PROCEEDINGS OF THE THIRD INTERNATIONAL CONFERENCE ON PRECIOUS METALS

PLATINUM METALS

IN THE MODERN INDUSTRY, HYDROGEN ENERGY AND LIFE MAINTENANCE IN THE FUTURE

XI'AN-PM'2008

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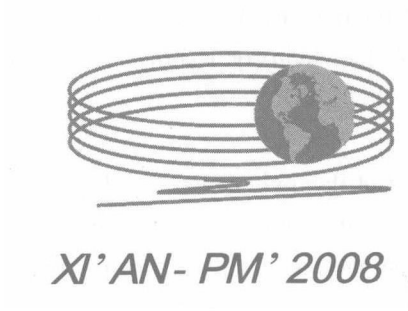

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ПРЕДСЕДАТЕЛЬ
СОВЕТА ФЕДЕРАЦИИ ФЕДЕРАЛЬНОГО СОБРАНИЯ РОССИЙСКОЙ ФЕДЕРАЦИИ

Участникам третьей международной конференции "Платиновые металлы в современной индустрии, водородной энергетике и в сферах жизнеобеспечения будущего"

Уважаемые участники конференции!

От имени Совета Федерации и от себя лично приветствую представителей "экономики знаний"—производителей и потребителей высокотехнологичных платиновых продуктов, собравшихся в Сиане, чтобы определить стратегические направления научных исследований и практических разработок для решения ряда жизненно важных проблем XXI века.

Сегодня мы все чаще слышим, что платина уже не столько роскошь, сколько средство выживания. Роль платиновых продуктов в жизни людей возрастает именно в сферах жизнеобеспечения—энергетике, транспорте, экологии, медицине и т. д. Использование платины в водородной энергетике позволяет существенно снизить стоимость вырабатываемой энергии, тем самым позволив ей успешно конкурировать с другими альтернативно развивающимися видами энергоносителей.

Показательно, что конференция проходит в Китае. Китайская Народная Республика—один из мировых лидеров в потреблении платиновых металлов и

один из крупнейших потребителей энергоресурсов в мире. В свою очередь Россия, являясь ведущим производителем в данных областях, безусловно, заинтересована развивать и укреплять стратегическое и деловое партнерство наших стран, содействовать углублению производственных связей в целях устойчивого развития всего мирового сообщества.

Своевременным и верным шагом следует назвать решение образовать на конференции специальную секцию по нанотехнологиям. Нанотехнологии, наряду с информационными технологиями, "собирают воедино"разрозненные в процессе специализации отрасли науки и промышленности, дают возможность решения энергетической проблемы, приобретающей все большую актуальность для человечества, становятся смысловым центром нового глобального проекта XXI века, аналогичного по масштабам атомному проекту двадцатого века.

Российским производителям нанотехнологии и наноматериалов есть, что показать на мировом рынке, в том числе в области инновационной энергетики и платиновых металлов. Экспорт платиновых металлов из России не в слитках, как это происходило до сих пор, а в виде высокотехнологичных продуктов выгоден и бизнесу, и государству. Эти продукты нужны всем странам: их применение не только в разы ускорит развитие производства, но и сделает его экологически чистым, сохраняя в неприкосновенности всю окружающую среду—землю, воду, воздух. Беречь все это—общечеловеческая обязанность людей по отношению к будущим поколениям, которым предстоит жить на планете.

Желаю всем гостям и участникам конференции успешной и конструктивной работы, плодотворных контактов и новых свершений!

С. М. МИРОНОВ

Preface

It has been widely aware of that the 21st century features environmental protection, communication science, life science and new energy resources. High technologies including surface, new materials, computer, automation, sensor, electron, biology and medicine technologies are key to the social and economic development in this century, which provides a lot of opportunities and challenges to the development of R & D of precious metals. Nowadays, precious metal materials are more and more widespread applied in the fields of electric and electronic engineering, chemical industry, automobile industry, glass and fiber industry, navigation, aviation and aerospace, ornaments, medicine and military. It is also prospected that this kind of materials will be found broad usage in the areas of environmental control and protection, biology and new development of energy resources. Various kinds of new precious metal materials, such as composites, low-dimensional materials, etc. have been developed rapidly.

