocatalytic activity as compared to that of WO$_3$-CdS. The sample sintered at 800°C had higher efficiency than that sintered at 300°C.

Photodissociation of Phosgene on Pd(111) at 193 nm


The UV photodissociation of phosgene (Cl,CO) on Pd(111) was studied by isothermal mass spectroscopy during irradiation and by TPD and XPS following irradiation. Phosgene absorbs reversibly on Pd(111) at 110K and photodissociates when irradiated with 6.4 eV photons, thus resulting in the evolution of CO and retention of Cl adatoms. The initial photodissociation cross-section is 5.3±0.8 × 10$^{-18}$ cm$^2$.

Photocatalysis of the Homogeneous Water-Gas Shift Reaction under Ambient Conditions by Cationic Iridium(III) Complexes


The first highly efficient light-assisted water gas shift reaction to take place under the extremely mild conditions of room temperature, ambient pressure, neutral pH and visible light is reported. It is catalysed by Ir$^{3+}$ pentamethylcyclopentadienyl complexes containing novel 4,4'-bipyridine ligands, substituted by electron-withdrawing groups which enhance the catalytic activity.

Formation of Paramagnetic Complex from Bischelate of Palladium (II) with Dehydrogenated N-(3-Hydroximinol-2-Methylbutyl-2) Hydroxylaminoxime and o-Phenanthroline


Paramagnetic Pd complexes were formed during interaction in pure ethanol of o-phenanthroline and diamagnetic bischelate of Pd(II) containing ligand anions of N-(3-hydroximinol-2-methylbutyl-2) hydroxylaminoxime. The paramagnetic Pd complexes contained co-ordinated anion-radical dehydrogenated 1,2-hydroxylaminoxime.
Chemiluminescence of Tryptophan with Electrogenerated \textit{Tris}(2,2'-Bipyridine) Ruthenium(III)


A system for producing electrogenerated chemiluminescence based on the reaction of electrogenerated Ru(bpy)$_{3}^{2+}$ (1) with tryptophan (2) is described. The orange luminescence is generated by the reaction of (1) with (2) in acidic solution. The lowest detection limit was 0.1 pmol for (2), and this system should therefore be useful for selective and sensitive detection of tryptophan and related compounds.

Electron-Transfer Quenching of a Photoexcited Ruthenium Complex by Stearyl Viologen in Barium Stearate Langmuir-Blodgett Films


Photoinduced electron transfer of the Ru complex tris(4,7-diphenyl-1,10-phenanthroline)Ru, that is (Ru(dpphen)$_{3}^{2+}$), to stearyl viologen (SV$^{+}$) in Ba stearate LB assembly systems was studied by a steady-state quenching method. Even when the monolayer of the Ru complex was in direct contact with the layer of SV$^{+}$ quencher at the hydrophilic interface, the quenching of the Ru complex had low efficiency, indicating that Ru(dpphen)$_{3}^{2+}$ is located at a more hydrophobic region. In an assembly where both Ru(dpphen)$_{3}^{2+}$ and SV$^{+}$ exist within the same monolayer, the quenching efficiency depended strongly on the two-dimensional density of SV$^{+}$. The results showed that electron-transfer rate decreases exponentially with distance and agrees with the conclusion that electron-transfer quenching proceeds via an electron-tunnelling mechanism.

A Novel Photosynthetic Mimic Reaction Catalysed by K[Ru(H$_{2}$EDTA)Cl]$_{2}$H$_{2}$O; Reduction of Carbon Dioxide to Formate and Formaldehyde in the Presence of an Aqueous Suspension of Pt-CdS-RuO$_{2}$


An efficient photocatalytic reduction of CO$_{2}$ to HCOOH and HCHO is reported, using the title Ru compound, and Pt-CdS-RuO$_{2}$, as photon absorber at 505 nm. The system produces 0.22 M of HCOOH and 0.10 M of HCHO in 6 h of photolysis at rates of 3.05 x 10$^{-7}$ M/h and 2.0 x 10$^{-7}$ M/h, respectively. The rates of formation exhibit a first-order dependence on the catalyst and dissolved CO$_{2}$ concentrations. The reaction shows D isotope effects ($k_{D}/k_{H}$) of 1.5 and 2.0 for the formation of HCOOH and HCHO, respectively. The rate of formate decomposition was slower by 2 orders of magnitude than the formate formation rate, even at high formate concentrations.

