

Highlights from Recent Literature

1 Analytical

1.1 Atomic Force Microscope Manipulation of Gold Nanoparticles for Controlled Raman Enhancement

The authors report on the controlled manipulation of 2, 3 and 4 Au nanoparticles (AuNPs) using an at. force microscope (AFM) for use as surface-enhanced Raman scattering substrates. L Tong, T Zhu, Z Liu from the Center for Nanoscale Science and Technology, Beijing National Laboratory for Molecular Sciences, State Key Laboratory for Structural Chemistry of Unstable and Stable Species, College of Chemistry and Molecular Engineering, Peking University, Beijing, 100871, Peop. Rep. China, *Applied Physics Letters*, 2008, **92(2)**, 023109/1. For each arrangement, the interparticle electromagnetic (EM) coupling between adjacent AuNPs is studied at different polarization angles. The strength of EM coupling strongly depends on the arrangement of the AuNPs. In particular, the highest enhancement and the most pronounced polarization dependence is found for linear arrangement of closely spaced particles. Results show that AFM manipulation has great potential for fabrication and study of controlled arrangements of nanoscale objects. (c) 2008 American Institute of Physics.

2 Catalysis

2.1 Gold Nanocatalysts Supported on Protonic Titanate Nanotubes and Titania Nanocrystals

Gold nanoparticles were first supported on protonic titanate nanotubes with the formation of Au/titanate nanocomposites. They were further transformed to Au/titania nanocomposites via an acetic acid treatment at 70.degree.C for 60 h. J Jiang, Q Gao, Z Chen from the State Key Laboratory of High Performance Ceramics and Superfine Microstructures, Shanghai Institute of Ceramics, Graduate School, Chinese Academy of Sciences, Shanghai, Peop. Rep. China, *Journal of Molecular Catalysis A: Chemical*, 2008, **280(1-2)**, 233. The porosity, crystal structure and morphology of those composites have been studied by X-ray diffraction (XRD), High-resolution transmission electron microscope (HRTEM), and low-temperature nitrogen adsorption. Catalytic tests for CO oxidation show that the Au/titanate nanocomposites had a promising activity with complete conversion of CO at 70.degree.C and that of Au/titania was at room temperature (25.degree.C). Both catalysts exhibited good thermal and long-term stabilities. The influence of the crystal vacancies

and surface properties of the titanate and titania supports on the catalytic activities were evaluated.

2.2 Preparation Of TiO₂ Using Supercritical CO₂ Antisolvent Precipitation (SAS): A Support For High Activity Gold Catalysts

A supercrit. anti-solvent precipitation technique has been used to prepare a novel Titania catalyst support. The Titania precursor was prepared by pptg. TiO(acac)₂ from a solution of methanol using supercrit. carbon dioxide at 110 bar and 40.degree.C. Z Tang, J Bartley, S Taylor, G Hutchings from the School of Chemistry, Cardiff University, Cardiff, UK, *Studies in Surface Science and Catalysis* 2006, **162** (Scientific Bases for the Preparation of Heterogeneous Catalysts), 219-226. The surface area of the supercrit. precursor was 160 m²g⁻¹ and this decreased to 35 m²g⁻¹ after calcination, although there was no significant reduction of particle size. The new titania support was used to prepare a supported gold catalyst and this was tested for ambient temperature carbon monoxide oxidation. The supercrit. catalyst demonstrated notably high activity when compared with catalysts prepared by other nonsupercritical methods.

2.3 Complete Oxidation of 2-Propanol Over Gold-Based Catalysts Supported on Metal Oxides

This paper concerns the preparation of metal oxide-supported gold catalysts and their application to 2-propanol abatement in order to lower the light off temperature. Catalytic oxidation of 2-propanol was investigated on Au/CeO₂, Au/Fe₂O₃, Au/TiO₂ and Au/Al₂O₃ catalysts prepared from the deposition-precipitation (DP) method. S Liu, S Yang from the National Central University, Department of Chemical and Materials Engineering, Taoyuan, 32001, Taiwan, *Applied Catalysis, A: General*, 2008, **334(1-2)**, 92. The catalysts are characterized by XRD (X-ray diffraction), BET (Brunner-Emmett-Teller), TEM (transmission electron microscopy), NH₃-TPD (NH₃-temperature programmed desorption), H₂-TPR (H₂-temperature Programmed reduction), ICP-AES (inductively coupled plasma-at. emission spectroscopy) and XPS (XPS) techniques. The catalytic activity of Au/metal oxide samples towards the deep oxidation of 2-propanol to CO₂ and water has been found to be strongly dependent on the kind of supports, the amount of gold loading, the calcination temperature and the moisture content in the feed.