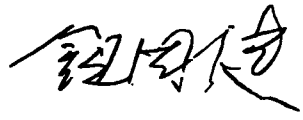
In the past half century, especially in last decides, with rapid increasing of Chinese economy the precious metal industry in China grew up at a great pace. The scale has expanded tremendously and the technology improved significantly by the way mainly from modeling to independent innovation. Recently, the precious metal materials and its components produced and developed in China by itself have been successfully used in various national economy and defense areas. It can basically meet the requirements of modern manufacture industry in China and the quality of some products has approached to the international level. However, up to now most of the R & D of precious metal materials are still far legged behind developed countries. For improvement of the innovation and academic levels more efforts have to be made.

Facing the reserve limitation and the increasing requirement of platinum metals in the automobile catalyzers, ornaments, chemical industry and hydrogen energy developed in the future, The Third International Conference on Precious Metals will be held in Xi' an, China, June 23 to 26, 2008. The topics of the conference are focused on applications of platinum metals in the modern industry, hydrogen energy resource and daily life in the future. Active response has been received from abroad and at home. A total of 57 papers are accepted and collected in this proceedings, which will be presented at the conference sharing latest achieve-

ments of research and development of precious metals. I sincerely hope that through the international exchange this conference will promote the progress of the science and technology of precious metal industry in China as well as in the world.

Secretary General of The Nonferrous Metals Society of China

Professor Niu Yinjian



Monday, May 19, 2008

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Hydrogen Energy, Platinum Metals, and Nanotechnologies in Russia

Chechenov Kh. D.
The Council of the Federation of the Federal Assembly of the Russian Federation, Moscow, Russia

Dear Colleagues!

There is such an intensive exchange of information on the subjects of the Xi' an Conference today in Russia, that even students are aware of the Russian-Chinese relations in this field of science and production. For example, the students of the Moscow State Institute of Radio Engineering, Electronics and Automation have launched a website about the Conference and write that the homeland of the Conference is Russia (Moscow is the mother, and Berlin is the father) .

This is true. The idea of this Conference was suggested in 2004 at the First International Symposium on Hydrogen Power Engineering and Platinum Group Metals in Moscow by an outstanding Russian scientist Professor Eugeny Rytvin. He had been the chief of Supermetal for more than 40 years. It was him who organized the first conference in Berlin. The second one in Berlin was held in his memory. And today, let us stand in memory of Professor Rytvin.

Thank you.

Now, the subject of my report is as follows.

The recent G-8 summits, especially the 2006 G-8 Summit, have directed Russia and other G-8 countries at the solution of principal energy-ecological problems. The basic document on the global energy security at the Saint Petersburg G-8 Summit declared: "Given political will, the international community can effectively address three interrelated issues: energy security, economic growth and environmental protection (the "3Es") . Applying fair and competitive market-based responses to the global energy challenges will help preclude potentially disruptive actions affecting energy sources, supplies and transit, and create a secure basis for dynamic and sustainable development of our civilization over the long term" (Item 4) . Apparently, the viewpoint of China and other major Russia' s partners will be taken into consideration at the 2008 G-8 Summit, which is going to be the next incitement for innovations in the field of hydrogen power engineering and hydrogen economy.

Today, Russia' s hydrogen power engineering is fast developing, which is characterized by:

(1) Novel technologies (including nanotechnologies) , devices and materials (especially platinum) for hydrogen technologies which are patented by the Russian scientists, inventors, and even students;

(2) Intense activity of the major Russian players in the domestic and world market of hydro-

gen power engineering and platinum group metals, including acquisition of the successful foreign companies;

(3) Intense information interchange at the national and international level, with participation of new specialized mass-media, forums, conferences, symposiums, and round tables, on the problems of hydrogen and other kinds of ecologically clean power engineering, as well as platinum group metals and nanotechnologies;

(4) Fruitful discussions of the first draft of the National Scientific & Innovative Program "Hydrogen Energy 2050" ("Draft Program 2050").

