

NEW PATENTS

METALS AND ALLOYS

Sintered Ceramic Matrix-Metal Composite

JOHNSON MATTHEY P.L.C. *British Appl. 2,245,557A*

A compacted and sintered material consists of a matrix of ceramic grains of 0.5–1 μm in size, dispersed in which are 2–1000 nm particles of Pt, Pd, Ru, Mo, W or a mixture of these. The material has improved toughness and crack resistance, significant catalytic activity even though the metal is not exposed, and is used for cutting tools, catalysts, and components for internal combustion engines, for example cylinder liners and heads.

ELECTROCHEMISTRY

Low Overvoltage Cathodes for Chlor-Alkali Cells

DOW CHEMICAL CO. *U.S. Patent 5,066,380*

Electrolytic cathodes for chlor-alkali cells are manufactured by contacting a metal substrate with a solution of pH < 2.8 containing Ru, Rh, Ir, Os and/or Pt ions, especially Ru ions, and Pd ions. The Pd promotes enhanced deposition of the electrocatalytic metal, by non-electrolytic reduction, to give a mixture of the metal and Pd in hard, continuous non-dendritic form. The cathodes obtained have low overvoltage, tightly adherent coatings and improved electrocatalyst loading.

ELECTRODEPOSITION AND SURFACE COATINGS

Platinum Plating or Electroforming Bath

ELECTROPLATING ENG. *European Appl. 465,073A*

A plating bath consists of 2–100 g/l Pt from at least one Pt compound, 20–100 g/l alkali metal hydroxide, a compound selected from soluble carboxylates, phosphates and sulphates, and an alloying metal salt of Pd, Ir, Ru, Au or Ag. The bath is used for electroplating or electroforming at 65°C or more, at 1–3 A/dm², to give products of not more than 50 μm and at least 10 μm thickness, respectively. Materials with high hardness, thickness and therefore improved corrosion and scratch resistance are obtained.

Rhodium Plated Copper Laminated Layered Plate for Slip Rings

NIPPON AVIONICS K.K. *Japanese Appl. 3/223,486*

A Cu laminated layered plate consisting of a base material, a resin insulating layer, and a Cu foil, is wet plated with Cu, Ni and Au, and then plated with Rh to give a 1.0–2.5 μm thick layer. Preferably soft etching using ammonium persulphate is effected between the Cu, Ni and Au plating steps.

Pore-Free Precious Metal Coating for Electrodes

TANAKA KIKINZOKU KOGYO *Japanese Appl. 3/285,091*

A Ti, Ta, Nb or precious metal electrode base is coated with an organo-Pt, organo-Ir or organo-Ru ink containing 1–100 wt.% of an organometallic resinate, 50 wt.% or less of resin and 80 wt.% or less of an organic solvent, followed by drying and firing. The method provides electrodes coated with a thin film of precious metal at a thickness of 0.5–1.5 μm .

Electroless Plating of Palladium-Silver Alloy Film

EBARA CORP. *Japanese Appl. 3/287,781*

A Pd-Ag alloy film is precipitated on a catalytically active carrier from a plating bath containing 0.001–0.500 mol/l (total) of Pd and Ag salts, 0.01–50 mol/l (total) of NH₃ and/or an amine compound, 0.0005–0.5000 mol/l of hydrazine and/or a hydrazinium salt as the reducing agent, and 0.001–10 mol/l of aminopolyhydric acetic acid and/or its salt as the chelating agent.

Electrolytic Deposition of a Palladium-Nickel Alloy Contact Layer

KONTAKT SPEZIAL GOR. *East German Patent 292,596*

A Pd-Ni alloy contact layer is deposited from an electroplating bath containing 10–15 g/l Pd and 5–10 g/l Ni as salts, preferably in ammonia solution, and 0.01–1.0 g/l of a polyfunctional 5-membered heterocyclic compound, added as an aqueous solution.

APPARATUS AND TECHNIQUE

Electrochemical Sensor for Monitoring Zirconium Alloy Corrosion

HITACHI K.K. *Japanese Appl. 3/218,452*

An electrochemical sensor for monitoring the corrosion of Zr alloy has a Zr alloy sample electrode, a membrane coated Ag-Ag chloride reference electrode, and a Pt counter electrode, all sealed in a ceramic mould, within a corrosion resistant stainless steel casing. The corrosion of Zr alloy in service is surmised from that of the sample alloy, and measurement of the corrosion current detects the state of deterioration of the environmental water quality.