Temperature Effect on Photolytic Deposition of Platinum Ohmic Contacts and Schottky Diodes


The deposition of Pt from Pt biphenafluoroacetacetate by an Ar laser inducing laser chemical vapour deposition was investigated. The process can be photolytic or pyrolytic, depending on the laser power. Photolytic deposition takes place in the adsorbed phase or in the gaseous phase, depending on the temperature induced by radiation absorption. The effect of the substrate base temperature and the precursor product vapour pressure confirms photolytic deposition from the adsorbed phase for low powers and from the vapour phase onwards for high powers. The deposits obtained have a typical 96% Pt composition and good device characteristics are obtained by this method in Schottky diodes.

APPARATUS AND TECHNIQUE

Microstructure and Superconducting Properties of Bi-Sr-Ca-Cu-O System Prepared by a Melt Process


Bi$_{x}$Sr$_{y}$Ca$_{z}$Cu$_{5}$O$_{y}$, where x=0, 0.2, 1.0, was prepared from powders and calcined several times at 950°C for 30 h. It was melted in a Pt crucible at >1000°C and splat-quench onto Cu. The microstructure and superconducting properties were examined. The magnetic field dependence of the intragrain critical current density was improved by enriching the Ca and Cu contents. Two precipitates were found: (Ca,Sr)$_{2}$Cu$_{O}$. and the much smaller ($1 \mu m$) Sr-Pt-O compounds. The latter may be more effective in enhancing the pinning force.

All-Solid-State Glucose Sensor Using Proton-Conductive Thick Film


A solid state glucose sensor using a proton-conductor thick film was tested as a miniaturised enzyme sensor. A planar electrochemical cell, of sputtered Au (reference electrode)/antimonie acid thick film (proton conductor)/sputtered Pt-glucose oxidase (sensing electrode) was fabricated on a porous Al$_{2}$O$_{3}$ substrate. In phosphate buffer solution the e.m.f. of the sensor varied logarithmically, with change in glucose concentration in the range 5 x 10$^{-4}$ to 4 x 10$^{-5}$ M, following a Nernst equation. The 90% response time was ~1 minute. The glucose sensitivity was fairly stable for 10 days, and the Nernst slope ~54 mV/decade was very close to that of the response to H$_{2}$O$_{2}$, indicating that the glucose sensing signal was generated by responding to the H$_{2}$O$_{2}$ produced by the enzymatic reaction of glucose. Extensions of this type of sensor to other enzymes is possible.
Bulk Single Crystal Growth of Bi$_{12}$TiO$_{20}$ by the Czochralski Method

A Pt wire was used as an initial seed crystal and crystals were grown from melts of differing TiO$_2$:Bi$_2$O$_3$ ratios to produce the title photorefractive crystal. Crystals were grown in a 15 kW r.f. heating Czochralski furnace with a Pt crucible of 50 mm diameter. Crystals of diameter up to 2 cm and 3 cm long were grown from a Bi$_2$O$_3$ rich melt, with an upper limit of 11 mol% TiO$_2$.

Detection of Nitrite Using Electrodes Modified with an Electrodeposited Ruthenium-Containing Polymer

The electrochemical detection of nitrite in flowing solutions using a polymer modified electrode with electocatalytic properties is described. The modifier used was an electrodeposited film of the [Ru(bpy)$_3$(vpy)$_2$]$^{2+}$ complex where bpy is 2,2’-bipyridyl and vpy is 4-vinylpyridine. The modified electrode enhances the response to nitrite and avoids surface fouling. The electrodeposited films thus produced exhibit high mechanical stability.

