

ABSTRACTS

of current literature on the platinum metals and their alloys

PROPERTIES

A New Approach for Atomistic Modeling of Pd/Cu(110) Surface Alloy Formation

J. E. GARCÉS, G. H. BOZZOLO, P. ABEL and H. O. MOSCA, *Appl. Surf. Sci.*, 2000, 167, (1–2), 18–33

The formation of Pd/Cu(110) surface alloys was investigated using the Bozzolo-Ferrante-Smith method for alloys. A straightforward modelling approach was introduced, ranging from the deposition of one single-Pd atom to the formation of Pd/Cu surface alloy. The approach gave information on the exchange mechanism between adatoms and substrate atoms, the formation of Pd-Cu chains and the formation of Cu islands.

Deuterium Solubility and Electrical Resistance of Palladium-Rhodium Alloys

A. K. M. FAZLE KIBRIA, *Int. J. Hydrogen Energy*, 2000, 25, (10), 997–1003

Pd-5.0 and 10.0 at.% Rh alloys were investigated at different temperatures by a gas phase method. A decrease in low pressure D solubilities and increase in plateau pressures with increasing Rh content were observed. The miscibility gap decreased with increasing Rh content. Higher D solubility was attained for lower Rh content alloy at the maximum exerting pressure. The α_{\max} resistance values gradually decreased with increasing Rh content and increased with increasing temperature.

Preparation of Pd Cluster/Polymer Composites Using Bis(acetylacetonato)palladium(II) Vapor

Y. NAKAO, *Chem. Lett. Jpn.*, 2000, (7), 766–767

Pd cluster/polymer composites (1) were prepared using bis(acetylacetonato)Pd(II) vapour. (1) with Pd concentrations > 20% or in which the Pd clusters are locally distributed were achievable. Nylon 6 and poly(ethylene terephthalate) were applicable to the preparation of (1). Composites containing Pt clusters were also obtained using the Pt acetylacetonate.

Low Temperature Specific Heat of CeRu₂Si₂ at the Field Induced Metamagnetic Instability

K. HEUSER, E.-W. SCHEIDT, T. SCHREINER, Z. FISK and G. R. STEWART, *J. Low. Temp. Phys.*, 2000, 118, (3/4), 235–239

Specific heat measurements are reported at 0.06–20 K on CeRu₂Si₂ in magnetic fields applied parallel to the *c*-direction around the critical field B_M , where the metamagnetic transition from the itinerant to the localised state takes place. In the critical field B_M $\epsilon = 7.8$ T a distinct deviation from the usual Fermi-liquid behaviour was found down to the lowest temperature. Below 1.8 K $C/T \propto (1 - aT)$, while for 1.8 K < $T < 20$ K a power law $T^{\lambda-1}$ with $\lambda = 0.66$ was found.

CHEMICAL COMPOUNDS

A Novel N-Heterocyclic Carbene of Platinum(II): Synthesis in Ionic Liquids and Crystal Structure

M. HASAN, I. V. KOZHEVNIKOV, M. R. H. SIDDIQUI, A. STEINER and N. WINTERTON, *J. Chem. Res. (S)*, 2000, (8), 392–393

cis-(C₂H₄)(1-Ethyl-3-methylimidazol-2-ylidene)PtCl₂ was obtained by reacting a mixture of PtCl₂ and PtCl₄ with C₂H₄ (50 atm) in the basic [EMIM]Cl/AlCl₃ (1:3:1) ionic liquid ([EMIM]⁺ = 1-ethyl-3-methylimidazolium) at 200°C. PtCl₄ assists the reaction by enhancing the formation of PtCl₄²⁻.

Cationic Unsymmetrical 1,4-Diazabutadiene Complexes of Platinum(II)

P. J. ALBIETZ, K. YANG, R. J. LACHICOTTE and R. EISENBERG, *Organometallics*, 2000, 19, (18), 3543–3555

Glyoxal-bis((2- α -triisopropylsiloxyethyl)-6-methylphenyl)diimine (TIPS-6-MPD) (1) and glyoxal-bis((2- α -triisopropylsiloxyethyl)-4-methylphenyl)diimine (TIPS-4-MPD) (2) were reacted with *trans*-Pt(SMe₂)₂(Me)Cl to give (TIPS-6-MPD)Pt(Me)Cl (3) and (TIPS-4-MPD)Pt(Me)Cl (4), respectively. Cationic complexes [(N,N-chelate)Pt(Me)(L)]BF₄ (L = solvent/olefin; N,N-chelate = (1) and (2)) were generated by reaction of (3) and (4) with AgBF₄ in L.