High Durability Corrosion Sensor with Zinc-Platinum Galvanic Pair

NISSAN MOTOR K.K. *Japanese Appl. 3/242,546*

A sensor for monitoring corrosion rate for carrying out an accurate corrosion test consists of a Zn-Pt galvanic pair and a mechanism for removing Zn corrosion products to prevent deterioration of the galvanic pair. This gives a large signal level, and lowering of the signal by deposition of corrosion products can be prevented.

JOINING

Improved Soldering Material for Electronic Parts

KYOCERA CORP. *Japanese Appl.* 3/248,796
A soldering material consists of Au, 0.1–15.0 wt.% In, and 0.1–5.0 wt.% of at least one of Pd, Rh, Co and Cr; with preferred materials containing 0.5–1.0 wt.% In and 0.1–1.0 wt.% Pd. The solder material has improved soldering strength (14.0 kg or higher), improved corrosion resistance, is free from electromigration, and is used for soldering outer leads.

HETEROGENEOUS CATALYSIS

Platinum Catalysts for Conversion of n-Butane to Isobutene

ENIRICERCHE S.P.A. *British Appl.* 2,246,524A
Catalysts for production of isobutene by dehydroisomerisation of n-butane consist of 0.1–1 wt.% Pt, 0.1–1 wt.% In and/or 0.05–1 wt.% Sn, and 0.5–5 wt.% SiO₂ deposited on the surface of a porous granular γ -Al₂O₃ support having specified physical characteristics. The catalysts, used alone or in combination with SiO₂-Al₂O₃ or Boralite B catalysts, give high yields of the product: for example 45–59% conversion with 20–25% selectivity for isobutene.

New Catalysts for Denitration of Vehicle Exhaust

SAKAI CHEMICAL IND. K.K. *European Appl.* 455,491A
New denitration catalysts consist of 0.1–10 wt.% Pt, Pd, Rh, Ru and/or Ag or their oxides supported on TiO₂, or a rare earth metal oxide plus TiO₂, Al₂O₃, ZrO₂ and/or SiO₂ and Pt, Pd, Rh, Ru and/or Ag or their oxides. Other forms of the catalyst are based on zeolites or perovskites. The catalysts are used to remove NO_x from vehicle exhaust gases in the presence of a hydrocarbon reduction agent, and with O₂, avoiding use of NH₃ as reductant.

Single Step Production of Methyl Isobutyl Ketone

MITSUBISHI KASEI CORP. *European Appl.* 458,216A
Methyl isobutyl ketone is produced by contacting acetone and H₂ with a catalyst of Pd/C, Pd/Al₂O₃, Pd black or Pd supported on a metal oxide and/or hydroxide treated with an organosilicon compound. Methyl isobutyl ketone is used as an organic solvent, and is produced in good yield.

Palladium-Tellurium Catalyst for Preparation of Dialkoxybutenes

RHONE-POULENC CHIM. *European Appl.* 462,031A
A new method for preparation of dialkoxybutenes is by reaction of 1,3-butadiene with an alcohol in the presence of O₂ and a catalyst consisting of at least one of Pt, Pd or Rh, particularly Pd, and at least one of Te, Se and/or S, preferably Te, optionally combined with Cu, Sb and/or Sn, on a support.

Method for Minimising Emissions from Methane Fuelled Engines

GENERAL MOTORS CORP. *European Appl.* 468,556A
A method for reducing the exhaust from CH₄ fuelled engines involves controlling the composition of the CH₄ containing fuel-air mixture to within the range 0.99–1.02, and contacting the combustion products in the exhaust gas with a catalyst consisting of 2–3 parts Pt and one part Pd dispersed as fine particles on an Al₂O₃-based carrier. This method minimises emissions of CH₄, hydrocarbons, CO and NO_x.

Stable Ruthenium Catalyst for Fischer-Tropsch Synthesis

UOP *U.S. Patent* 5,059,574
A catalyst for Fischer-Tropsch synthesis of C₃+ hydrocarbons from H₂ and CO consists of 0.3–6.0 wt.% Ru present as particles of 40–60 Å and 0.1–5.0 wt.% of a modifier selected from Al, Si, Pb, As and Bi, preferably Si, on an inorganic oxide support, preferably of Al₂O₃ or TiO₂. The catalyst has modified conversion activity for the Fischer-Tropsch synthesis, but good selectivity and stability.