2.4 The States of Gold Species In CeO₂ Supported Gold Catalyst For Formaldehyde Oxidation

The authors objective was to develop HCHO oxidation catalysts which work at moderate temperatures, a series of Au/CeO₂ catalysts with a Au content <0.85 wt.% were prepared by co-precipitation and subsequent calcination at 300.degree. HCHO oxidation on these catalysts at temperatures close to 100.degree. was conducted; catalyst structures were characterized by x-ray diffraction (XRD) and transmission electronic microscopy (TEM). Y Shen, X Yang, Y Wang, Y Zhang, H Zhu, L Gao, M Jia from the College of Chemistry

and Chemical Engineering, Inner Mongolia University, Huhhot, 010021, Peop. Rep. China, *Applied Catalysis, B: Environmental*, 2008, **79(2)**, 142. Au exists in highly dispersed crystallite clusters on these catalysts; no Au crystals >2-3 nm were observed. In contrast, the CeO₂ support was well crystd.; fringes from the (1 1 1) lattice plane of the CeO₂ support were very clear in the TEM image. Au crystals with a mean size of .apprx.10 nm formed in a sample contg. 0.78 wt.% Au (0.78 Au) when it was calcined at 400.degree. for 2 h; however, formation of larger Au crystals decreased catalytic activity. It appears the highly dispersed Au catalyst provided more active sites for HCHO oxidation. When a sample 0.78 Au was calcined at 700.degree. for 2 h, large Au particles (.gtoreq.50 nm) appeared and HCHO oxidation activity decreased further, but was still better than that of CeO₂. XRD and XPS results showed some Au was incorporated into the CeO₂ lattice.

3 Chemistry

3.1 Chemically Synthesized Gold Nanoparticles Embedded in a SiO₂ Matrix: A Model System to Give Insights into Nucleation and Growth Under Irradiation

The control over the size and the dispersion of the ion beam-synthesized nanoparticles is generally poor. This is partially due to the scarce knowledge of the behavior of the ppt. phase in the first stages of the nucleation and growth processes. G Rizza, Y Ramjauny, T Gacoin, L Vieille, S Henry from the Ecole Polytechnique, Laboratoire des Solides Irradies, France, *Physical Review B: Condensed Matter and Materials Physics*, 2007, **76(24)**, 245414/1. To overcome this difficulty, the authors explored the formation and growth under MeV ion irradiation of satellites clusters around chem. synthesized Au particles embedded in a silica matrix. The results showed that the satellites evolve in an Ostwald ripening regime limited by the diffusion in an open system. In addition, the complete evolution of the gold supersatn. is obtained and the temporal window for the nucleation regime is detected. It allows the authors to give a guideline method to improve the control of the particles monodispersity during the ion beam synthesis. Moreover, an estn. of the threshold concentration for nucleation, an effective value for the surface tension of the Au nanoparticles and the gold diffusivity under irradiation are given.

