

A newsletter on developments and progress in gold catalysis and its applications

We are pleased to present CatGold News as an integral part of *Gold Bulletin* for the first time in this issue. By so doing, this publication should reach a wider audience and so be more effective.

At World Gold Council we continue to note the very high rate of downloads of *Gold Bulletin* papers from our website, and we expect that this will also now happen with CatGold News.

Two exciting international catalyst conferences will take place during the next few months and highlight reports of the new gold catalysis developments reported at these meetings will be published in CatGold News later this year.

In the meantime, if you have news or information for inclusion in CatGold News please let us know.

CatGold News is available at
www.goldbulletin.org

WORLD GOLD COUNCIL

Nanostellar Introduces Gold in New Automotive Diesel Catalyst



Nanostellar Inc has announced the introduction of the NS Gold™ catalyst which it claims enables manufacturers of light- and heavy-duty diesel engines to reduce noxious emissions by as much as 40 percent more than existing pure-platinum catalysts at equal cost.

In recent years, Nanostellar and other producers of catalyst materials have introduced the use of palladium to partially replace the four-times more expensive platinum used traditionally. Now, to further reduce the amount of platinum needed and the overall cost of the catalysts, Nanostellar has pioneered the addition of gold to the platinum and palladium, for diesel emission control.

NS Gold™ is potentially suitable for treating all lean-stream exhaust, where air is in excess of fuel-borne hydrocarbon gases. Applications include treating particulates and hydrocarbons in soot filters, stationary-source volatile organic compound (VOC) emissions, and ammonia slip in selective catalytic reduction (SCR) systems. The catalyst is immediately available for targeted application-specific testing. Production quantities will be available as production programs are identified and released.

For more information, visit www.nanostellar.com ■

Gold Clusters Enhance Platinum Fuel Cell Catalyst Stability

In a paper entitled 'Stabilization of platinum oxygen-reduction electrocatalysts using gold clusters', J Zhang, K Sasaki, E Sutter and RR Adzic, *Science*, 2007, 315, 220-222, describe an Au-Pt/C system, where gold clusters are deposited on carbon-supported platinum nanoparticles which is shown to be much more stable over 30,000 cycles (0.6 – 1.1 V in presence of 0.1 M HClO₄) than the equivalent Pt/C catalyst under the oxidizing conditions of the oxygen reduction reaction (ORR) at room temperature.

So the use of gold to stabilise the Pt at the higher temperatures (110-120°C) being considered for automotive fuel cell applications could prove to be significant: they have already demonstrated no loss of activity for the Au-Pt/C catalyst at 60°C.

A patent corresponding to this work entitled 'Electrocatalysts having gold monolayers on platinum nanoparticle cores, and uses thereof' by R Adzic and J Zhang, US Patent 2007026292, was published on 1 Feb 2007, and another 'Electrocatalysts having platinum monolayers on palladium, palladium alloy, and gold alloy nanoparticle cores, and uses thereof' by R Adzic, J Zhang, K Sasaki, Y Mo and M Vukmirovic, US Patent 2007031722 A1, 8 Feb 2007. ■

Post-Auricat Network Meeting

Members of Auricat, the EU-funded training network on gold catalysis, that recently finished, met in Stuttgart earlier this year.

Prof Graham Hutchings opened the meeting (at Stuttgart University, January 23-24, 2007) by highlighting the scientific and training achievements of the 4 year (Sept 2002 – August 2006) EU AURICAT project which had involved eight Universities and four industrial units as well as the World Gold Council at an exciting, pioneering time for gold catalysis. Almost all the stated project objectives had been met and the final report has now been circulated to all participants.

Each of the University groups summarized the results of their experimental work and the four AURICAT postdocs present expressed satisfaction with the training they had received. Much of the work has now been published and the two project consultants are authors of a book entitled 'Catalysis by Gold', the first on this topic (see <http://www.icpress.co.uk/chemistry/p450.html>) where there are many references to these and other papers describing research in this area.

It was clear that work on gold catalysis was continuing at most of the centres and the content of programmes needed for further funding applications was discussed, and these constructive deliberations are likely to lead to further collaboration. ■

Novax Materials Licenses Nano-Gold Catalyst

After successfully applying for patents for its nano-gold catalyst technologies in the U.S., Industrial Technology Research Institute (ITRI) based in Taiwan has agreed a 10-year licensing agreement with Novax Material & Technology for related nano-gold catalyst based device production. Novax has said it will first use the gold-based material in gas mask production and anticipates that the derived business potential is worth about US\$100 million.



Potential use of gold catalyst in safety device.

For more information visit www.novax-material.com ■

Toyota Work on Gold Catalysts for Air Purification

Anil K Sinha *et al* (*Angew Chem Int Ed.*, 2007, 46, 2891-2894) have reported the preparation of nano-gold particles on high surface area manganese dioxide support using vacuum-UV laser ablation. Using this material a wide range of VOCs can be efficiently eliminated under ambient dark conditions.