At the same time, there are the following problems that should be solved in Russia:

(1) Absence of a well-defined national policy and legislation in the field of hydrogen power engineering;

(2) Slow and contradictory evolution of state-private partnership in the field of hydrogen and other renewable energy sources;

(3) Technocratic approach to the problems of hydrogen power engineering and renewable energy sources;

(4) Lack of perception of the real processes of development of an effective base for dynamic and sustainable development of Russia and the world civilization over the long term;

(5) Energy-ecological education problems relating to students in Russia.

I would like to speak about some of these problems in detail now, because (according the International Association of Hydrogen Energy) they are common for the global hydrogen community.

The case in point is the epoch-making movement "hydrogen energy→ hydrogen economy→ hydrogen civilization". There are two negative tendencies in this movement (based on Vernadsky biosphere doctrine).

First, hydrogen energy is opposed to other renewable energy sources. Hydrogen is considered as fuel, not as accumulator or carrier. As a result, the atomic-hydrogen, solar-hydrogen, wind, geothermal, and other kinds of renewable ecologically clean energy are separated from hydrogen energy in programs and projects, which is wrong even from the scientific and technical point of view.

Second, ordinary people and the "elite" (including those in so-called golden billion countries) do not realize the real climatic menace for the whole world civilization. They think that it is the distant future. But the menace is knocking at our doors today. The International Association of Hydrogen Energy pays special attention to the scientists, businessmen and officials who underestimate such a great danger to the world and the role of hydrogen power engineering.

All this takes place in Russia, too, and a large-scale work on acceleration of development of hydrogen power engineering and renewable energy sources, including that with the use of nanotechnologies, is being done in Russia. We are trying to make technocratic specialists, bureaucratic officials, and egoistical businessmen, think about the national interests of the country and the prevention of the planetary climatic catastrophe.

In accordance with the Program of Development of Russia till 2020, the political will of the leaders of the country and all branches of power, including legislative power, is able to efficiently

solve within the nearest four years three interrelated energy-ecological problems (power engineering, economy, ecology) in the field of hydrogen power engineering, renewable energy sources and platinum group metals.

Without slacking off the realization of priority national projects, which were initiated a few years ago, the country will concentrate its efforts on four major directions, namely, institutes, infrastructure, innovations, and investments. In this process, the key principles of renovation of the country are the realization of the human capital, growth of the initiative, and the responsibility of the citizens.

We focus our attention on the development of medium and, especially, small-scale businesses; awaking the young people' s interest in the effective application of scientific, educational and information technologies; and development and integration of all three elements of "the triangle of knowledge" (education, research, innovations) . This work is based on the priority national "Education" Project; it has to interest the young Russians in the innovative development, which is completely meeting the requirements of the sixth technological structure.

In view of all this, we should improve the legislation to make the new laws support the long-term plans in the field of hydrogen power engineering, renewable energy sources and platinum group metals, instead of putting the breaks on them, which, unfortunately, still exists. We need ecological regulations, taxes, penalties and other principles of law today to protect the people and territory of Russia against the negative consequences of industrial emissions. We are developing them now to present them later for discussion and public appraisal.

According to foreign experts, the purposeful state industrial policy and drawing on the international experience already have been considerably accelerating the introduction of progressive standards of environmental control on the base of high-tech products made of the platinum group metals during the last two or three years in Russia. This is only a beginning. You will see the results.

Thank you.

Platinum Group Metals Resources and Extraction Metallurgical Technology Progress

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Abstract: The thesis briefly introduced the distribution, mining, consumption structure, supply and demand condition of the platinum group metals. It also analyzed the situation of the platinum industry faced in our country, and the market pattern and technology of the metallurgy. Furthermore, the thesis gives some strategies and suggestions accordingly.