Palladium Catalyst for Methylpyridine Production

STANDARD OIL CO. (OHIO) *U.S. Patent* 5,066,809
A process for the production of 3-methylpyridine involves contacting 2-methylglutaronitrile with H₂ and a catalyst containing Pd promoted with at least one of Cr, W, Ni, Co and Ge, on a support preferably containing 0–30 wt.% SiO₂ and 100–70 wt.% Al₂O₃. The catalyst gives high yields, for example 78% yield at 100% conversion.

Catalytic Production of Synthesis Gas from Hydrocarbons

EASTMAN KODAK CO. *U.S. Patent* 5,068,057
Synthesis gas with an H₂:CO molar ratio of 1:1.5–2:1 is produced by contacting an anhydrous mixture of CO₂ and one or more hydrocarbons with a fixed catalyst bed of Pt or Pd on Al₂O₃ or SiO₂-Al₂O₃, at 650–1000°C. The reaction proceeds smoothly with no apparent loss of catalyst activity, and the process gives higher CO:H₂ ratios than conventional steam reforming, so the synthesis gas is suitable for hydroformylation or carbonylation.

Platinum-Gallium Catalyst for Isomerisation of Xylenes

UOP *U.S. Patent* 5,081,084
A catalyst for isomerisation of alkyl aromatic hydrocarbons consists of a Pt group metal, especially 0.1–1.0 wt.% Pt, optionally 0.05–0.5 wt.% S, a Ga substituted pentasil zeolite containing 0.1–10 wt.% Ga, and an Al₂O₃ matrix. The catalyst is used for isomerisation of xylenes containing ethylbenzene, by contact in the presence of H₂ at 300–500°C and 69–6895 kPa, and gives an optimised yield of para-xylene without the high loss of C₈ aromatics.

Preparation of Biphenyltetracarboxylic Acid in High Yield

DU PONT DE NEMOURS CO. *U.S. Patent* 5,081,291
3,3',4,4'-Biphenyltetracarboxylic acid is prepared from an alkaline solution of the Na or K salt of 4-bromophthalic acid, at 50–150°C, using hydroxylamine, and in the presence of a 1–10 wt.% Pd/C catalyst. The process uses less than one tenth of the catalyst required in prior art processes, and gives a high yield of the product which is used as a starting material for heat resistant polyimide resins.

Palladium Catalyst for Removal of Nitrogen Oxides from Exhaust Gas

AGENCY OF IND. SCI. TECH. *Japanese Appl.* 3/221,143
A catalyst for NO_x removal consists of Pd supported on an oxide support containing > 5 wt.% Mg, for example MgO. The catalyst can decompose NO_x into N₂ and O₂ without using a reducing agent and is used for efficient removal of NO_x from combustion exhaust gas from diesel engines and boilers.

Three-Way Catalyst with Separate Rhodium and Platinum Layers

NISSAN MOTOR K.K. *Japanese Appl.* 3/232,531
A catalyst for purification of internal combustion engine exhaust gas consists of a honeycomb support, a first layer containing Pt and/or Pd, and a second layer containing a mixture of Rh black of < 1000 Å particle diameter and a metal oxide—preferably Al₂O₃, optionally mixed with ZrO₂, TiO₂, or a rare earth element oxide. The catalyst removes hydrocarbons, CO and NO_x from the exhaust gas, and has less deterioration in activity at high temperature by inhibiting formation of a solid solution of Rh and Al₂O₃.

Palladium Catalyst for Production of Diphenylethane Derivatives

MITSUBISHI KASEI CORP. *Japanese Appl.* 3/232,825
1,2-Diphenylethane derivatives are produced by catalytic hydrogenation of benzoyl derivatives such as benzoin or 4,4'-dimethylbenzoin at 0–200°C, in the presence of a Pd catalyst such as 5% Pd/C, 1% Pd/C or 2% Pd/Al₂O₃, in an organic solvent. The products are produced under mild conditions, at the usual temperature, under atmospheric pressure, and are useful as intermediates for ethanone oximes as anti-ulcer agents.

