GLASS TECHNOLOGY

An Electrochemical Theory for Oxygen Reboil
O₂ reboil with the development of O₂ blisters may occur during glass melting in air in Pt vessels but can be reduced by elimination of electron conductors from the system, removal of O₂ from the atmosphere above the melt, application of an external bucking potential, reversal of concentration gradients, and removal of temperature gradients. A mechanism for the phenomenon is proposed.

ELECTRICAL AND ELECTRONIC ENGINEERING

Influence of Platinum Group Metal Films on Oxide Cathode Emission
Thermionic emission from an heated cathode can be controlled by coating with Pt, Ir, or Os, which suppress emission from the coated areas. 0.3-0.5μ coatings of Ir reduce emission from an oxide cathode by 300 times, 0.3-0.5μ Pt by 10 times, 0.01μ Os by 100 times.

NEW PATENTS

METALS AND ALLOYS

Composite Metal
DEUTSCHE GOLDSILBER-SCHEIDEANSTALT
British Patent 1,051,994
Better adherence of Pt to Ti is achieved when the Ti is pickled in a solution which is at least 10 N in H⁺ and 10 N in Cl⁻ until a dark grey covering layer is formed and a metal of the Pt group is firmly bonded to the treated substrate by cold welding with a reduction in thickness of at least 25%.

Ruthenium Alloys for Powder Metallurgy
THE INTERNATIONAL NICKEL CO. INC.
U.S. Patent 3,278,280
A liquid-phase sintered alloy which has powder metallurgy applications comprises 5-35 wt. % Au, 5-35 wt. % Pd and the balance Ru.

Magnetic Platinum Metal Alloys
E. I. DU PONT DE NEMOURS & CO.
U.S. Patent 3,279,914
A new alloy consists of 20-75 % Mg, 20-62 % Ge and 1-35 % Pd and/or Rh.

Ruthenium Alloys
INTERNATIONAL NICKEL LTD.
French Patent 1,438,650
Alloys which are extremely useful in powder metallurgy comprise 0.25-2.5 wt. % Re and the balance Ru.

Iridium Alloy for Springs
INTERNATIONAL NICKEL LTD.
German Patent 1,224,936
A suitable alloy for springs exposed to temperatures of 500°C and more consists of Ir with 0.5-7 %, especially 2-7 % W.

CHEMICAL COMPOUNDS

Production of Trimeric Ruthenium Tetra-carbonyl
LONZA LTD.
British Patent 1,047,794
Trimeric Ru(CO)₃ is produced by reacting an enolisable Ru compound or basic Ru carboxylate with CO and H₂ in the presence of an organic solvent, at 100-250°C and 50-350 atm.
ELECTROCHEMISTRY

Hot Electrodes for Electrode Systems
LEYBOLD HOLDING A.G.  British Patent 1,047,290
A hot electrode operating at elevated temperatures in O₂-containing gases is suspended between connections on two electrode holders and has intermediate members made of Ir or Ir-Pt alloy interspersed between the holders. These intermediate members are so dimensioned that they ensure that the electrode temperature is maintained above the temperature range within which the electrode material forms oxides.

Electrolytic Anode
E. M. NELSON  U.S. Patent 3,278,410
An electrolytic anode for cells in which Cl₂ or Cl₂-containing radical are formed comprises a screen-brazing made of Ti coated with Pt and loose graphite particles arranged within the housing so that at least some bear against the Pt-coated screen.

Platinised Titanium Anode
FARBENFABRIKEN BAYER A.G.  German Patent 1,225,618
A Cl₂ electrolysis cell is fitted with a Ti anode which is provided with an electrochemically active Pt layer on the amalgam side.

ELECTRODEPOSITION AND SURFACE COATINGS

Deposition of Gold-Palladium Alloys
TECHNIC INC.  British Patent 1,051,383
The new bath contains Au as a cyanide, a suitable buffering salt, a Pd compound other than a cyanide, e.g. a complex or chelate, and acid or alkali to adjust the pH.

Metallised Ceramic Members
CIE. FRANCAISE THOMSON-HOUSTON  U.S. Patent 3,265,473
A metallised ceramic structure comprises a ceramic body, a metallised layer of highly refractory material bonded to it, e.g. Mo, a layer of Rh, Pt or Ir or their combinations and an outer layer of Au.