Hydrogen Bonding in Transition Metal Complexes: Synthesis, Dynamics, and Reactivity of Platinum Hydride Bifluoride Complexes

N. A. JASIM and R. N. PERUTZ, *J. Am. Chem. Soc.*, 2000, 122, (36), 8685–8693

trans-[Pt(PR₃)₂H(FHF)] (R = Cy, ⁱPr) (FHF = bifluoride) complexes (1) were synthesised by the reaction of the corresponding *trans*-dihydride complex (2) with NEt₃·3(HF) in THF. (1) were also formed in C–F activation reactions of (2) with C₆F₆ in the presence of [Me₄N]F. The NMR and IR spectra show that the bifluoride ligand (3) involves a H bond Pt–F···H–F. (3) is easily replaced by anionic ligands such as OTf⁻ or neutral ligands such as PPh₃ or py.

The Preparation of the First Examples of Sulfimide Complexes of Platinum; the X-Ray Crystal Structure of [Pt(Ph₂SNH)₄]Cl₂

P. F. KELLY, A. C. MACKLIN, A. M. Z. SLAWIN and K. W. WARING, *Polyhedron*, 2000, 19, (18–19), 2077–2081

Solutions of Ph₂SNH (1) and [PtCl₂(PMe₂Ph)₂] exhibited an equilibrium between the starting materials and *cis*-[PtCl(Ph₂SNH)(PMe₂Ph)₂]Cl. The addition of [NH₄][BF₄] gave *cis*-[PtCl(Ph₂SNH)(PMe₂Ph)₂][BF₄]. Four equiv. of (1) reacted with [PPh₄]₂[PtCl₄] over a week to give crystalline [Pt(Ph₂SNH)₄]Cl₂ which has square planar geometry with significant H-bonding interactions between the cation and the chlorides.

PHOTOCONVERSION

Characterization by Resonance Raman

Spectroscopy of Sol-Gel TiO₂ Films Sensitized by the Ru(PPh₃)₂(dcbipy)Cl₂ Complex for Solar Cells Application

P. FALARAS, A. HUGOT-LE GOFF, M. C. BERNARD and A. XAGAS, *Sol. Energy Mater. Sol. Cells*, 2000, 64, (2), 167–184

Ru(PPh₃)₂(dcbipy)Cl₂ (1) (dcbipy = 2,2'-bipyridyl-4,4'-dicarboxylate) was tested as a TiO₂ sensitizer in a wet regenerative photoelectrochemical cell. Very intense Raman bands due to PPh₃ and dcbipy were observed for (1) on TiO₂, when characterised by Raman spectroscopy. Altering the potential applied to the TiO₂ electrode for a given laser excitation energy can selectively enhance the PPh₃ vibrational modes. A reversible shift of dcbipy Raman lines was observed.

Efficient Solar Water Splitting, Exemplified by RuO₂-Catalyzed AlGaAs/Si Photoelectrolysis

S. LICHT, B. WANG, S. MUKERJI, T. SOGA, M. UMENO and H. TRUBUTSCH, *J. Phys. Chem. B*, 2000, 104, (38), 8920–8924

A solar photovoltaic-electrolysis cell containing illuminated AlGaAs/Si RuO₂/Pt_{black} evolves H₂ and O₂ at a record solar-driven H₂O electrolysis efficiency (18.3% conversion). With the RuO₂ and Pt_{black} electrocatalysts, efficient electrolysis may be achievable by using large areas of the electrolysis electrode, compared to the illuminated area.

ELECTRODEPOSITION AND SURFACE COATINGS

Catalytic Activity of Sputtered Palladium Films for Electroless Nickel Plating Studied Using a Quartz Crystal Microbalance

K. KOBAYAKAWA, M. MORITA, K. MIYAUCHI, Y. SATO and E. FUJIMOTO, *Plat. Surf. Finish*, 2000, 87, (9), 77–79

The catalytic activity of Pd film (1) sputtered on a quartz resonator was studied using a Ni plating bath and a quartz crystal microbalance. The adhesive interface between (1) and the quartz surface influenced activity. A Cr underlayer (2) suppressed the catalytic activity of (1), but a Au underlayer (3) did not. (1) sputtered on (3) is usable as an active anode for monitoring electroless plating. The catalytic activity of (1) on (2) was enhanced by cathodic treatment in HCl.