HETEROGENEOUS CATALYSIS

Combinations of Platinum and Palladium on Alumina Supports as Oxidation Catalysts

The effects of the total Pd+Pt content, the mol% ratio of Pd+Pt, the hydrothermal treatment of the catalyst wash-coat, and the O$_2$ concentration on the light-off temperature were studied for the complete oxidation of xylene isomers, propene, and CO. The light-off temperatures had a minimum at a Pd:Pt mol% ratio of 80:20, and decreased with increasing total metals concentration, increasing O$_2$ concentration and hydrothermal treatment of the Al$_2$O$_3$ wash-coat.

Effect of Gamma Irradiation on Textural and Dehydrogenation Properties of Pt/Al$_2$O$_3$ System

Pt/Al$_2$O$_3$ catalysts with 0.2–2 mol% Pt were prepared and irradiated with $\gamma$-radiation to a dose of 50 Mrad. Textural properties were found from the low temperature N$_2$ adsorption. The catalytic dehydrogenation of cyclohexane was determined for irradiated and non-irradiated catalysts. $\gamma$-Irradiation caused textural changes of the metal/metal oxide system depending on the metal content, and increased the dispersion of the metal on the surface.


Detailed product distribution from the bifunctional conversion of decane over Pt/ZSM-22, Pt/ZSM-5 and Pt/USY catalysts were compared. Pt/ZSM-22 produced high yields of feed isomers under mild reaction conditions. It is suggested that isomerisation of decane on ZSM-22 is a zeolite pore-mouth catalysis. Type C hydrotackling of methylnnonanes does not occur on Pt/ZSM-22, due to the limited access of these molecules in the zeolite pores.

Influence of Iridium, Rhenium and Lanthanum on Propane Aromatization over Platinum/ZSM-5 Catalysts

A study of the effect of operating conditions on the conversion of propane to aromatics over Pt-Me/ZSM-5 catalysts (Me=Ir, Re, La) showed that the catalytic behaviour of Pt-Me/ZSM-5 depended on the nature of the added elements. Pt-Ir/ZSM-5 was the most selective catalyst, with a yield of 61.2%.

Effects of Hydroxylation of a Silica Surface on the Metal Dispersion in Supported Platinum Catalysts

The effect of the surface hydroxyl groups of porous SiO$_2$ on the degree of Pt dispersion was studied using SiO$_2$ supports with the same surface area but with an increasing number of these functional groups. The supports were prepared by immersing a calcined SiO$_2$ in H$_2$O at 70°C and Pt was deposited on it by wet impregnation with aqueous solutions of Pt tetraamine dichloride (PTD) and chloroplatinic acid. Catalysts with PTD reduced at 400°C showed that maximum Pt dispersion occurred on supports with moderately hydroxylated surfaces.

Catalytic Palladium-Based Membrane Reactors: A Review

A review of literature on catalytic membrane reactors using H permeable Pd and Pd-Ag alloys is presented. Factors involved in H purification, design parameters of the membranes and reactors, hydrogenation and dehydrogenation reactions and H diffusion are discussed. Thin Pd coatings on porous inorganic and polymeric supports are expected to increase the implementation of this technology.
Maximum Conversion of Dehydrogenation in Palladium Membrane Reactors


Studies of the surface compositions of Ni-Pd/Al₂O₃ catalysts were performed by adsorption methods and by X-ray spectroscopy. The results showed that bimetallic catalysts differ from monometallic Pd- and Ni-catalysts by dispersion of metallic phases, depending on a method of preparation and on the presence of K⁺ promoter. Catalysts prepared by the immersion method had more strongly Pd enriched surfaces, as compared to those prepared by precipitation.

Adsorption Properties of Ni-Pd Catalysts Supported on the Al₂O₃


Design of the Catalyst for Partial Oxidation of Ethylene by Applying an Electrochemical Device


An electrochemical device composed of a H₂PO₄ membrane on which were attached Pt and Pd blacks, Ru, Rh, Os and Ir, M/H₂PO₄/M', where M=anode metal and M' =cathode metal, was demonstrated as a probe of the catalysts for the partial oxidation of C₂H₂. From the results a catalyst, Pd-Ru-graphite-H₂PO₄, has been designed for the selective synthesis of CH₂C=O from C₂H₂ - a Wacker oxidation. The formation rate of CH₂C=O was 3.18 μmol/min.