Electroless Plating with Platinum Group Metals
AMALGAMATED CURACAO PATENTS CO. N.V.  U.S. Patent 3,265,526
Glass, C, steel, Fe, Ti, Ni, etc. are coated with Pt group metals or their alloys, by applying on them at least one reducible salt of the plating metal, heating in a gaseous mixture of reducing and alkaline reagents and ensuring that decomposition of the metal salt takes place without the substrate being damaged.

Electroless Deposition of Palladium
THE INTERNATIONAL NICKEL CO. INC.  U.S. Patent 3,274,022
A bath for the electroless deposition of Pd comprises an aqueous solution containing 1-20 g/l Pd(II), 0.04-0.5 g/l unsymmetrical dimethylhydrazine, an organic amine in a molar concentration equivalent to 100-350 g/l NH₃ and up to 80 g/l NH₄Cl or (NH₄)₂SO₄ or EDTA as stabiliser.

BRAZING

Brazing Alloys for Tungsten and Molybdenum
UNITED STATES ATOMIC ENERGY COMMISSION  British Patent 1,049,957
A brazing alloy for joining W, Mo and their alloys comprises 42-95% Mo, 5-44 wt.% Rh and 0-45 wt.% Re.

Brazing of Tungsten
U.S. SECRETARY OF THE NAVY  U.S. Patent 3,276,113
W elements are joined together at low temperatures by placing between the elements an alloy of 1-4.5 wt.% B and the balance Pt, heating the assembly to at least 2000°F at minimum rate of 25°F/min and then brazing the elements together for 5-60 sec at about 2000°F.

Alloys for Brazing Tungsten and Molybdenum
UNITED STATES ATOMIC ENERGY COMMISSION  French Patent 1,440,987
An alloy for brazing together Mo, W and their alloys comprises 48-87 wt.% Mo, 30-75 wt.% Pd and the balance Ni.

LABORATORY APPARATUS AND TECHNIQUE

Stabilising Metal Surfaces, Especially of Platinum Metals Heated at High Temperature
J. FUKA  Czech Patent 117,397
An Al₂O₃ layer, formed by treatment of Al compounds on the surface of a Pt conductor, prevents evaporation of Pt at 900-1250°C when determining CH₄ or CO based on their infra-red radiation absorbancy. Most emitted Pt molecules
then remain within the Al₂O₃ protective layer, participate in conduction of the current and improve the element’s stability.

**Catalysis**

**Cyclic Acetals and Ketals and their Preparation**

_SHELL INTERNATIONALE RESEARCH MIJ. N.V._

_British Patent 1,046,608_

A cyclic acetal or ketal is produced by heating a glycol with an aldehyde or ketone at 140-220°C in the presence of a catalyst comprising 0.5-15 wt.% supported Rh, Ir, Pd or Pt.

**Continuous Production of Hydroxylammonium Salts**

_BADISCH & SODA-FABRIK A.G._

_British Patent 1,046,656_

An improved process for the production of hydroxylammonium salts utilises, as catalyst, 0.3-5 wt.% Pt/C.

**Selective Hydrogenation of Cycloalkenes**

_THE GEIGY CO. LTD._

_British Patent 1,046,780_

An improved process for the selective hydrogenation of cycloalkenes is carried out in the presence of Pd black or Pd supported on SiO₂, Al₂O₃, pumice, etc.

**Catalytic Oxidation of Ethylenically Unsaturated Compounds**

CELERAN CORPORATION OF AMERICA

_British Patent 1,047,172_

Carbonyl compounds are produced by the oxidation with O₂ of an ethylenically unsaturated compound at 20-90°C, 1-5 atm in the presence of an aqueous solution containing ions of a Pt group metal and NO₃ or NO₂ ions.

**Preparation of Alkenyl Acetate**

_SHELL INTERNATIONALE RESEARCH MIJ. N.V._

_British Patent 1,047,835_

Alkenyl acetate is produced by reacting an up to 4C straight chain olefine with Ru, Rh, Pd, Os, Ir or Pt acetate in the presence of H₂O so that the desired alkenyl acetate is formed, oxidising the aldehyde and/or ketone formed during this reaction to CH₂COOH and using this CH₂COOH together with O₂ to regenerate the reduced precious metal acetate.