Electrosynthesis and Characterisation of Nanostructured Palladium-Polypyrrole Composites

N. CIOFFI, L. TORSI, L. SABBATINI, P. G. ZAMBONIN and T. BLEVE-ZACHEO, *J. Electroanal. Chem.*, 2000, 488, (1), 42–47

Electroactive Pd-polypyrrole composite thin films were obtained using three different bottom-up procedures. The procedures all comprised electrochemical synthesis of Pd nanoparticles which are subsequently potentiostatically deposited or embedded into electrochemically produced polypyrrole thin film. The metallic Pd inclusions have a mean diameter of ~ 5 nm with a homogeneous size distribution.

APPARATUS AND TECHNIQUE

Organoplatinum Crystals for Gas-Triggered Switches

M. ALBRECHT, M. LUTZ, A. L. SPEK and G. VAN KOTEN, *Nature*, 2000, 406, (6799), 970–974

Non-porous crystalline materials consisting of [PtCl(NCN-OH)] (NCN-OH = C₆H₂(CH₂NMe₂)₂-2,6-OH-4) (1) undergo a controlled and fully reversible crystalline-state reaction with gaseous SO₂. (1) dramatically changes colour from colourless to deep orange due to the formation of the corresponding adduct [PtCl(NCN-OH)(SO₂)]. Similarly, the reverse reaction in a SO₂-free environment leads to the complete regeneration of (1). (1) has potential for gas storage devices and optoelectronic switches.

A Fiber-Optic Evanescent-Wave Hydrogen Gas Sensor Using Palladium-Supported Tungsten Oxide

S. SEKIMOTO, H. NAKAGAWA, S. OKAZAKI, K. FUKUDA, S. ASAKURA, T. SHIGEMORI and S. TAKAHASHI, *Sens. Actuators B, Chem.*, 2000, 66, (1–3), 142–145

Pt or Pd supported on WO₃ were used as H₂ sensing media in an optical-fibre H₂ sensor (1). Two types of clad fibre were fabricated: (a) Pd/WO₃ containing silicone resin as the clad and (b) a sol-gel Pt/WO₃ or Pd/WO₃ thin clad. In the presence of H₂, strong evanescent-wave absorption was observed as a result of W bronze formation. (1) formed from (b) gave improved response time compared to (a). The properties of (1) are controlled by the amount of catalyst.

Lifetime-Based pH Sensor System Based on a Polymer-Supported Ruthenium(II) Complex

Y. CLARKE, W. XU, J. N. DEMAS and B. A. DEGRAFF, *Anal. Chem.*, 2000, 72, (15), 3468–3475

A luminescence pH sensor system is based on [Ru(Ph₂phen)₂DCbpy]²⁺ dye (DCbpy = 4,4'-dicarboxy-2,2'-bipyridine) immobilised in a mixed domain network copolymer utilising hydrophobic regions in a hydrophilic, H₂O-swellaable, poly(ethylene oxide) (PEO) matrix. The Ru dye binds irreversibly to the hydrophobic domains leaving pH-sensing COOH groups projecting into a H₂O-rich PEO region. The lifetime of the immobilised Ru dye has increased 3–4 fold. The sensor provides a usable pH range of ~ 3–5.

Sol-Gel Immobilised Ruthenium(II) Polypyridyl Complexes as Chemical Transducers for Optical pH Sensing

C. MALINS, H. G. GLEVER, T. E. KEYES, J. G. VOS, W. J. DRESSICK and B. D. MACCRAITH, *Sens. Actuators B, Chem.*, 2000, 67, (1–2), 89–95

Protonable Ru(II) polypyridyl complexes (1) have been evaluated for use as the chemical transducer component in optical pH sensor devices. The immobilisation of (1) in a microporous sol-gel glass matrix resulted in a similar modulation of fluorescence emission with changing pH as is shown by (1) in solution. The matrix provided a highly stable support that widened the working pH sensitive range to pH 3–9 with only minimal sensitivity to O₂.