3.2 Gold Nanoparticles From Induced Au³⁺. FWDARW.AuO Reaction In Polyvinyl Alcohol Molecules In Presence Of Sucrose In Hot Water

In hot water (50-60.degree.), polyvinyl alc. (PVA) mols. have coordination reaction with Au³⁺ cations, forming an Au³⁺-PVA polymer complex. In the proposed model reaction in small templates, the complex converts to AuO capping in PVA mols. P Tripathy, S Ram, H Fecht from the Materials Science Centre, Indian Institute of Technology, West Bengal, India, *Plasmonics*, 2006, **1(2-4)**, 121. Adding sucrose (5-10 times

the PVA in mass) in a typical batch promotes Au³⁺.fwdarw.AuO reaction, showing absorption coeff. .alpha. in AuO surface plasmon band to be enhanced as much as 28 times the value in reaction with PVA. The band shifts at 547 nm from 566 nm (.alpha. = 21.4 cm⁻¹ mol⁻¹) in the PVA sample. Drying AuO-PVA/sucrose (2-5 wt% AuO) colloid at 60-70.degree. and then heating at 450.degree. in air burns off the organic part, leaving behind a light ash colored powder with AuO nanoprisms or nanofibrils (.apprxeq.30 nm average width). X-ray diffractograms has 6 reflections, (111), (200), (220), (311), (222), and (400), of Fm3m fcc AuO of lattice parameter a = 0.4080 nm. The powder has photoluminescence in transversal and longitudinal AuO plasmon bands of 535 and 585 nm, resp.

3.3 Kinetics of gold nanoparticle aggregation: Experiments and modelling

The authors study the aggregation kinetics of Au nanoparticles using both experimental techniques (i.e., quasi-elastic light scattering, UV-visible spectroscopy, and TEM) and math. modeling (i.e., const.-no. Monte Carlo). T Kim, C Lee, S Joo, K Lee from the Department of Chemical Engineering, Yonsei University, Seoul, S. Korea, *Journal of Colloid and Interface Science* (2008), **318(2)**, 238. Aggregation of Au nanoparticles is induced by replacing the surface citrate groups with benzyl mercaptan. The experimental results can be well described by the model in which interparticle interactions are described by the classical DLVO theory. Final Au nanoparticle aggregates have a fractal structure with a mass fractal dimension of 2.1-2.2. Aggregation of .apprx.11 initial Au nanoparticles appears to be responsible for the initial color change of suspension. This kinetic study can be used to predict the time required for the initial color change of a Au nanoparticle suspension and should provide insights into the design and optimization of colorimetric sensors that use aggregation of Au nanoparticles.

4 Electrochemistry

4.1 Characterization of Gold Nanoparticles Electrochemically Deposited on Amine-Functioned Mesoporous Silica Films and Electrocatalytic Oxidation of Glucose

This study reports the preparation and characterization of Au nanoparticles deposited on amine-functioned hexagonal mesoporous SiO₂ (NH₂-HSM) films and the electrocatalytic oxidation of glucose. J Yu, S Lu, J Li, F Zhao, B Zeng from the Department of Chemistry, Wuhan University, Wuhan, 430072, Peop. Rep. China, *Journal of Solid State Electrochemistry*, 2007, **11(9)**, 1211. Au nanoparticles are fabricated by electrochem. reducing chloroauric acid on the surface of NH₂-HSM film, using potential step technol. The Au nanoparticles deposited have an average diameter of 80 nm and show high electroactivity. Prussian blue film can form easily on them while cycling the potential between

-0.2 and 0.6 V (vs. SCE) in single ferricyanide solution. The Au nanoparticles loading NH_2 -HSM-film-coated glassy C electrode (Au- NH_2 -HSM/GCE) shows strong catalysis to the oxidation of glucose, and according to the cathodic oxidation peak at .apprx.0.16 V, the catalytic current is .apprx.2.5 .mu. A mM⁻¹. Under optimized conditions, the peak current of the cathodic oxidation peak is linear to the concentration of glucose at 0.2-70 mM. The detection limit is 0.1 mM. Some electrochem. parameters about glucose oxidation are estd.

4.2 Electrochemical Synthesis of Silver and Gold Nanoparticles

Ag and Au nanoparticles were prepared by electrodeposition from sulfite based solutions as a possible alternative to the std. chem. usually proposed in the literature for electrochem. deposition of Ag and Au nanoparticles. P Cojocar, A Vicenzo, P Cavallotti from the Dipartimento di Chimica, Materiali, Ingegneria Chimica "Giulio Natta", Politecnico di Milano, Milan, Italy *ECS Transactions*, 2007, **2**(20, Nanotechnology), 67. The voltammetric behavior of the electrolytes was studied at glassy C and Ti surface, showing that kinetic control plays a role in the discharge of the sulfite complex of either Ag or Au. The formation of particles on Ti substrate and their morphology features were examd., changing the deposition conditions, pulse potential and duration or potential scan rate. Remarkable differences in the formation of Ag and Au particles on the Ti substrate are highlighted: growth and aggregation characterize the formation of Ag particles; on the contrary, Au particles are deposited with high nucleation d. and uniform size distribution, though the particle dimension is rather on the mesoscale than in the nanoscale dimension.