Oxidative Leaching of Cu Atoms from PdCu Particles in Zeolite Y


NaY-supported PdCu samples of various Cu:Pd ratios were prepared by ion exchange with Pd(NH₃)₂Cl₂ and Cu(NH₃)₂Cl₂ precursors. Reduction of Cu was enhanced by Pd. Reduction with H₂ resulted in bimetallic PdCu particles and protons of high Bronsted acidity. Complete oxidation of the Cu component occurred at 500°C and the Cu ions leached from PdCu particles migrated to small zeolite cages. After complete leaching of Cu, the monometallic Pd particles were discerned from the original particles in PdCu/NaY and PdCu₇/NaY by their propensity to form TPD-detectable hydrides.

Conversion of Primary Amines to N,N'-Disubstituted Ureas Using Montmorillonite-pyridinepalladium(II) Acetate and Di-Tert Butyl Peroxide


A simple convenient method for the synthesis of N,N'-disubstituted ureas from primary amines is reported, using a Pd(II) complex anchored on an inexpensive clay support, and with a cocatalyst of cupric chloride as reoxidant. The conditions are room temperature and atmospheric pressure.

Polymer-Bound Palladium Acetate as a Catalyst for the Reduction of Nitro and Azo Groups


Pd(OAc)₃ anchored to a copolymer containing pyridyl and carboxyl groups was used as a catalyst for the hydrogenation of azo and nitro groups under 1 atm H₂ pressure and 30°C. The selective hydrogenation of azobenzene to hydrazobenzene was highly selective on using the polymer-bound Pd catalyst, and is reported for the first time. The catalyst is quite stable and has been well used for more than a year.

Reactions of Formic Acid and Formaldehyde on Rh(111) and Rh(111)-(2x2)O Surfaces


The adsorption and decomposition of HCOOH and HCHO on the Rh(111) surface was studied by HREELS. HCOOH adsorbed on the surface via the lone pair electrons on the hydroxyl O, and H bonding among the molecule in the adlayer is indicated. At ~140 K a formate intermediate was formed, which decomposed to CO, CO₂, H₂ and H₂O via two channels. Adding 1/4 monolayer of O atoms to the Rh(111) surface shifted the formate decomposition temperature to 330 K. Below 130 K on a clean Rh(111) surface HCHO dehydrogenated completely to adsorbed CO and H atoms. Exposing an O predoped surface to HCHO resulted in formation of adsorbed paraformaldehyde, CO, formate and HCHO.

Infrared Spectroscopy of High Pressure Interaction of H₂ and D₂ with Rh/Al₂O₃


A novel high pressure-IR-cell reactor was used to study the interaction of ultrapure, high-pressure H₂ and D₂ with Rh/Al₂O₃ films. The H₂ may dissociate on the Rh sites to produce a weakly bound Rh-H surface species, with the remaining H spilling over to the support where it reacts with surface hydroxyl groups to produce H₂O. The new Rh-H species was easily removed by reduction under H₂ pressure.
Effects of Polymer Support on the Substrate Selectivity of Covalently Immobilized Ultrafine Rhodium Particles as a Catalyst for Olefin Hydrogenation


Immobilised ultrafine Rh particles were prepared from a protective polymer, and deposited onto a cross-linked polymer support, by forming the amide Macromolecules, 1991, a Catalyst for Olefin Hydrogenation Substrate Selectivity of Covalently Im-

bond between the primary amino group contained in the support and the methyl acrylate residue in the protective polymer of the Rh. The catalytic activity of the Rh was investigated by olefin hydrogenations. Activity strongly depended on the substrates used. The Rh preferentially hydrogenated hydrophilic substrates. Substrates containing a carboxyl group were hydrogenated by the immobilised catalyst more easily than by the dispersed catalyst. The difference in hydrogenation rates can be correlated with the solubility parameter of the substrate. Electrostatic interaction between substrates and the polymer support leads to increased reaction rates.