Keywords: The platinum group metals; Renewable recourses; Extraction

1 Preface

The platinum group metals include platinum, palladium, osmium, iridium, ruthenium, rhodium. These elements is in the Ⅷ group and fifth, sixth cycle of the periodic table. They are all silvery white except that osmium is sky grey. They share the property of high chemical stability, excellent catalytic effect, high gas adsorption rate, biological coordination, greater density, high melting point and excellent heat conducting. The high gas adsorption rate shows as: Platinum powder can absorb hydrogen 114 times of its own volume at normal temperature and this ability rise with temperature goes high, as for platinum, the number goes as high as 3000, osmium, iridium, ruthenium, and rhodium also have this ability[1,2]; The steady chemical property shows in its high resistance to acid. Besides, their oxidation resistance to air and oxygen is much better than other metals. Formation of complex occurs when they reacting with many ligand, meanwhile, a great amount of oxides, sulphides, phosphides and halides are generated[3].

The platinum are widely used in economic life today. Their usage correlates closely with their unique property and electronic structure. The distinctive, excellent physical and chemical property determines their special function in many fields. They have received a frequent usage in automobile industry, petrochemical engineering, power electronics industry, glass industry, pharmaceutical industry, jewelry industry and the aerospace industry[1~7]. They are called "the vitamin of industry", "the first hi-tech metal" and "modern metal"[8~10].

As the deplete of the world fossil power and the increase of people' s environmental awareness, and the enactment of laws that stress the protection of energy, the environmental protection techniques will improve furthermore. This will surely increase the use and needs of the platinum group metals. They will become the cornerstone of new technology for their great effect in saving energy, speeding up chemical reactions and decreasing the discharge of pollutions. The family have had glorious years and of course a more bright future.

2 The Nature Resource and Mining[11~16]

2.1 The resource of ore

2.1.1 The nature resource and mining in the world

So far these metals are found in more than 60 countries and regions. The countries are: South Africa, Russia, US, Zimbabwe, Canada, China, Finland and Australia, etc. The global deposit is 63,000t of platinum group metals in 2000, basic storage is 79,000t. They are mostly concentrate in South Africa, Russia, US and Canada, covering 97.84% of the global total amount. The ore grade and distribution in the world is showed as the Table 1.

Table 1 The grade and reserves

Nations	South Africa	U.S.	Zimbabwe	Russia	Canada	China(Jingchuan)	Others
Grade/g·t^{-1}	8.03	22.3	4.7	3.8	0.9	0.5~0.6	—
Reserves/t	61700	1100	7900	6200	394	310	1396
Percentage/%	78.1	1.4	10.0	7.85	0.49	0.39	1.77
Total/t	79000						

From Table 1 we could see the distribution is unequal, a few countries has a monopoly of the resources. This unequalness shows not only in the reserves but also the quality. South Africa, Zimbabwe, Russia and US owns more than 95% of the platinum group metals resources.

The highest grade ore of the platinum group metals are mostly concentrate in US, Zimbabwe and South Africa, while the less grade ore are concentrate in Russia, and the low grade ore are concentrate in Canada and China.

In 2006, the total production and the deposit of the platinum are in the world' s major 29 mines are 216.25t and 12149t, respectively. The global total production of platinum and palladium between 2001 and 2005 is showed in Table 2. The price of the nonferrous metals continually rises in the recent years and the platinum also follows this trend from 2003. This has greatly promoted the prospect and mining of the platinum. That' s why the investment for the mining continually rises. In 2006, the number goes up to 2.19 billion . The average annual growth rate from 2001 to 2006 has exceeds 30% (as it is shown in Table 3). The number of mine which could used to mining will be 14 more, and the capacity increase by 51.68t/a. Among the 24 large scale platinum mines which are now under mining and feasibility study, 21 locates in South Africa, 2 in Finland, 1 in Russia, the total amount of platinum is 19539t[12].

Table 2 The production of platinum group metals in recent years(t)

Countries and regions	2001		2002		2003		2004		2005	
	Pt	Pd	Pt	Pd	Pt	Pd	Pt	Pd	Pt	Pd
South Africa	131.8	64.6	143.1	69.6	150.1	74.3	161.0	75.8	164.3	78.0
Russia	41.8	139.5	31.5	62.1	33.8	94.8	37.6	144.2	35.4	144.8