5 Electronics and Sensors

5.1 Dissolution of Embedded Gold Nanoparticles in Sol-Gel Glass Film

Materials with metallic nanoparticles are widely studied to fabricate plasmonic devices, for which the control of the material properties is required. I Carvalho, F Mezzapesa, P Kazansky, O Deparis, M Kawazu, K Sakaguchi from the Optoelectronics Research Centre, University of Southampton, UK, *Materials Science & Engineering, C: Biomimetic and Supramolecular Systems*, 2007, **27**(5-8), 1313. A simple way to control the metal surface plasmon resonance in selected regions of the material is to dissolve the embedded metallic nanoparticles by d.c. elec. field. Dissolution of embedded Ag and Cu nanoparticles was demonstrated recently through poling-assisted bleaching of Ag-doped and Cu-doped nanocomposite glasses, respectively. The next challenge is the dissolution of other metallic nanoparticles, such as Au, which are more difficult to ionize. The dissolution is demonstrated of Au nanoparticles (15 nm in diameter) by d.c. electric field thanks to a novel material design in which the nanoparticles were embedded in a high resistivity sol-gel film on top of a soda-lime-silicate glass substrate with a higher cond.

compared to the film. The role of the film resistivity is made obvious by studying 2 different film compounds. This result brings about the possibility to use other metallic nanoparticles for tailoring the region of transparency of glasses and opens perspectives for the fabrication of new plasmonic devices.

6 Medical and Dental

6.1 Clinical Observation of High-Gold Alloy Ceramic Crown with Porcelain Margins

This study reexamined and compared the repair effect of 50 high-gold alloy ceramic crown with porcelain margins, 50 In-ceram aluminum oxide ceramic crown with porcelain margins, and 50 high-gold alloy ceramic crown with gold porcelain margins after 1 yr. J Zhu, X Hang, W Lian, D Zhan, from the Department of Prosthodontics, Affiliated Stomatology Hospital, China, Medical Universit, Peop. Rep. China, *Zhongguo Yike Daxue Xuebao*, 2007, **36**(1), 64. The results show that application of porcelain margins technology can enhance the aesthetic effect of high-gold alloy ceramic crown.

6.2 Dendrimer-Entrapped Gold Nanoparticles as a Platform for Cancer-Cell Targeting and Imaging

The authors present a general approach for the targeting and imaging of cancer cells using dendrimer-entrapped gold nanoparticles (Au DENPs). X Shi, S Wang, S Meshinchi, M Van Antwerp, X Bi, I Lee, J Baker from the Michigan Nanotechnology Institute for Medicine and Biological Sciences, University of Michigan, Ann Arbor, MI, USA, *Small*, 2007, **3**(7), 1245. Au DENPs were able to covalently link with targeting and imaging ligands for subsequent cancer-cell targeting and imaging. The Au DENPs linked with defined nos. of folic acid (FA) and fluorescein isothiocyanate (FI) mols. are water sol., stable, and biocompatible. *In vitro* studies show that the FA- and FI-modified Au DENPs can specifically bind to KB cells (a human epithelial carcinoma cell line) that over express high-affinity folate receptors and they are internalized dominantly into lysosomes of target cells within 2 h. These findings demonstrate that Au DENPs may serve as a general platform for cancer imaging and therapeutics.