Studies of Rh-complexes with N-based chiral ligands which were anchored on a modified USY-zeolite containing profuse supermicropores showed a remarkable increase of enantioselectivity (>95%) in the hydrogenation of N-acyldehydmphenylalanine derivatives. The zeolite-supported-Rh catalysts were re-used several times with no loss of activity or Rh content. The increase obtained in the enantioselectivity indicated that this type of catalyst is a truly heterogeneous counterpart of the homogeneous catalysts for the hydrogenation of prochiral alkenes.

Catalytic and Physical-Chemical Properties of Indium Modified Iridium-Alumina Catalysts for Dehydrogenation of Highest Normal Paraffins


Spectroscopic studies of monometallic and In modified Ir/AlO catalysts during dehydrogenation of high n-paraffins showed that Ir-In/AlO catalysts had higher activity and increased selectivity towards the highest olefins. In modified the Ir surface, forming mixed clusters. At the same time, a decrease was observed in the number of surface Ir atoms capable of adsorbing H, at 300K, but the number of centres of high temperature H dissociation which adsorbed H on the support noticeably increased.

Alcohol Synthesis from Syngas on Supported Ir-Based Composite Catalyst


Alcohol synthesis from syngas over supported Ir-based composite catalysts was examined. Ir catalysts promoted with Mo, V and Cr had the highest activity for alcohol formation. The predominant formation of MeOH and 2-methylalcohol on the Ir-Cr catalyst strongly suggests that CO insertion occurs. Alcohols produced on Ir/Cr, O, seem to be formed in the same way as for the Ir-Cr composite catalyst. Ir/MoO, had the highest CO conversion, but CH, was the main product.

A Mild, Osmium Tetraoxide-Catalyzed Method for the Oxidation of Sulphides to Sulfones


OsO, was examined for the chemoselective oxidation of sulphides to sulphones, in the presence of the co-oxidant N-methylmorpholine-N-oxide. One mole per cent of the catalyst was sufficient at room temperature to oxidise a variety of sulphides to the corresponding sulphones in nearly quantitative yields. The oxidation is tolerant of the presence of a number of other functional groups.

HOMOGENEOUS CATALYSIS

π-Stacking and the Platinum-Catalyzed Asymmetric Hydroformylation Reaction: A Molecular Modeling Study


The importance of steric factors in determining the regioselectivity of a class of Pt(II) hydroformylation catalysts (L,Pt(CO)X) was theoretically studied by using an augmented Dreiding force field. The differential stabilisation of the initially formed Pt alkyl complexes resulting from styrene insertion into a Pt-H bond formed either the primary phenethyl product or the secondary α-methyl styryl intermediate.

A Homogeneous Platinum Catalyst in the Stationary BF,H,O Phase for the Hydrogenation of Arenes


A stationary liquid-phase catalyst comprising PtCl(CH,CN), in BF,H,O on clay or silica supports was prepared and used for the hydrogenation of various aromatic hydrocarbons under mild conditions. The catalyst was tested for continuous performance in a tubular trickle-bed reactor. Products are separable by simple filtration, and the hydrogenation proceeds selectively, in a 1:1:1 mixture of benzene, toluene, α-xylene and 1,2,4-trimethylbenzene.
Platinum(II) Catalysed Selective Remote Oxidation of Unactivated C-H Bonds in Aliphatic Carboxylic Acids


The use of the 'chelate effect' in achieving the selective oxidation (hydroxylation) of C-H bonds of aliphatic chains by Pt(II) in aqueous medium under mild conditions is reported. By adding a co-oxidant that is capable of reoxidising Pt(II) to Pt(IV), it is possible to make the system catalytic in Pt(II). In the presence of Pt(IV), Pt(II) ion was found to catalyse the hydroxylation of unactivated C-H bonds of aliphatic carboxylic acids in water.