Ruthenium Catalyst for Coal Liquefaction

AGENCY OF IND. SCI. TECH. *Japanese Appl.* 3/242,243
Coal liquefaction using H₂ gas is carried out in the presence of a solvent and a Ru catalyst. In an example the catalyst was prepared by impregnating FeS₂ with Ru trichloride at 120°C, to give a catalyst containing 0.013 wt.% Ru. This method uses a small amount of catalyst, gives improved efficiency coal liquefaction, and uses moderate reaction conditions.

Aromatic Hydrocarbon Production Using Crystalline Platinum-Gallosilicate Catalyst

NIIPPON MINING K.K. *Japanese Appl.* 3/262,539
Aromatic hydrocarbons are produced from 2–7C aliphatic and/or alicyclic hydrocarbons by contacting with a crystalline gallosilicate catalyst containing Pt. The catalyst is prepared by maintaining a solution of Si, Ga and Pt compounds and an alkali metal salt at a pH of 9–12 and 100–200°C, for 3–200 h. Using the catalyst, higher conversion and selectivity can be obtained.

Combustion Catalyst with Several Catalytic Layers

BABCOCK-HITACHI K.K. *Japanese Appl.* 3/275,140
A combustion catalyst consists of a support with at least three layers of Pd and/or Pt loaded catalysts placed along the flow direction of the combustion gas. Higher activity can be obtained by replacing part of the Pt catalysts with less expensive Pd catalysts. The combustion catalyst is used to combust methane- or propane-containing fuel in hydrocarbon gas combustors, or to remove CO, hydrocarbons, ethyl acetate or aldehyde from car exhaust.

Palladium Catalyst for Preparation of Unsaturated Diesters

TOHOKU CORP. *Japanese Appl.* 3/275,141 and 3/279,349
A Pd catalyst is used to prepare an unsaturated diester from a conjugated diene, a carboxylic acid, O₂, and optionally an organic halogen compound, at 140–210°C, under ordinary or elevated pressure. The catalyst contains Pd, Sb, V, a metal carboxylate and a metal halide, and is optionally prepared by treating a silicic acid support and the catalyst metal with tartaric acid and HCl solution, then reducing.

Alloy Catalyst with Varied Uses

YOSHIDA KOGYO K.K. *Japanese Appl.* 3/275,144
An amorphous alloy containing Zr or Ti; Fe, Co, Cu or Al; and Pt or Pd is thermally treated in an oxidizing atmosphere at three temperature steps to form an alloy catalyst, useful for catalytic combustion of H₂, reduction of NO_x and SO_x, or decomposition of fluorocarbons. In an example, a Zr₃CO₃Pd₃ amorphous alloy is thermally treated at 250°C for 64 h, 300°C for 170 h, and 700°C for 2 h to form a crystalline alloy catalyst.

Rhodium Catalyst System for Preparation of N,N-Dimethylacetamide

MITSUBISHI GAS CHEM K.K. *Japanese Appl.* 3/275,656
N,N-Dimethylacetamide is prepared by reaction of trimethylamine with CO in the presence of a catalyst consisting of elemental Rh and elemental I and/or Br, with an at. ratio of I or Br:Rh of 0.1–100. The product is obtained with high selectivity (77.7–89 mol %), at a good reaction rate, under reduced pressure.

HOMOGENEOUS CATALYSIS

Palladium Catalyst System for Thiolester Preparation

SHELL INT. RES. Mij. B.V. *British Appl.* 2,246,130A
A thiolester is prepared from an olefinically unsaturated compound, CO and a primary thiol in the presence of a catalyst system consisting of a source of Pd cations, a phosphine having a defined measure of basicity, and a protonic acid. Primary thiols have not previously been reactive in this type of reaction, but using this method a good reaction rate and high selectivity to the thiolester are obtained.

High Yield Production of High Purity Aniline

MITSUI TOATSU CHEM. INC. *European Appl.* 458,006A
Aniline is prepared continuously by hydrogenation of nitrobenzene at 150–250°C under anhydrous conditions, in the presence of a catalyst of Pd or Pd-Pt deposited on a lipophilic C suspended in an aniline solvent, and with a Zn compound and an alkali metal carbonate or bicarbonate as promoters. High purity aniline free of unreacted nitrobenzene is prepared in high yield; and is suitable for methylenedianiline production without further purification.