7 Metallurgy, Materials and Coatings

7.1 Synthesis of Nanoporous Gold Structures via Dealloying of Electroplated Au-Ni Alloy Films

The preparation of nanoporous gold (NPG) films using electrodeposited Au-Ni as a precursor for dealloying was studied. Potentiostatic dealloying of amorphous Au-Ni (Ni 65, 77, and 85 at%) films at 0.7VSCE in 10 mM H_2SO_4 , resulted in the formation of nanoporous structures with average pore diameter increasing with Ni content from 69 to 107 nm. E Rouya, M Reed, R Kelly, H Bart-Smith, M Begley, G Zangari

from the Department of Materials Science and Engineering, University of Virginia, Charlottesville, VA, USA, *ECS Transactions*, 2007, **6**(11, Nanoporous Materials), 41. Alloy films with high Ni content are more susceptible to surface cracking due to large internal stresses. Potentiostatic dealloying of amorphous Au-Ni 73 at% at 1.0, 1.3, and 1.5 VSCE in 10 mM H₂SO₄ yielded NPG structures with an average pore size which decreased with increasing applied voltage, from 57 to 36 nm. At higher anodic potentials, surface cracks become more apparent. Finally, the NPG structure could be tuned also by potentiostatic dealloying of partially crystd. Au-Ni 73 at% at 0.7 VSCE in 10 mM H₂SO₄. The average pore size measured .apprxq.9 nm, much smaller than those observed in dealloyed amorphous Au-Ni films.

7.2 The Effects of Annealing Prior to Dealloying on the Mechanical Properties of Nanoporous Gold Microbeams

Free-standing nanoporous gold microbeam fracture during dealloying due to volume shrinkage. This study illustrates that annealing after release, yet prior to dealloying, prevents failure during the selective chem. dissolution step. E Seker, J Gaskins, H Bart-Smith, J Zhu, M Reed, G Zangari, R Kelly, M Begley from the Department of Electrical and Computer Engineering, University of Virginia, Charlottesville, VA, USA, *Acta Materialia*, 2007, Volume Date 2008, **56**(3), 324. Expts. in which annealing was performed at temperatures .ltoreq.400.degree. illustrate that permanent buckling of the free-standing solid alloy beams is required to prevent failure of the nanoporous beams during dealloying. In contrast, annealing of the beams prior to release or annealing at temperatures .ltoreq.200.degree. which do not cause permanent buckling deformation do not mitigate dealloying failures. The fabrication yield and residual stresses in the final nanoporous beams correlate with the permanent buckling deflection of the alloy due to annealing, with the max. yield >95% and min. residual stress of 4-7 MPa occurring for annealing at .apprx.300.degree.. The present experimental results are used with elementary elastic buckling models to explain the critical temperature that produces permanent deflection, as well as discussing the mechanisms underlying the phenomena.

7.3 Spectral Encoding on Gold Nanorods Doped in a Silica Sol-Gel Matrix and its Application to High-Density Optical Data Storage

Metallic nanorods exhibit fascinating optical properties due to surface plasmons-collective oscillation of the electron cloud within a particle. J Chon, C Bullen, P Zijlstra, M Gu from the Centre for Micro-Photonics Faculty of Engineering and Industrial Sciences, Swinburne University of Technology, Hawthorn, Australia, *Advanced Functional Materials*, 2007, **17**(6), 875. They exhibit two principle absorption bands that correspond to surface plasmon resonance (SPR) along the longitudinal and transverse directions of the nanorod. Most importantly, the longitudinal band can be tuned with

the aspect ratio of the rod, making it a spectrally tuneable optical material, which can be applied to a variety of devices from bio-imaging to high-d. optical storage. Here, spectral encoding for high-d. Optical storage applications is demonstrated on two sizes of gold nanorods (aspect ratios of three and five) doped in a silica sol-gel matrix by femtosecond pulsed laser irradiation. It is widely known that high-power pulsed laser irradiation causes metal nanorods to undergo shape transformations via the process of melting or fragmentation. The process is enhanced if the laser wavelength is tuned at the longitudinal surface plasmon resonance peak of the nanorods, which results in a significant reduction or shift in the surface plasmon resonance peak. As such a shape change occurs only on the subpopulation of rods that have a longitudinal plasmon band matching the laser wavelength, a size- or spectrum-selective shape transition is possible in a rod mixture with varying aspect ratios. The current spectral technology can be incorporated into existing optical disk technology, such as three-dimensional bit-by-bit and holog., and can increase the capacity limit by utilizing the spectral domain.