Isomerisation and Carboxylation of Esters Catalysed by Platinum Phosphide Complexes in the Presence of Lewis Acids


Polymeric Pt phosphide complexes [PPh3.Pt]n (n = 8–10) in RCOOR solution, containing acid types BF3, SbF5, CF3COOH or C6H5OCF(CF3)2.CF3.OC,F.SO,H, catalysed the isomerisation of methylformate in acetic acid, and carboxylation of methylacetate in acetic anhydride at 20–25°C and in Ar or CO, respectively.

Palladium-Catalysed Insertion of Isocyanides into the Silicon-Silicon Linkages of Oligosilanes


Oligosilanes were reacted with isocyanides when promoted by a Pd catalyst. Heating oligosilanes with excess 2,6-disubstituted aryl isocyanide in the presence of Pd(II) acetate led to the complete insertion of isocyanide into all Si-Si linkages, giving oligo(silylimine) derivatives. The oligo(silylimine)s were isolated and characterised in the complete insertion reaction with oligosilanes up to a hexasilane. New skeletal rearrangement of oligosilanes took place in a Pd-catalysed reaction of substituted aryl isocyanide with tetra- and hexasilanes, yielding 3,3-bis(silyl)-1-aza-2,4-disilacyclobutane derivatives.

Synthesis and Catalytic Activity of Pd(II) Complexes with Biv- and Tridentate Salicylaldimines Containing Sterically Hindered Phenols


The synthesis of binuclear Pd chelates with tridentate salicylaldimines is reported. The catalytic activity of the Pd complexes was studied during the hydrogenation of nitrobenzene in a homogeneous medium. The dependence of the activity on solvents and circumferential ligand substituents is discussed.

Efficient Palladium Catalysts for the Copolymerization of Carbon Monoxide with Olefins to Produce Perfectly Alternating Polyketones


Highly efficient homogeneous Pd catalyst systems were developed to produce perfectly alternating copolymers of CO with C2H4, CO2, C2H6, and propene mixtures are converted into the corresponding alternating CO/olefin terpolymers where C2H4 units randomly replace C2H2 units in the chain. The catalyst systems are formed by combining an equimolar quantity of a suitable bidentate phosphine ligand with a Pd(II) species in which the counter anions are very weakly co-ordinating. For diphenylphosphinoalkanes: \( \text{Ph}_2\text{P(\text{CH}_2)}_m\text{PPh}_3 \), the most efficient system to produce high molecular weight polyketones has \( m = 3 \). High rates with conversions of \( >10\% \) molecules of CO and C2H4 per Pd centre are obtained.

Palladium-Catalyzed Intramolecular Addition of Amines to Acetylenes. Synthesis of Cyclic Imines


Intramolecular aminopalladation of alkynylamines gave intermediary alkenyl Pd compounds that hydrolysed and isomerised to thermodynamically stable cyclic imines. Treating 3-alkynylamines with PdCl2(MeCN)2, gave exclusively 1-pyrrolines in good yields; 5-alkynylamines afforded 2,3,4,5-tetahydro-pyridines selectively. Treating 4-alkynylamines with Pd(II) gave mixtures of both 5- and 6-membered cyclic imines.

Palladium Catalyzed Carboxylation of Cyclohexane with Carbon Monoxide


Very high turnover numbers have been obtained for the carboxylation of cyclohexane with CO to form cyclohexancarboxylic acid using Pd(OAc)2. The product yield was 8.8% based on the starting alkane and the turnover number was 205.

Synthesis of \( \alpha,\beta \)-Disubstituted Aldehydes from Metallated 1-Aza-1,3-Butadienes and Palladium Phosphine Complexes


\( \alpha,\beta \)-Disubstituted aldehydes were prepared from metallated 1-aza-1,3-butadienes in the presence of Pd(acac)2, \( +2\text{Ph}_2\text{P} \) catalysts by reactions of \( \text{N}_2 \), O- and S-containing allyl electrophiles with Mg azaenolate and organic halogenides. The reaction performed with the Pd phoshine catalyst was highly regio- and stereoselective.