**Catalysts**

_ESSO RESEARCH & ENGINEERING CO._

_British Patent 1,047,933_

A finely divided metal alloy is produced by adding a solution of a Pt salt, a second metal salt and optionally a third metal salt to a NaHB₄ solution and selecting the other metals from Ru, Rh, Pd, Os, Ir, Au, Ag, Fe, Co, Ni, Mn, Re, Mo, W, Cu, Cd, Zn, Cr, Ti or V.

**Activity Maintenance of Hydrocracking Catalyst**

_ESSO RESEARCH & ENGINEERING CO._

_British Patent 1,048,343_

A catalyst comprising crystalline alumino-silicate zeolite containing less than 10% Na₂O, having pore size 6-15Å and activated by a Pt group metal, is reactivated by contacting it with H₂ at 600-1,000°F.

**Indole Derivatives**

_MERCK & CO. LTD._

_British Patent 1,050,730_

Indolyl aliphatic acids are produced by hydrolysing a suitable indole acetal and oxidising the resulting aldehyde with Ag₂O or PtO₂ in an inert solvent. See also 1,050,731-1,050,740.

**Catalyst and Process for Reforming Hydrocarbons**

_UNIVERSAL OIL PRODUCTS CO._

_British Patent 1,052,892_

A gasoline boiling range fraction is catalytically reformed using a reduced composite of a refractory metal oxide, a Group VIII metal and combined halogen, e.g. Pt and Cl₂ on Al₂O₃ support.

**Production of Carboxylic Acid Esters of Unsaturated Monohydric Alcohols**

_IMPERIAL CHEMICAL INDUSTRIES LTD._

_British Patent 1,053,421_

These esters are obtained by contacting an olefine with a liquid mixture containing a Pd salt other than a fluoride, a carboxylate which is ionised in the reaction conditions, a redox system, a carboxylic acid and less than 5 wt.% H₂O.

**Production of Unsaturated Carboxylic Acids**

_IMPERIAL CHEMICAL INDUSTRIES LTD._

_British Patent 1,054,132_

Unsaturated acids are oxidised with O₂ in the presence of a Pd salt, a Cu or Fe salt and a nucleophile (H₂O or carboxylate ions).

**Preparation of Diols**

_THE BRITISH PETROLEUM CO. LTD._

_British Patent 1,054,173_

Pd/C is a far more selective catalyst for the hydrogenation of epoxy alcohols to diols than many conventional hydrogenation catalysts.

**Copolymerisable Organosilicon Compositions**

_GENERAL ELECTRIC CO._

_British Patent 1,054,658_

Pt catalysts are more easily added to silicon compositions in the form of a ligand with a N compound, e.g., picoline or C₅H₅N.

**Hydrogenation of Oligomers**

_FARBENFABRIKEN A.G._

_British Patent 1,055,233_

Oligomers of propylene and butylene are hydrogenated in the presence of Pt and/or Pd metal deposited on a support containing no free inorganic acid or acid salt.
Catalyst Regeneration
ALLIED CHEMICAL CORP. British Patent 1,055,672
Catalysts containing Pd, which have been used in the continuous hydrogenation of organic nitro compounds, are regenerated by washing with water until the initial catalytic activity is restored.

Platinum Group Metal Hydrocracking Catalysts
UNION OIL COMPANY OF CALIFORNIA U.S. Patent 3,267,022
Hydrocarbon feedstock is subjected to hydrocracking over a fixed bed catalyst consisting of zeolite of 6-14 Å pore size supporting a Pt group metal catalyst and at least 10 wt. % Al₂O₃, MgO, SiO₂ and/or H₄ clays.

Zeolite-Platinum Group Metal Hydrocracking Catalysts
MOBIL OIL CO. U.S. Patent 3,267,023
An improved hydrocracking catalyst is a combination of crystalline aluminosilicate zeolite and a Pt group metal.

Platinum Group Metal Dimerisation Catalysts
SHELL OIL CO. U.S. Patent 3,267,169
8-10 C 1,3,7-octatriene is produced by contacting together 8-10 C 2,7-octadienyl ether, Pt, Pd or Ru, phenoxide anion catalyst promoter and a tertiary phosphate.

Platinum Group Metal Sulphide Catalysts
ESSO RESEARCH & ENGINEERING CO. U.S. Patents 3,267,170-1
A catalyst comprising a support and a Group VIII metal sulphide, preferably Pt or Pd sulphide, is used in the production of olefines by H transfer.