HETEROGENEOUS CATALYSIS

Effects of the Radial Distribution of Platinum in Spherical Alumina Catalysts on the Oxidation of CO in Air

A. DREWSEN, A. LJUNGVIST, M. SKOGLUNDH and B. ANDERSSON, *Chem. Eng. Sci.*, 2000, 55, (21), 4939–4951

Pt/Al₂O₃ catalysts with a shell (1) and a homogeneous distribution (2) of Pt were prepared. Co-impregnation of chloroplatinic acid (3) and citric acid was used to prepare (2), resulting in a lower Pt dispersion than the traditional impregnation method with (3) which was used to prepare (1). Compared to (1), the conversion of CO started at lower temperatures when using (2), but higher temperatures were needed for total conversion.

The Role of Pt/SiO₂ in the Catalytic Denitration by HCO₂H of HNO₃ Concentrated Media

S. GUENAI-S LANGLOIS, C. BOUYER, J.-C. BROUDIC and B. COQ, *Appl. Catal. B: Environ.*, 2000, 27, (3), 199–204

Pt/SiO₂ catalysts (1) are used together with HCO₂H in chemical denitration to reduce nuclear fuel reprocessing waste. Two types of (1) were prepared from H₂PtCl₆, Pt(NH₃)₄Cl₂ and SiO₂. (1) suppress the induction period of the chemical denitration by the fast initial catalytic generation of HNO₂ from HNO₃. These then become the active species in the homogeneous phase. Leaching of Pt from (1) for large Pt aggregates (> 10 nm) is limited, but is very significant for nanosized particles (1–2 nm).

Solid-Solid Palladium-Catalysed Water Reduction with Zinc: Mechanisms of Hydrogen Generation and Direct Hydrogen Transfer Reactions

S. MUKHOPADHYAY, G. ROTHENBERG, H. WIENER and Y. SASSON, *New J. Chem.*, 2000, 24, (5), 305–308

H₂ generation from H₂O occurred under moderate conditions in the presence of 1 equiv. of untreated Zn powder and 0.005 equiv. of 5% Pd/C. Pd-H and Zn-O interactions are important in this system. In the presence of an organic H acceptor, such as benzaldehyde, direct H transfer from "Zn-activated" H₂O to the substrate, without the participation of Pd-H intermediates takes place. Hydrogenation of benzaldehyde to benzyl alcohol, and of aromatic nitro compounds to the corresponding amines, was achieved.

Heck Reaction Using Palladium Complexed to Dendrimers on Silica

H. ALPER, P. ARYA, S. C. BOURQUE, G. R. JEFFERSON and L. E. MANZER, *Can. J. Chem.*, 2000, 78, (6), 920–924

Pd-PPh₂-PAMAM-SiO₂ (PAMAM = poly(amino-amido) (1) are highly active catalysts for the Heck reaction of aryl bromides with styrene and butyl acrylate, affording *para* substituted stilbenes and cinnamate esters in good yields. PAMAM dendrimers, on the surface of SiO₂, were phosphonated using diphenylphosphinomethanol (prepared *in situ*) and complexed to give (1). (1) can be recycled.

HOMOGENEOUS CATALYSIS

New Highly Active Chiral Phosphapalladacycle Catalysts. First Isolation and Characterization of a Pd(IV) Intermediate

J. M. BRUNEL, M.-H. HIRLEMANN, A. HEUMANN and G. BUONO, *Chem. Commun.*, 2000, (19), 1869–1870

A new active P*-chiral phosphapalladacycle (1) was synthesised from the chiral *o*-tolylidiazaphospholidine ligand and Pd(OAc)₂ in refluxing toluene. (1) was successfully used in the asymmetric hydroarylation of norbornene at 120°C in DMSO, with turnover numbers ≤ 10¹⁰. An intermediate Pd(IV) complex was fully characterised by X-ray structure analysis.

Wacker Reaction in Supercritical Carbon Dioxide

H. JIANG, L. JIA and J. LI, *Green Chem.*, 2000, 2, (4), 161–164

The Wacker reaction of alkenes such as oct-1-ene, styrene and cyclohexene was carried out smoothly in sc-CO₂ or ROH/sc-CO₂ (R = Me, Et). PdCl₂ and CuCl₂ were the catalysts with O₂ as oxidant. Both sc-CO₂ and co-solvent affect the selectivity towards methyl ketone and the presence of ROH accelerates the reaction. The presence of a small amount of H₂O reduces the reaction rate although selectivity is retained. It is suggested that the reaction is homogeneous since Pd and substrates may form organo-Pd complexes in the oxidative process.