Platinum Metals Rev., 1992, 36, (1) 57
Kinetics of the Water Gas Shift Reaction Catalyzed by Rhodium(III) Chloride in Aqueous Picoline Studied by Use of a Continuous-Flow Stirred Reactor


Homogeneous water gas shift catalysis by Rh(III)Cl₃, 3H₂O in aqueous picoline solution in a continuous-flow stirred reactor is described. The catalysis rates were non-linear in total IRhl over the range 3–20 mM, which was interpreted by the system having dinuclear and mononuclear Rh species present, with the mononuclear cycles being more reactive. The rates have a non-linear dependence on [Rhl]. There may be reversible addition of CO to the catalytically active species prior to rate-limiting in the mono- and dinuclear catalytic cycles.

CORROSION PROTECTION

Cathodic Protection System


Steel corrosion in sea water and methods of overcoming it are discussed, with particular reference to the design and implementation of a cathodic protection system for steel piles. An impressed current cathodic protection system was chosen, and typical current requirements for various steel structures are given. The design characteristics and application for different types of anodes are given. Pt clad Nb anodes were selected as having the highest current carrying capacity, lowest anode consumption and longest life. The Pt metal available on the anodes is expected to last longer than the designed life of the cathodic protection system, assuming that only 90% of the Pt can be used. The anodes have current output of 25–35 A.

Effect of Paint Damage and Under-Way Conditions upon Ship ICCP Current Demands


The dimension and conductivity scaling modelling technique was used to assess three impressed current cathodic protection systems on ships' hulls. Up to six Pt foil anodes, each mounted on a polymethyl methacrylate shield placed directly on the plate were tested. Two current outputs of these systems in static and simulated under-way conditions with an intact paint coating and with damage along the hull were examined. Potential profiles with anodes in different places are presented. The best protection overall came from the two-zone system: with one potentiostat, midship reference electrodes (RE), two forward and two after anodes, plus second potentiostat, stern RE, and two stern anodes. Modelling predicts the performance and current output of impressed current cathodic protection systems.

ELECTRICAL AND ELECTRONIC ENGINEERING

Magnetoresistance of Co/Pd and Co/Pt Multilayer Films for Magneto-Optical Data Storage Applications


Galvanomagnetic, magnetic and magneto-optical properties of multilayered Co/Pd and Co/Pt films with varied Co content were studied. In Co/Pt films, an increase of Co content resulted in a decrease of the s-d slope approaching the value for a pure Co film. The magnetic and electronic properties of these films were correlated with the magnetoresistance measurements performed with fields applied parallel and perpendicular to the plane of the samples.

Through-Wafer Optical Communication Using Monolithic InGaAs-on-Si LED's and Monolithic PtSi-Si Schottky-Barrier Detectors


Through wafer optical communication has been shown for the first time using two vertically stacked Si wafers, the upper one with InGaAs-InAlAs double-heterostructure LEDs grown by MBE on its top surface and the lower one with PtSi-Si Schottky barrier detectors fabricated on its bottom surface. IR radiation emitted by the LEDs in a band peaking at 1.12 μm just beyond the Si absorption edge is transmitted through the upper Si wafer, focused with a lens of focal length 25 mm, transmitted through the lower Si wafer and detected by the Pt-Si detectors. In a single LED-detector pair the detector S:N ratio was 10:1, for a LED drive current of 1 mA at room temperature.

Annealing Studies on Pd/n-GaAs Schottky Diodes


Pd/n-GaAs Schottky diodes were fabricated using either spin-on or evaporated Pd sources. Barrier heights and electrical characteristics were measured. The ideality factor for both diodes was close to 1. Ageing at temperatures up to 200°C for 1000 h produced little or no change in diode parameters; but annealing at 250°C for up to 1000 h produced a gradual degradation of diode parameters. This degradation was significantly faster during a 400°C anneal, and is attributed to the atomic intermixing and/or diffusion at the Pd-GaAs interface. Pd spin-on devices had a much longer operating life compared to the evaporated ones. The spin-on technique is economical, simple and easy to implement in any existing GaAs device technology.
Palladium as a Lead Finish for Surface Mount Integrated Circuit Packages


The use of a thin preplated Pd Pb finish as an alternative to Sn/Pb solder is discussed for surface mount wetting, solder joint metallurgy, wire bonding, interaction with molding compounds and electrochemical characteristics. Reliability and performance tests were also run, including operating life, temperature/humidity, thermal cycle/shock, Pb finish performance and mechanical tests. Pd plated leadframes were successful on small outline packages (8–28 pin) and fine pitch packages.