The addition of gold to the MnO₂ increased its efficiency for removal of toluene and n-hexane. 100% toluene combustion was reported at 220°C. ■

WGC – Project AuTEK at 20 NAM and EuropaCatVIII



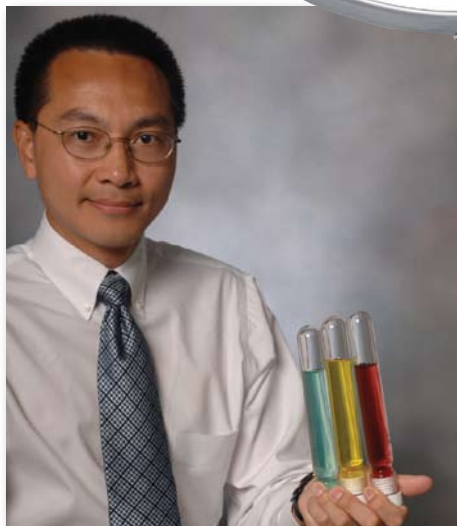
WGC, London, UK and Project AuTEK, Johannesburg, South Africa are planning collaborative exhibition stands for these important conferences describing applications for gold catalysts at both 20NAM in June and EuropaCatVIII in Turku, Abo, Finland in August. There will also be collaborative presentations entitled 'New Catalysts with Commercial Potential Based on Gold' and 'Progress Towards Producing Stable Gold Catalysts' at 20NAM and an AuTEK presentation entitled 'Commercial Applications of Gold Catalysts for CO Oxidation – Performance, Deactivation, Regeneration'. There will be over 40 presentations on gold catalysis at 20NAM

including work relevant to environmental control, fuel cells and chemical processing.

Gold presentations are also likely to feature in some of the sessions at EuropaCatVIII which include 'Nanotechnology in Catalysis', 'Catalysis for Pollution Control', 'Photocatalysis', 'Catalyst Deactivation' and 'The Hydrogen Society'.

These two conferences will provide ideal opportunities to discuss recent advances in catalysis by gold and progress towards commercialization of the innovative advances. ■

Gold Catalysis on Podcast



You can now listen to Prof Graham Hutchings and Prof Michael Wong talk about gold catalysis for chemical processing and ground water clean-up via a new podcast available on the World Gold Council website at www.gold.org/discover/sci_indu/podcasts/index/html ■

Gold and Green Chemistry

At the 3rd International Conference on Green and Sustainable Chemistry taking place 1-5 July 2007 in Delft, The Netherlands it is planned to include a symposium on Gold Catalysis and Green Chemistry. The conference covers developments at the frontiers of green chemistry and sustainable technologies, focusing on the design, development and implementation of chemical products and processes that reduce the use of hazardous substances and the generation of waste.

See <http://www.greenchem2007.tudelft.nl/> for more information. ■

14th ICC, Seoul, Korea

The 14th International Congress on Catalysis (ICC) is to be held in Seoul, Korea from July 13–18 2008. Topics for the conference include 'Innovations in catalyst design', 'New findings in reaction mechanisms', 'Advances in catalytic reaction engineering', 'Catalysis in energy/fuel production', 'Catalysis for fine chemicals/industrial chemicals production' and 'Sustainable green catalysis'.

Further information can be found on the conference website (www.icc2008korea.com) ■



Recent Papers and Patents

Review on Gold as a Homogeneous Catalyst

In a paper entitled 'Relativistic Effects in Homogeneous Gold Catalysis', by David J Gorin and F Dean Toste of the University of California, Berkeley, *Nature*, 2007, **446**, 395-403, cationic phosphine-gold(II) complexes are shown to be especially versatile and selective catalysts for a growing number of synthetic transformations. Theoretical studies on gold provide the context for understanding the development of a new methodology based on homogeneous catalysis by gold.

Selective Oxidation of Carbohydrates with Gold Catalysts in the Liquid Phase

Nadine Thielecke, Mehmet Aytemir and Ulf Pruesse, *Catal. Today*, 2007, **121**, 115-120, have reported their results on the oxidation of glucose to gluconic acid, carried out in a continuous stirred tank reactor using 0.25% Au/Al₂O₃. No loss in activity or selectivity occurred over 70 days (40°C, pH 9 1 bar O₂). Even longer periods of stability (110 days) were reported at GOLD 2006.

Related papers by the Federal Agricultural Research Centre (FAL) in Germany include 'Long-term stability of a 0.45% Au/TiO₂ catalyst in the selective oxidation of glucose at optimized reaction conditions', A Mirescu, H Berndt, A Martin and U Pruesse, *Appl Catal A: Gen*, 2007, **317**, 204-209; 'A new environmentally friendly method for the preparation of sugar acids via catalytic oxidation on gold catalysts', A Mirescu and U Pruesse, *Appl Catal B: Env*, 2007, **70**, 644-652, and 'Influence of the preparation conditions on the properties of gold catalysts for the oxidation of glucose', C Baatz, N Thielecke and U Pruesse, *Appl Catal B: Env*, 2007, **70**, 653-660.

Complete Oxidation of Ethylene over Supported Gold Nanoparticle Catalysts

Complete oxidation of ethene has been achieved using 4 - 5nm particles of gold on Al₂O₃, or molybdenum, iron and manganese oxides (H-G Ahn, BM Choi and D-J Lee, *Journal of Nanoscience and Nanotechnology*, 2006, **6**(11), 3599-3603). Deposition precipitation and coprecipitation preparation routes were better than impregnation for getting small particles of gold. These results could be important for application in preventing fruit ripening too quickly during transportation.

Direct Synthesis of Hydrogen Peroxide from H₂ and O₂ using Zeolite-Supported Au-Pd Catalysts

Au-Pd on ZSM-5 and zeolite Y prepared using impregnation give highest rates of hydrogen peroxide production (Gang Li, Jennifer Edwards, Albert F. Carley and Graham J. Hutchings, *Catalysis Today*, 2007, in press). Au-Pd is best of bimetallic catalyst systems examined to date. Acid pretreatment of H-ZSM-5 leads to a further enhancement of activity.

In a recent hydrogen peroxide formation patent by members of the Cardiff Group (WO 2007/007075 A2, 18 January 2007), high selectivity to H₂O₂ and low product decomposition is claimed for acid washed catalyst supports (eg silica, titania, alumina and activated carbon) and mixed metal catalysts eg Au-Pd. ■

If you have a contribution for CatGold News please email industry@gold.org