7.4 Mesoporous Gold Sponge

Mesoporous gold sponge was prepared by the removal of aluminum from sputtered AuAl₂ films by using alk. leaching with NaOH solution M B Cortie, A Maarroof, N Stokes, A Mortari from the Institute for Nanoscale Technology, University of Technology, Sydney, Australia, *Australian Journal of Chemistry*, 2007, **60**(7), 524. The resulting sponge has nanoscale pores and channels with a high sp. Surface area that can be exploited in electrochem. applications. For example, the sponge may serve as the basis of a more sensitive capacitive sensor or biosensor, electrode for a high efficiency ultracapacitor, semi-transparent current collector in a dye sensitized photovoltaic cell, or lithium storage electrode in a lithium ion cell. Properties of the sponge may be controlled by varying its d., pore size, and pore size distribution, factors which are in turn controlled by the microstructure of the precursor intermetallic compound and deposition conditions.

8 Nanotechnology

8.1 Low-Cost Environmentally Friendly Method for Preparing Gold Nanoparticles

In this invention, Au nanoparticles with uniform shape, uniform particle size and narrow particle size distribution were prepared by using non-ionic surfactant, and reducing agent and exterior energy is not needed. K Geckeler, T Premkumar, D Kim, J Lee from the Gwangju Institute of Science and Technology, S. Korea, KR 2007102204 A2, Jan 2008. It is possible to regulate the particle size of the Au nanoparticles through changing reaction conditions. The title method comprises mixing Au salt with aqueous solution containing non-ionic surfactant, and reacting to obtain the final product. The particle size is controlled through controlling the

concentration of the nonionic surfactant and the reaction temperature. The method is environment-friendly, and is low cost.

8.2 Synthesis of Gold Nanorods In Organic Media

A seed mediated approach for the synthesis of anisotropic rod shaped gold nanoparticles in org. media (toluene) is demonstrated. Pre-formed gold nanoparticles stabilized in toluene by 4-hexadecylaniline (HDA) are used as seeds. S Chandran, P Prathap, B Renu, M Umananda, P Satyam, M Sastry from the Nanoscience Group, Materials Chemistry Division, National Chemical Laboratory, Pune, India, *Journal of Nanoscience and Nanotechnology*, 2007, **7(8)**, 2808. These when reacted with 1-octadecylamine (ODA) hydrophobised chloroaurate ions in toluene lead to the formation of gold nanorods. ODA or alkylamines of different chain lengths which are the chloroaurate ion phase transfer agent were found to play a key role in the formation of the nanorods. The gold nanorods that have a five-fold symmetry evolve from multiple twinned particles and are bound at the tips by {111} faces and at the sides by {100} faces. The gold nanorods were shown to grow under the shape directing effect of the alkylamines which stabilize the high energy {100} faces. The concentration of the alkylamines was found to play a crit. role in the formation of the gold nanorods. Higher concns. of the alkylamines lead to formation of spherical particles, at times of narrow size distribution.

8.3 Preparation of Silver-Gold Alloy Nanoparticles at Higher Concentration using Sodium Dodecyl Sulphate

Highly stable gold-silver alloy nanoparticles with varying mole fractions were prepared in aqueous SDS solution by simultaneous reduction of HAuCl_4 and AgNO_3 using sodium citrate. A Pal, S Shah, S Devi from the Department of Chemistry, Faculty of Science, The Maharaja Sayajirao, University of Baroda, Vadodara, Gujara, India, *Australian Journal of Chemistry*, 2008, **61(1)**, 66. The formation of alloy nanoparticles was confirmed by UV-visible spectroscopy and TEM. Particle size distribution was measured by dynamic light scattering. The surface plasmon absorption band of the Au-Ag alloy nanoparticles shows linear bathochromic shift with increasing Au content. Appearance of a single absorption peak in the visible region and lack of apparent core-shell structures in the transmission electron microscope images confirm the formation of homogeneous Au-Ag alloy nanoparticles.