AC Complex Impedance Investigation for RuO₂-Glass Composites


The AC complex impedance spectra of RuO₂-glass composites were investigated from 1 kHz–13 MHz, as functions of RuO₂ content and heat treatment conditions. Since the amount of Ru ion in the PbO-B₂O₃-SiO₂-Al₂O₃-ZnO system increases with increasing reaction temperature and time, the electronic properties of the matrix are changed. Samples reacted at low temperature and for short times showed vertical lines in complex impedance spectra plots, which indicated that the samples consisted of lone capacitor circuits. As temperature and time increased, the spectra consisted of semicircle arcs representing RC combination circuits. Samples with more RuO₂ showed a change from a vertical line to semicircle arcs at a lower reaction temperature. A sample with 5 vol.% RuO₂ and reacted at 100°C had an equivalent circuit model which was only resistive.

TEMPERATURE MEASUREMENT

A Gold/Platinum Thermocouple Reference Table


The thermoelectric voltage of the Au/Pt thermocouple was measured over the range 0–962°C, by comparison with calibrated Pt resistance thermometers. From 0 to 500°C the measurements were taken in a stirred liquid bath, while from 660 to 964°C they were performed in a pressure controlled Na-filled heat pipe furnace that provided an isothermal intercomparison environment. Measurements were made at the freezing points of In, Sn, Zn, Sb and Ag, at the melting point of Ga and at the liquidus point of the Ag-Cu eutectic. A reference function was obtained that gives e.m.f. as a function of temperature to within ±10 mK from 0 to 962°C.

MEDICAL USES

Design and in Vitro Studies of a Needle-Type Glucose Sensor for Subcutaneous Monitoring


A new miniaturised glucose oxidase based needle-type glucose microsensor has been developed for subcutaneous glucose monitoring. The sensor has a 10 cm long Teflon coated Pt-Ir wire of 0.25 mm o.d. with a 1 mm long bare part acting as a sensing cavity. The reference electrode was Ag/AgCl, and the whole sensor was coated with 5% polyurethane solution in 98% THF-2% DMF.

The Effect of Some Platinum Compounds on the Activity of the CTP Synthetase of Ehrlich Ascites Tumor Cells: In Vitro and In Vivo Studies


The effect of cis-diaminedichloroPt(II): (cis-DDP), trans-DDP, spermine Pt(II) and K₂PtCl₆ on the activity of CTP synthetase in the cytosol of Ehrlich ascites tumour cells was studied. For in vitro study the Pt compounds were added to the incubation mixture for the enzyme assay. A concentration dependent inhibition of CTP synthetase was found, which was strongest for the trans-DDP. Ascites cells from mice pretreated in vivo with Pt compounds showed that inhibition is strongest for cis-DDP and K₂PtCl₆.

Synthesis and Characterization of Highly Lipophilic Antitumor Platinum(II) Complexes


The preparation and characterisation of a series of highly lipophilic Pt(II) complexes of type [Pt(OCOR)₂(A)] or [Pt(OCOR)₂(A')] are described, where R=a highly branched or long chain alkyl group of 4–13 C atoms, A=1R,2R-diaminocyclohexane, cis-1,2-diaminocyclohexane, 1,1-bis (aminomethyl)cyclohexane or ethylenediamine and A' = neo-pentylamine or cyclopentylamine.

Myoglobin Oxygen Binding Curves Determined by Phosphorescence Quenching of Palladium Porphyrin


A completely optical method has been developed for evaluating myoglobin-O₂ saturation. Using this solution O₂ concentrations were computed for functioning heart muscle by measuring the phosphorescence decay of a soluble Pd porphyrin, 5,10,15,20-tetrakis (4-sulphanatophenyl)-porphyrin Pd(II), according to the Stern-Volmer quenching relationship.