Osmium Catalyst for Asymmetric Dihydroxylation of Olefins

MASSACHUSETTS INST. TECH. *World Appl.* 91/16,322A
An asymmetrically dihydroxylated olefin is prepared by combining a polymeric chiral ligand which is an alkaloid or alkaloid derivative, an organic solvent, an aqueous solution, a base, K ferricyanide, adding a small amount of an Os containing catalyst, and adding the olefin for asymmetric addition to occur. The method is used for the production of chiral intermediates for the synthesis of insect hormones and pheromones, and anti-tumour compounds.

Regiospecific Carbonylation Process for Preparing Acyl Compounds

AMOCO CORP. *U.S. Patent* 5,081,250
Acyl compounds having the carbonyl group ortho to the heterocyclic N atom are prepared from the reaction of a N-containing aromatic heterocyclic compound, an olefin and CO, under carbonylation conditions, and in the presence of a Ru carbonyl compound. The process is highly regioselective, giving acyl compounds of use in the pharmaceutical, agricultural and plating fields.

Palladium Carboxylation Catalyst for Methyl Methacrylate Preparation

SHELL OIL CO. *U.S. Patent* 5,081,286
An alkyl methacrylate is prepared by reacting a propyne feed with CO₂ and an alkanol, preferably CH₃OH, in the presence of a Pd carboxylation catalyst. The by-product stream from, for example, an ethene cracker is treated to give the propyne feed.

Preparation of Silylamines with Improved Yield

MITSUI TOATSU CHEM. INC. *Japanese Appl.* 3/261,789

Silylamines are prepared from the reaction of amines with hydrosilanes at 0–300°C in the gas or liquid phase, in the presence of Ru and/or Rh halide(s), preferably chlorides, and phosphine(s), for example tributylphosphine or triphenylphosphine.

Palladium Catalyst Composition for Hydrogenation of Unsaturated Groups

BAYER A.G. *German Appl.* 4,020,689
A Pd-containing catalyst preparation is made by reacting PdX₂, where X is Cl, Br or O₂CR, with a functional siloxane containing at least one reactive group per molecule. The catalyst preparations are homogeneous, liquid, and are soluble in a polar media. They are very active for hydrogenation of aliphatic unsaturated C bonds, CHO, keto or NO₂ groups, and in double bond hydrogenation.

FUEL CELLS

Quaternary Platinum Alloy Electrocatalyst for Acid Fuel Cell

N.E. CHEMCAT CORP. *European Appl.* 469,514A
An electrocatalyst consists of a conductive carrier and a dispersed alloy which is preferably a solid solution having a cubic ordered structure; consisting of 40–70 at.% Pt, 9–27 at.% Co, 9–27 at.% Ni and 9–27 at.% Cu. The electrocatalyst has improved activity and life, and is used in an acid electrolyte fuel cell.

Preparation of High Loading, Noble Metal Alloy Catalysts for Fuel Cells

INT. FUEL CELLS *World Appl.* 91/19,566A
A noble metal alloy catalyst is prepared by precipitating a noble metal compound from solution onto a support, reducing the activity of the precipitate to prevent re-solution, adding a soluble alloying metal compound to the solution, precipitating onto the support, and calcining at 500°C under H₂. The noble metals are preferably Pt and Pd. The method gives high loadings, reduced waste, and is used for fuel cell catalysts.

CORROSION PROTECTION

Corrosion Resistant Stainless Steel Containing Palladium

MITSUBISHI JUKOGYO *European Appl.* 458,606A
A Pd-containing austenitic stainless steel for use in a highly acidic, high temperature environment contains 0.004–0.04 wt.% C, 5–7 wt.% Si, up to 2.0 wt.% Mn, 15–25 wt.% Cr, 4–24 wt.% Ni, 0.01–1.07 wt.% Pd, balance Fe, <50 ppm O, and unavoidable impurities of P and S. The steel is for use in absorption towers, pumps and vessels in the H₂SO₄ industry.

ELECTRICAL AND ELECTRONIC ENGINEERING

Magnetic Recording Media Having Vertical Magnetisation Films

OKI ELECTRIC IND. K.K. *European Appl.* 459,411A and 459,413A

Magnetic recording media consist of a substrate and a vertical magnetisation film, where the latter is either (a) an artificial superlattice of alternate layers of Co and Pt or Pd, or (b) an artificial superlattice of alternate Co and Pt layers, and a Pt, Pd or Co thin film alternately deposited on the substrate. The magnetic recording media have high residual flux density, high coercivity and low Curie temperature.