8.4 Synthesis And Characterization Of Long Gold Nanorods

A new approach to fabricate long Au nanorods by controlling the vol. of the growth solution is reported. Shapes ranging from fusiform nanoparticles to 1-dimensional rods evolve. R Liu, H Chen, S Hu from the Department of Chemistry, National Taiwan University, Taipei, Taiwan *IEEJ Transactions on Electrical and Electronic Engineering*, 2007, **2(4)**, 468.

Increasing the growth solution can control the length of the nanorods. The length of the rods could be extended to 2 μm , and nanorods with aspect ratios of up to ≈ 70 could be obtained. Also, x-ray absorption spectroscopy (XAS) was used to elucidate the growth mechanism of Au nanorods. The Au ions were directly reduced to Au atoms by ascorbic acid during the reaction, and the Au atoms were deposited on the surface of Au seeds, which were introduced into the reaction. Extended x-ray absorption fine structure (EXAFS) confirmed the growth of Au and the environment around Au atoms during the reaction. XAS is expected to have wide applications in the growth of Au and other related materials.

9 Refining

9.1 Recovery Palladium, Gold and Platinum from Hydrochloric Acid Solution Using 2-Hydroxy-4-Sec Octanoyl Diphenyl-Ketoxime

The selective solvent extraction of Pd(II) over Au(III) and Pt(IV) as well as subsequent selective extraction of Au(III) over Pt(IV) from hydrochloric acid solution were achieved by using 2-hydroxy-4-sec-octanoyl diphenyl-ketoxime dild. in kerosene as an extractant. Y Shen, W Xue, from the Key Laboratory for Anisotropy and Texture of Materials (Ministry of Education), Northeastern University, Shenyang, Peop. Rep. China, *Separation and Purification Technology*, 2007, **56(3)**, 278. The typical compn. of solution used contained Pd 5.95, Au 5.42 and Pt 10.23 g/L. Pd(II) is extd. into the org. phase quant. after a three-stage counter-current extn. operation with extraction percentage >99.9% at pH 2. At a higher HCl concentration of 5 M, Au(III) is effectively extracted into the org. phase from the resulting raffinate by a four-stage counter-current extn. operation. On the other hand, stripping of Pd(II) from the loaded org. phase needs highly acid solution, while the stripping of Au(III) can be achieved at pH 2. Four-stage stripping with 6 M HCl at O:A = 2:1 yielded a >99.9% Pd(II) stripping efficiency, and four-stages stripping with 0.01 M HCl at O:A phase ratio of 2:1 enabled a >99.9% Au(III) stripping efficiency. The resulting solutions for each metal, after the corresponding process such as precipitation or reduction, can be used for yielding metal powder with a purity of >99.99%. A complete process flow sheet for the sepn. and recovery of Pd(II), Au(III) and Pt(IV) is given.

9.2 Criteria for Choice of a Brand of Activated Carbon for Hydrometallurgical Recovery of Gold from Ore Pulps in Carbon-In-Leaching and Carbon-In-Pulp Processes

Criteria used to choose activated carbons suitable for sorption recovery of the $[\text{Au}(\text{CN})_2]^-$ anion from cyanide ore pulps are considered. R Ibragimova, A Mil'chenko, N Vorob'ev-Desyatovskii from the JSC Polymetal Engineering, St. Petersburg, Russia, *Russian Journal of Applied Chemistry*, 2007, **80(6)**, 891. Results for determining the mechanical strength and loss of carbons via their disintegration in this

process are presented. Changes occurring on the surface of activated carbon particles during their agitation in abrasive media and specific features of design of the sorption app. that can be used for rationally carrying out carbon-in-pulp and carbon-in-leaching processes are discussed.