Novel Carbon–Carbon Bond Formation through Mizoroki–Heck Type Reaction of Silanols and Organotin Compounds

K. HIRABAYASHI, J.-I. ANDO, J. KAWASHIMA, Y. NISHIHARA, A. MORI and T. HIYAMA, *Bull. Chem. Soc. Jpn.*, 2000, 73, (6), 1409–1417

Aryl- or alkenylsilanols and aryl-Sn compounds react with various olefins in the presence of a stoichiometric amount of Pd(OAc)₂ or by a combination of 0.1 molar amount of Pd(OAc)₂ and Cu(OAc)₂/LiOAc (molar ratio 3:2) to give aryl- or alkenyl-substituted olefins. Aryl-Sn compounds show reactivity superior to silanols, although the Sn reagents sometimes induce undesirable homocoupling. Arylsilanols and aryl-Sn compounds react with C₂H₄ to give styrene derivatives without formation of stilbenes.

Palladium-Catalyzed C–C Coupling under Thermomorphic Conditions

D. E. BERGBREITER, P. L. OSBURN, A. WILSON and E. M. SINK, *J. Am. Chem. Soc.*, 2000, 122, (38), 9058–9064

Poly(*N*-isopropylacrylamide) (PNIPAM)-bound phosphine ligands with a Pd(0) catalyst are shown to be efficient catalysts in Heck, Suzuki, and sp²-sp² cross-coupling reactions under thermomorphic conditions. Air-stable tridentate S-C-S-Pd(II) catalysts bound to soluble polymer supports of PNIPAM or poly(ethylene glycol) are also described. The use of a thermomorphic solvent system in conjunction with the selectively soluble polymer support, allowed for facile product isolation and catalyst recycling.

Rhodium-Catalyzed Copolymerization of Norbornadienes and Norbornenes with Carbon Monoxide

S.-W. ZHANG, T. KANEKO and S. TAKAHASHI, *Macromolecules*, 2000, 33, (19), 6930–6936

Alternate copolymerisation of norbornadienes and norbornenes with CO is catalysed by $\text{Rh}_6(\text{CO})_{16}$ under water gas shift reaction conditions selectively to give the corresponding polyketones in high yields. A possible mechanism based on the structure of the oligomeric products is discussed.

Practical Synthesis of (*S*)-1-(3-Trifluoromethylphenyl)ethanol via Ruthenium(II)-Catalyzed Asymmetric Transfer Hydrogenation

M. MIYAGI, J. TAKEHARA, S. COLLET and K. OKANO, *Org. Process Res. Dev.*, 2000, 4, (5), 346–348

(*S*)-1-(3-Trifluoromethylphenyl)ethanol was prepared from the corresponding acetophenone by Noyori's Ru(II)-catalysed asymmetric transfer hydrogenation. This route gives high ee, low catalyst cost, and safe operation. When *sec*-alcohols were used as the H source, the catalyst was prepared *in situ* from $[\text{RuCl}_2(\text{arene})]_2$ and (1*S*,2*S*)-*N*-(arylsulfonyl)-1,2-diphenylethylenediamine. With formic acid as the H source, the chiral catalyst (*S,S*)-*N*-*p*-tosyl-1,2-diphenylethylene-1,2-diamine–Ru was used.

FUEL CELLS

Platinum-Tin Alloy Electrodes for Direct Methanol Fuel Cells

M. A. ABDEL RAHIM, M. W. KHALIL and H. B. HASSAN, *J. Appl. Electrochem.*, 2000, 30, (10), 1151–1155

Pt electrodes, modified by partial galvanostatic or potentiostatic Sn electrodeposition, were used as anodes for the catalytic electrooxidation of MeOH in acid medium. Cyclic voltammetry was used to study MeOH electrooxidation. From the MeOH peak current densities, Pt-Sn electrodes are claimed to be superior to pure Pt electrodes. Sn also improved the performance of anode stability over repeated cycles.