Magneto-Optical Devices with Laminated Film Containing Platinum

SANYO ELECTRIC K.K. *Japanese Appl.* 3/224,210

Magneto-optical devices for use in optical isolators, optical shutters or optical memory devices are produced by alternately soaking or contacting a substrate with a solution containing at least a transition metal ion or its reducing agent, and a solution containing at least a Pt ion. The method gives a laminated film of low energy and particle diffusion on the interface.

Magneto-Optical Recording Medium with Improved Rectangular Angle

SUMITOMO METAL IND. K.K. *Japanese Appl.* 3/230,342

A magneto-optical recording medium that can be over-written consists of a magnetisation film preferably made of Fe, up to 40 at.% Pt, optionally a solid state material excluding Fe and Pt, and unavoidable impurities. The medium has lowered Curie temperature and coefficient of thermal expansion, and lateral Kerr effect.

Conductive Paste Composition for Filling Via Holes

SUN WAVE IND. K.K. *Japanese Appl.* 3/250,068

A conductive paste composition consists of (a) 80–90 wt.% Pd solder and 10–20 wt.% organic vehicle, or (b) 30–80 wt.% Ni solder, 5–50 wt.% Ag, 5–15 wt.% Co-W carbide and 10–20 wt.% organic vehicle. The composition is useful for electrically bonding conductive materials without the use of lead wire or wire bonding, prevents oxidation, has good adhesion, and is stable up to 850°C.

Electric Switch Contact Element Containing Palladium

SIEMENS A.G. *German Appl.* 4,013,627

A contact element consists of a non-porous metal support having a 2–6 μm thick Pd-containing deposit, which has an at least 0.1 μm thick Pd-Au or Pd-Ag alloy outer layer with an Au or Ag content of 40–90 wt.%. The contact element is used for an electric switch contact, especially for electromagnetic relays.

Nucleation Process for Partial Currentless Metallisation

ELEKTRONIK-EB-G.m.b.H.

East German Patent 292,444

In partial currentless metallisation, the lacquer structure of dielectric or non-catalytically working surfaces is dissolved and nucleation with Pd or Ag atoms with an atom concentration of at least 0.1 mg/dm² is effected. The Pd or Ag atomic structure left on the surface is metallised using chemically reductive baths to give a multi-layer arrangement completely enclosing the contact layer system. The method is used for production of microcircuits for chip structures.

TEMPERATURE MEASUREMENT

Thermocouple Assembly for Metallurgical Vessel

VESUVIUS CRUCIBLE C. *U.S. Patent* 5,071,258

A thermocouple assembly for sensing the temperature of molten metals in a metallurgical vessel includes a double bore insulator containing the 2 noble metal alloy lead wires of the thermocouple, preferably Pt-Rh alloys. O₂ is able to diffuse along the bores of the double bore insulator to protect the Pt alloy from reaction with C and silica which may be present in trace amounts. The assembly can be used as a tundish in continuous steel casting, and helps to avoid e.m.f. drift.

Temperature Sensor with Platinum Alloy Flange

UCHU KAIHATSU JIGYO *Japanese Appl.* 3/239,932

A temperature sensor consists of a rod-shaped wound frame having a cap-shaped Pt alloy flange fitted at one end, which is fitted inside a connecting metal fitting, and bonded with a soldering material. The ceramics wound frame can be bonded with the connecting metal fitting, and the difference in elongation created at high temperature can be absorbed by the Pt alloy flange, so that the cable is not broken.

MEDICAL USES

New Platinum Double Nuclear Complexes Useful as Anti-Oncotic Agents

SANKYO K.K. *Japanese Appl.* 3/271,297

Tetra-co-ordinated divalent Pt double nuclear complexes are new, for example *cis*-(trans)-(1)-1,2-diaminocyclohexane Pt(II)-N-(*cis*-diammine-hydroxy Pt(II))-azetidine-2-one-4,4-dicarboxylate. The complexes have high anti-oncotic action so are useful as anti-oncotic agents, and have reduced side effects such as nephrotoxicity or marrow depression.

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