Precious Metals Symposium in China

China held its first international meeting on precious metals, the International Symposium on Precious Metals, in Kunming, from 20th to 24th September 1999. The symposium was hosted by The Precious Metals Academic Committee of China, and sponsored by the Non-Ferrous Metals Society of China, the International Precious Metals Institute and the Gold Society of China. Of the almost 160 delegates, 30 were from outside China. Some of the papers presented are reviewed here.

The first scientific plenary session was opened by Professor Deng Deguo (Institute of Precious Metals, IPM, Kunming) with a talk entitled "Precious Metals Catalysts for Modern Society in China". About 50 per cent of the catalysts used by the Chinese chemical industry involve precious metals, and these are finding increasing use in solar and fuel cells. Platinum group metals catalysts are now increasingly important in controlling environmental pollution in China. For example, the number of automobiles in China is forecast to increase from 20×10^6 to 40×10^6 between the years 2000 and 2010 and it is therefore essential that automobile catalysts are successfully commercialised in China.

It was appropriate that the next talk, given by M. Wyatt (Johnson Matthey, Wayne, U.S.A.) was entitled "Recent Advances in the Use of Precious Metals in Emission Control Catalysts". He discussed the delicate balance between the market prices of platinum, palladium and rhodium, and their technical efficiencies. Platinum metals catalysts have been employed in emission control systems for over a quarter of a century. The first three-way catalysts were based on platinum and rhodium. However, over the last decade, palladium and palladium-rhodium systems have been increasingly used and this has driven up the price of palladium, making palladium thrifting important.

Weijian Han (Ford Motor Company, Dearborn, U.S.A.) described work produced in collaboration with Deng Deguo's group in Kunming on developing catalysts containing increased proportions of rare earth oxides to platinum group metals, for the Chinese market. Rare earth oxides are abundant in China and while rare earth oxide catalysts have a similar ability in oxidising carbon monoxide and hydrocarbons, their NOx conversions to-date are not as good as those of platinum metals catalysts.

New developments in refining technologies for platinum group metals, silver and gold which achieve significant cost reductions were reported by Adalbert Prior (Prior Technologie, Austria). For example, a chromatography process has been used to separate pure rhodium, palladium, platinum and iridium from base metals. Such new technologies are expected to play an increasing role in refining precious metals well into the next century, and are being developed by several independent organisations with various claims to the proprietary positions.

After the first day of plenary lectures, parallel sessions on the second day, were grouped under the four headings below.

Precious Metals and the Environment

Joseph Ching (Heraeus, Hong Kong) spoke on "Obviate Environmental Damage Through Integrated Quality Management". Environmental concerns are being collectively addressed at the international level through the establishment of the ISO-14000 series of environmental standards which are leading to changes in the raw materials, production technology and equipment, and improved operations and procedures.

Research aimed at understanding the mechanism of action of anticancer drugs cisplatin and carboplatin was discussed by Pan Qi-Chao (Sun Yat-sen University of Medical Sciences, Guangzhou). This involves, for example, defining the mode of bonding of platinum to glutathione, formed by the combination of glutamic acid and cysteine. Liu Weiping (IPM, Kunming) described studies on *cis*-diammine-norcantharitoplatinum(II), a unique platinum complex which contains as its leaving group a bioactive component of the traditional Chinese medicine cantharides. The results obtained in 0.9 per cent sodium chloride solution show that the complex undergoes substitution to give cisplatin.

Two further papers on the effects of rare earth

oxides on the activity of platinum metals catalysts, aimed at reducing catalyst costs were presented. Wang Shengping (General Research Institute for Non-Ferrous Metals, Beijing) investigated the effects of rare earth oxides and base metals on palladium catalysts, measuring their effects on light-off temperature. However, the influence was small for both oxidation and three-way modes. He Xiaokun and co-workers (IPM, Kunming) reported on the effect of rare earth oxides in increasing the working window of the catalysts. Here, 97 per cent of the noble metals in the washcoat were shown to be within 100 μm of the surface.

Dental alloys based on palladium and gold were described in papers by V. Vasekin (Scientific and Industrial Complex Supermetal, Russia) and I. Lebedenko (Moscow Medical Dentistry Institute), and by H. R. Ding and X. X. Ma (Fourth Military Medical University, Xi'an, China) and X. Z. Lan (Xi'an University of Architecture and Technology). The Xi'an workers have developed new palladium-gold and palladium-silver alloys which meet the Chinese requirements for biocompatibility, mechanical properties, chemical properties and cast accuracy.

Alloys and Materials

The capability of the platinum metals to resist high temperature, silicate and atmospheric corrosion, and their optimum high temperature strength were discussed by Professor Ye. I. Rytvin (Supermetal, Moscow). This allows their use in the production of homogeneous silicate melts for making special glasses and crystals, and fine glass and basalt fibres.

Work on the influence of the cobalt layer thickness, the cobalt:platinum ratio and the sputtering temperature on magneto-optical properties was described in a paper entitled "The Periodic Structure Dependence of the Magneto-Optical Properties of Co/Pt Multilayers", by Huiyun Li, Jun Wu, Hui Zhao and Yongli Zhang (IPM, Kunming).

The preparation of 10 nm rhodium powder by hydrogen reduction of chlororhodate solution was reported by Hiromichi Kiuchi, Minoru Kawasaki and Manabu Iguchi (Hokkaido University, Japan). While, two papers by Chen Qiao and co-workers (IPM, Kunming) discussed the preparation of 10 nm sized silver/palladium powders from a mixed solution of silver and palladium nitrates and the effects of dispersants on their morphology.

Refining and Recovery

Dong Xuling (IPM, Kunming) described a study on solvent extraction of impurity elements in the preparation of high purity osmium powder using hexachloro-osmate(IV) in acid solution. In another paper from the same Institute, Li Kaizhong, Dong Shouan and Liu Xiaorong reported the variations in aged aquo-chloroiridate(III) complexes in a range of acidities and concentrations of chloride ion and the pure species aquopentachloroiridate(III) ($[Ir(H_2O)Cl_5]^{2-}$), diaquotetrachloroiridate(III) ($[Ir(H_2O)_2Cl_4]^-$) and triaquotrichloroiridate(III) ($[Ir(H_2O)_3Cl_3]$) which were obtained by ion exchange separation.

Extraction and Metallurgy

Advances in extractive metallurgy in China for platinum metals ores and secondary sources were reviewed by Liu Shijie (IPM, Kunming), while Liu Xiaorong, Dong Shouan, Wu Changrong and Li Kaizhong, from the same Institute, described studies on the preconcentration of platinum metals from ores using nickel sulfide fire assay. Increasing demands for platinum metals in China are expected in the 21st Century.

Much of the work from laboratories in China was of basic research with an industrial orientation. It was encouraging to see so many young people making presentations: a healthy sign for the future of research and development in China.

The Proceedings of the Symposium, edited by Deng Deguo, Lan Xinzhe, Yang Yikun and Li Guanfang, can be obtained from Ms Li Ming, Kunming Institute of Precious Metals, Kunming 650221, Yunnan, China; (U.S.$60, including postage), Fax: +86 871 5151533.

G. LI and D. T. THOMPSON

The Authors

David Thompson is editor of "*Gold Bulletin*". His particular interest is the development of catalysis by gold for industrial uses.

Guanfang Li is an emeritus professor of the Institute of Precious Metals, Kunming, and editor of "*Precious Metals*". She is Deputy Secretary-General of the Precious Metals Academic Committee of China. Her interests include phase diagrams of precious metals alloys and extractive metallurgy of precious metals.