New Noble Metal Catalyst Surfaces
E.I. DU PONT DE NEMOURS & CO.
U.S. Patent 3,271,322
New catalysts comprise a film of polytetrafluoroethylene, a particulate carrier of one or more refractory metal oxides or chromites or manganites and a supported Ru, Pd, or Pt metal or oxide or Co, Ni, Ce, Ru, Pd or Pt oxide, cerate, manganate, manganite, chromate, chromite or vanadate partially carried on the surface of and partially embedded in said film.

Supported Palladium Catalysts
AIR PRODUCTS AND CHEMICALS INC. U.S. Patent 3,271,327
Supported hydrated Pd oxide catalysts are produced by neutralising an aqueous solution of PdCl₂ and HCl to a pH of 4-6.5 by the addition of a base, contacting a substantially non-porous support material with the neutralised solution, wet ageing the treated support material at 70-85°F and then drying the catalyst at 140°F.

Palladium Rehydrogenation Catalyst
ARCHER-DANIELS-MIDLAND CO. U.S. Patent 3,271,410
The quality of catalytically-hydrogenated fatty acid is improved by rehydrogenating it at 200-500°F and 10-5,000 psig in the presence of a 0.001-1 wt.% Pd supported catalyst.

Platinum Group Metal-Zeolite Catalysts
ESSO RESEARCH & ENGINEERING CO. U.S. Patent 3,272,734
A catalyst for the hydrocracking of a hydrocarbon oil feed comprises a crystalline aluminosilicate zeolite which contains less than about 10 wt.% Na₂O, has pore size 6-15 Å and is formed into a composition with 0.01-5 wt.% Pt group metal.

Platinum Group Metal Hydrocracking Catalysts
UNIVERSAL OIL PRODUCTS CO. U.S. Patent 3,274,124
A hydrocracking catalyst is produced by commingling an alkali metal silicate solution with acid solution to form a silica sol, forming a gel and ageing it, commingling it with Al salt to form a silica-alumina composite, drying it at 200-500°F, calcining at 800-1,400°F and finally impregnating with a Pt group metal component.

Palladium and Platinum Dioxide Hydrogenation Catalysts
NEPERA CHEMICAL CO. INC. U.S. Patent 3,274,206
Pyridine aldehydes are prepared by hydrogenating the corresponding nitriles at below 70°C in aqueous, acidic medium and in the presence of Pd or PtO₂.

Alkylation-hydrogenation Catalysts
UNIVERSAL OIL PRODUCTS CO. U.S. Patent 3,274,276
Non-condensed cycloalkyl aromatic compounds are produced by treating an aromatic compound with H₂ at 25-50°C in the presence of a catalyst comprising AlCl₃ and Pt/C or Pd/C.

Selective Hydrogenation Catalysts
CHEMISCHE WERKE HÜLS A.G. U.S. Patent 3,274,286
A catalyst for the selective hydrogenation of acetylenic hydrocarbons in the presence of diolefines comprises 5-50 wt.% Cu or Cu chromite, 0.01-20 wt.% Pt group metal, Zn or Ag 0.1-50 wt.% alkali or alkaline earth metal oxide or hydroxide and a carrier in amount constituting at least 40 wt.% of the mixed catalyst.

Platinum Group Metal Dehydrogenation Catalysts
MONSANTO CO. U.S. Patent 3,274,287
A catalyst for the dehydrogenation of mono-
ethylenically unsaturated hydrocarbons comprises 0.02-2.0 wt.% Pt group metal, preferably Pt or Pd, dispersed on a low acidity Al₂O₃ support.

**Platinum Group Metal Hydrocarbon Conversion Catalysts**

**Mobil Oil Corp.** U.S. Patent 3,276,993

A composite catalyst for hydrocarbon conversion is produced by rolling together preformed discrete macroporous base particles with finely divided Ru, Rh, Pd, Os, Ir, Pt, Cu chromite or crystalline aluminosilicate catalyst particles until 0.5-20 wt.% of such particles are sifted into the pores of the base particles.

**Platinum Group Metal Hydrocarbon Conversion Catalysts**

**Sinclair Research Inc.** U.S. Patent 3,277,071

A catalyst system for the polymerisation of C₂H₄ at 70-500°C and up to 30,000 psi comprises at least 75 wt.% SiO₂, 10-30 wt.% Al₂O₃ and 0.2-5 wt.% Pt group metal.