9.3 Analysis of Gold Leaching Systems Based on Thermodynamics

The thermodynamic and the equilibrium constant criterion of the gold leaching process is deduced and proposed on the basis of anal. of gold leaching systems. Z Wang, D Chen, L Chen from the College of Environmental Science and Engineering, Donghua University, Shanghai, Peop. Rep. China, *Youse Jinshu, Yelian Bufen*, 2006, (3), 36. The relationship of oxidants and ligands in gold leaching systems is discussed. The gold leaching process with the oxidant may proceed in thermodyn. The elec. potential criterion of the oxidant in gold leaching systems is related to the stability constant of gold(I/III) complexes. The stability constant is higher, and the min. elec. potential needed for the oxidant in the gold leaching systems is lower.

9.4 Gold Refining at Tokyo Refinery

Tokyo Refinery of Chugai Mining Co., Ltd. located in Keihinjima Oota-ku, Tokyo, started its operation in August 2005. S Imano, Susumu from the Tokyo Refinery, Chugai Mining Co., Ltd., Japan, *Journal of MMIJ*, 2007, 123(12), 741. They operate a solvent extraction process for gold recovery refining. Solvent extn. can provide significant reductions in operational costs. High grade secondary metallic sources with a high precious metal content, such as jewelry scrap, are first brought into solution with aqua regia. Silver forms insoluble AgCl which is separated and recovered by filtration. Gold is extracted by the solvent extraction schemes into the organic phase, and scrubbed with hydrochloric acid for impurity removal. Gold is reduced and recovered from the organic phase with reducing agent. The capacity of gold refining process is 520 kg per mo. The all manufacturing processes take only three days.

9.5 Roasting of Auriferous Refractory Ores Using Microwaves and Their Role in Gold Recovery

Two different minerals considered to be refractory in the Au recovery were submitted to the oxidating pre-treatment using microwaves as the energy source generating the heat of transformation of sulfides to oxides and then the minerals were leached with Na cyanide under conventional conditions with an objective of demonstrating the effect of the processing on the minerals or mineral species, resulting

in the refractoriness. C Gaviria C Ana, J Gonzalez, H Mora from the Escuela de Ingenieria de Materiales, Universidad Nacional de Colombia, Medellin, Colombia, *Dyna (Medellin, Colombia)*, 2006, 150, 29. The minerals originated from the Roble and the Zancudo mines, which presented a phys. and chem. refractoriness due to the associations with Au, were exposed to the microwaves, managing to oxidize more than 90% sulfides in no more than 10 min. The microwave energy was concluded to have a great potential in the field of the extractive metallurgy, esp. for auriferous refractory ores.

9.6 Potential for the Utilisation of Micro-Organisms in Gold Processing

A review. Using iron- and sulfur-oxidising bacteria to catalyze the breakdown of sulfides that host the gold is an important biological method for the pretreatment of refractory gold ores. F Reith, S Rogers, D McPhail, J Brugger from the School of Earth and Environmental Sciences, The University of Adelaide, Glen Osmond, SA, Australia, *Publications of the Australasian Institute of Mining and Metallurgy*, 2007, 9/2007 (World Gold 2007), 67. Following this biological treatment a combination of chem. and phys. methods are used for leaching (such as the cyanide process) and concentration (such as carbon-in-pulp or electrowinning) of gold. Although these methods are well accepted by industry, they harbor limitations in the processing of low-grade refractory ores, and regulatory agency/public acceptance of cyanide use. Thus, it is beneficial to industry to develop environmentally friendly, cost-efficient leaching and concentration techniques that are based on micro-organisms. This may soon be possible by adapting the results of recent regolith geoscience research, which has shown that microorganisms are capable of driving a biogeochemical cycle of gold dispersion, transport and reconcentration in the supergene environment. The indigenous microbiota in biol. active soil microcosms from a no. of Australian sites are capable of solubilising up to 80 wt.% of the gold contained in these materials during 50 days of incubation. Studies using mol. microbial techniques have shown that a metallophilic bacterium, *Ralstonia metallidurans*, is present in biofilms on gold grains from a no. of Australian sites. *R metallidurans* is capable of actively accumulating gold from solution, suggesting that the bacterium may contribute to the formation of secondary gold grains and nuggets. Identifying the biochemical and physiological pathways that lead to the dispersion and accumulation of gold in regolith, and quantifying the reaction kinetics of these processes may thus lead to the development of industrial bio-processing capacities for gold-containing ores.