ELECTRICAL AND ELECTRONIC ENGINEERING

X-Ray Study of Co/Ni and Co/Pt/Ni/Pt Multilayers

D. RAFAJA, J. VACÍNOVÁ and V. VALVODA, *Thin Solid Films*, 2000, 374, (1), 10–20

Ultrathin Co/Ni magnetic multilayers, deposited by dual electron beam evaporation, grow with poor interface quality, which destroys the superlattice structure after a few bilayers. However, the quality of the superlattice in Co/Pt/Ni/Pt magnetic multilayers (1) was substantially better, mostly due to the lower mutual diffusion of Pt and Co, and Pt and Ni. For (1), X-ray reflectivity measurements yielded information on thickness and interface roughness of individual layers. These were compared with thickness and interface roughness obtained from XRD.

PdGe-Based Ohmic Contact on n-GaAs with Highly and Poorly Doped Layers

J.-W. LIM, J.-K. MUN, S.-J. AN, S. NAM, M.-H. KWAK, H. KIM and J.-J. LEE, *Jpn. J. Appl. Phys., Part 1*, 2000, 39, (5A), 2546–2549

The ohmic contact formation mechanism for a low contact resistance PdGe-based system on GaAs containing highly and poorly doped layers annealed at 380–450°C is reported. The lowest average specific contact resistance of the Pd/Ge/Ti/Pt ohmic contact was $2.4 \times 10^{-6} \Omega \text{ cm}^2$ after annealing at 400°C.

Investigation of the Electrical Properties of Tantalum-Ruthenium Dioxide as a Diffusion Barrier for High Dielectric Capacitors

D.-S. YOON, S.-M. LEE and H. K. BAIK, *J. Electrochem. Soc.*, 2000, 147, (9), 3477–3481

The effects of RuO_2 addition on the electrical properties of the Ta- RuO_2 diffusion barriers of capacitor bottom electrodes as a function of the Ta: RuO_2 ratio and contact size, at 650–800°C in air, were studied. For both the Ta + $\text{RuO}_2/\text{n}^{++}$ -poly-SiSiO₂/Si and the Pt/Ta + $\text{RuO}_2/\text{n}^{++}$ -poly-SiSiO₂/Si contact systems, a conductive RuO_2 crystalline phase was formed after annealing. Surface oxidation of the diffusion barrier was prevented and the bottom electrode structure was retained at < 800°C.

MEDICAL USES

New Antitumor-Active Azole-Bridged Dinuclear Platinum(II) Complexes: Synthesis, Characterization, Crystal Structures, and Cytotoxic Studies

S. KOMEDA, M. LUTZ, A. L. SPEK, M. CHIKUMA and J. REEDIJK, *Inorg. Chem.*, 2000, 39, (19), 4230–4236

The antitumour properties of $[\{\text{cis-Pt}(\text{NH}_3)_2\}_2(\mu\text{-OH})(\mu\text{-}1,2,3\text{-ta})][\text{NO}_3]_2$ (1), $[\{\text{Pt}(\text{R,R-dach})\}(\mu\text{-OH})(\mu\text{-pz})\{\text{Pt}(\text{S,S-dach})\}][\text{NO}_3]_2$ (2) and $[\{\text{Pt}(\text{R,R-dach})\}(\mu\text{-}1,2,3\text{-ta})\{\text{Pt}(\text{S,S-dach})\}][\text{NO}_3]_2$ (3) (1,2,3-ta = 1,2,3-triazolate, dach = 1,2-diaminocyclohexane, pz = pyrazolate) were tested after preparation. (1) and the parent compound $[\{\text{cis-Pt}(\text{NH}_3)_2\}_2(\mu\text{-OH})(\mu\text{-pz})][\text{NO}_3]_2$ showed higher cytotoxicity than cisplatin, while (2) was shown to be moderately active and (3) was only marginally cytotoxic.

Synthesis, Spectroscopic, Electrochemical and Antibacterial Studies of New Ru(II) 1,10-Phenanthroline Complexes Containing Aryldiazopentane-2,4-dione as Co-ligand

L. MISHRA, A. K. YADAW, S. SRIVASTAVA and A. B. PATEL, *New J. Chem.*, 2000, 24, (7), 505–510

Mono- and dinuclear Ru(II) complexes of 1,10-phenanthroline containing aryldiazopentane-2,4-diones as co-ligands were prepared. Complexes having 1,10-phenanthroline as terminal ligand showed better bacterial inhibition than those bearing 2,2'-bipyridine as terminal ligand. The 1,10-phenanthroline system already bound with DNA showed poorer activity than the unbound system.