**Platinum Oxide Catalysts for Ethylene Polymerisation**

**Sinclair Research Inc.** U.S. Patent 3,277,158

Vinyl acetate is produced from C₂H₄ by an improved process carried out in the presence of 0.001-5 wt.% Pd, 0.05-5 wt.% halogen and 0.1-10 wt.% alkali metal acetate.

**Platinum Group Metal Catalysts in the Production of Unsaturated Esters**

**Shell Oil Co.** U.S. Patent 3,277,159

Unsaturated esters are prepared from hydrocarbon olefines by utilising catalytic amounts of Pt group metal.

**Platinum Group Metal Hydroforming Catalysts**

**Shell Oil Co.** U.S. Patent 3,278,419

A Pt metal reforming catalyst is reactivated by introducing C₁₅ and water into the feed until about 0.3 wt.% Cl₂ is introduced into the catalyst, removing at least part of the C deposits by burning and then maintaining the catalyst bed at 900-1,000°F for at least 8 h in the presence of an inert gas containing at least 20 vol.% O₂.

**Rhodium Hydrogenation Catalyst**

**Shell Oil Co.** U.S. Patent 3,278,611

Aromatic, halogenated halides are hydrogenated with H₂ in the liquid phase, at 10-90°C and in the presence of 0.0005-15 wt.% Rh.

**Platinum-on-Alumina Reforming Catalyst**

**American Cyanamid Co.** U.S. Patent 3,280,041

γ-Al₂O₃ catalyst supports are calcined, impregnated with H₂O and calcined again before receiving the catalyst metal to obtain better activity and crushing strength.

**Palladium Catalyst in the Production of Sulphur Dioxide**

**Allied Chemical Corp.** U.S. Patent 3,282,646

SO₂ gas is produced by heating (NH₄)₂HSO₄ at 400-500°C and in the presence of a Pd/C catalyst, whilst contacting it with a non-oxidising gas.

**Platinum Group Metal Halide Complex Catalyst**

**Geoffrey Wilkinson** Canadian Patent 745,663

An hydrogenation, hydroformylation or carbonylation process, in which an unsaturated organic compound is reacted with H₂ and/or CO, employs a liquid medium containing a dissolved catalyst, which is an halogen- or pseudo-halogen-containing Pt group metal complex with empirical formula LₙMₖX₉, where L = ligand, n = number of ligand molecules, M = Pt group metal, v = valency state of M, X = halogen atom or pseudo-halogen group, y = number of X (at least 1). At least one ligand is present and is one or more of: (a) organic isocyanides, (b) organic compounds which include in their molecules an atom of a Group Vb or VIb element with a lone pair of electrons, (c) (when M is Rh or Ir and the process is hydroformylation) stannous and Ge(II) halides.

**Preparation of an Alumina-Platinum Catalyst**

**All-Union Scientific-Research Institute of Petrochemical Processes** U.S.S.R. Patent 182,119

The catalyst for dehydrocyclisation of paraffins is prepared by impregnating Al₂O₃ with a Pt solution. To increase its capacity for repeated regeneration, 1-5% alkali metal is added to the Al₂O₃ during or directly after the precipitation of the Al(OH)₃ gel.

**FUEL CELLS**

**Rechargeable Batteries**

**Union Carbide Corp.** British Patent 1,047,831

A rechargeable battery includes an auxiliary electrode which is in contact with the cathode and which comprises a porous conductive base on which a Pt, Rh, Pd or Ir H₂-ionisation catalyst has been deposited.

**Fuel Cells**

'Shell' Research Ltd. British Patent 1,049,428

A fuel cell unit comprises a porous metal substrate having applied to one of its surfaces in the following order: a porous layer of Ni aluminate; a layer of solid oxide electrolyte constituted by ZrO₂ stabilised with lime or yttria; an O₂-permeable layer of Pt, Pd, Ir, Ru, Rh or Ag.
Fuel Cells
E.I. DU PONT DE NEMOURS & CO.
British Patent 1,052,327
The cell electrodes are of non-porous, hollow permeable polymeric filaments coated with an electron carrier and a catalyst, e.g. Pt/Ag.

Fuel Cell Electrode
ESSO RESEARCH & ENGINEERING CO.
British Patent 1,055,433
The electrode comprises an electroconductive base coated and/or impregnated with a binary catalytic mixture of 60-90 wt.% Pt, 10-40 wt.% Re.

Noble Metal Fuel Cell Electrodes
ALLIS-CHALMERS MANUFACTURING CO.
U.S. Patent 3,266,939
A fuel cell comprises a housing, a unitary fuel-oxidant-electrolyte solution comprising 5-50 wt.% alcohol, 0.5-5 vol.% H₂O, and the balance aqueous hydroxide electrolyte and electrodes at least partially immersed in this solution. Of these the fuel electrode carries a Pt, Pd, Ir, Rh, Ru or Os catalyst and the oxidant electrode carries Ag, Co, Ni or their oxides or Fe oxide as catalyst.

Production of Fuel Cell Electrode
AIR PRODUCTS & CHEMICAL INC. and NORTHERN NATURAL GAS CO.
U.S. Patent 3,276,976
A fuel cell electrode is produced by connecting an electroconductive base member as a cathode and a body of Pt as an anode in an electrolytic plating solution comprising Pt and Group IB or VIII promoter metal taken in 1:1 to 2:1 molar ratio and applying a pulsating current between the electrodes.

Noble Metal-Carbon Fuel Cell Electrodes
AMERICAN CYANAMID CO.
U.S. Patent 3,281,282
Noble metals are deposited by first impregnating with a base metal salt, e.g. CdCl₂ or CoCl₂, and then depositing the noble metal (Pt or Pd) by electrolytic displacement.

Noble Metal Electrodes
THE ELECTRIC STORAGE BATTERY CO.
U.S. Patent 3,282,737
A porous electrode for a fuel cell is produced by depositing a first metallic catalyst on a metallic surface of a finely divided substrate, depositing a second catalyst coating and shaping the electrode. The metallic surface of the finely divided substrate is selected from Ni, Ag, Cu or Co and the metallic catalyst coatings are selected from Ag, Pd, Au, Pt, Ru, Rh, Os and Ir.

Biochemical Fuel Cell
U.S. SECRETARY OF THE ARMY
U.S. Patent 3,284,239
Fuel cells using fuel substances generated bio-chemically are equipped with a Pt screen anode and a Pt/C air cathode.

CHEMICAL TECHNOLOGY
Separation of Acrylonitrile from Mixtures
ESSO RESEARCH & ENGINEERING CO.
British Patent 1,051,245
The gas containing acrylonitrile is passed through a bed of a solid salt of a monovalent Group IB metal or of Pt, Pd, Ir, Rh, Ru or Os capable of forming a complex with acrylonitrile, the bed being purged and stripped when saturated.

GLASS TECHNOLOGY
Glass Fibre Production
PITTSBURGH PLATE GLASS CO.
British Patent 1,049,517
A bushing for the production of glass fibres includes a glass contacting portion made of an alloy of 10-50 wt.% Au and 50-90 wt.% Pt.

ELECTRICAL AND ELECTRONIC ENGINEERING
Ternary Alloy Strain Gauge
KABUSHIKI KAISHA HITACHI SEISAKUSHO
British Patent 1,047,412
A mechno-electrical strain gauge comprises at least one wire or foil made of a ternary alloy comprising 20-60 at.% Pt, 20-60 at.% Pd and 5-30 at.% Ir.

Anhydrous Electrochemical Memory Device
SPERRY RAND CORP.
British Patent 1,051,342
The device has a cell with electrodes (e.g. made from Ag, Au or Pt metal), immersed in an electrolyte formed from Ag halides and Ag₂S.

An electrical resistance element is produced by admixing a composition of thermally decomposable organic metal compound containing at least one of the noble metals Ru, Rh, Ir and Pd and a thermally decomposable glass-forming organic metal compound in solution, applying a film of the mixture on to the surface of a high temperature resistant, non-conductive base, firing the film at 750-900°C to cause thermal decomposition and cooling the film consisting of glass and uniformly dispersed noble metal oxide.

Ceramic Capacitor Production
PACKARD-BELL ELECTRONICS CORP.
U.S. Patent 3,284,683
A Ni alloy support is coated on one surface with Au, Pt or Pd and this is diffused in before a BaTiO₃ layer is applied and fired.