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Test Flight with Regenerative Fuel Cell on Board

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1. Governmental Measures

(1) MEXT

Ministry of Education, Culture, Sports, Science and Technology (MEXT) will start on a development of a more efficient storage battery and hydrogen transport technology to create a system supporting stable supply of electricity in preparation of renewable energy gaining popularity, and requested ¥70 billion for the fiscal year 2013. The target is to improve energy density 10 times of the current lithium ion battery (LiB), which would reduce production cost down to approximately 10% of the current level. Converting hydrogen into another chemical material will be sought for transport and storage of hydrogen. One of the example is that methylcyclohexane is considered as a hydrogen carrier as well as ammonia for which transportation mean has already established. The methylcyclohexane is produced by hydrogenation of the toluene. (The Denki Shimbun, September 25, 2012)

(2) MLIT

Ministry of Land, Infrastructure, Transport and Tourism (MLIT) will add photovoltaic generation and electricity storage equipment for urban park facilities, which allows the facilities to be installed in these parks. Amendments on The Urban Park Act and its ordinance for enforcement will be included in the draft, and public comments will be collected prior to the notification and enforcement expected between late November and early December. Photovoltaic generators, fuel cells (FCs), storage batteries and heat providing facilities will be available to be used in the parks. (Architectures, Constructions & Engineerings News (Daily), October 12, 2012)

2. Local Governmental Measures

(1) Okinawa Prefecture

On September 26th, Okinawa Industry Promotion Public Corporation selected Bio Hydrogen Laboratory, Okinawa city, to support as a Bio-VB R&D Support Project. The laboratory was established by a venture firm of Yokohama National University and Okinawa Jitsugyo, Naha city, in July. Bacteria will be planted to sugar cane treacle, which is currently wasted, to create hydrogen by fermentation, and hydrogen will be provided to FCs to generate electricity. The project is aimed to be commercialized by April, 2015. (The Ryukyu Shimpo, September 28, 2012)

(2) Osaka Prefecture

Osaka Prefecture recently selected projects for the subsidy scheme to support firms who develop hydrogen infrastructure such as a hydrogen filling station in the prefecture. Two projects out of five applications were chosen; development of "Highly Functional and Super Thin Porous Electrode for Hydrogen Production of Taisei Kogyo" and "Supporting Technology for Commercialization of New Optical Hydrogen Gas Detector of Murakami Giken". The planned subsidy is ¥1.24 million. The prefecture has put more effort into promoting the hydrogen and FC fields and creating an earlier demand. The subsidy scheme started 2011 and assists hydrogen infrastructure related technology developments using a public and private joint project "Active Osaka Promotion Fund". (Nikkan Jidosha Shimbun, October 3, 2012)

(3) Fukuoka City

Fukuoka Strategy Conference for Hydrogen Energy, Fukuoka city, will expand promotional activity for FCVs to assist the "Northern Kyushu FCV Promotion Plan" which was compiled in February 2012. The number of test-ride and FC workshops for children will be increased to provide chances to attract people. Automakers and hydrogen providers expect mass produced FCVs to start spreading in urban areas from 2015, and the conference has been working out on Northern Kyushu FCV Promotion Plan which aims to increase the number of hydrogen filling stations. (The Nikkan Kogyo Shimbun, October 3, 2012)

(4) Niigata city

On October 9th, Niigata city started taking applications of Eco house/reform Promotion which partially subsidizes for the installation of the photovoltaic generator and energy saving facility and the renovation of houses to increase energy efficiency. The total budget is ¥89 million. The upper limit of the subsidies are, o ¥700,000 for a photovoltaic generator, ¥200,000 for a solar water heater and solar system, ¥500,000 for domestic a FC and ¥100,000 for a pellet stove, respectively. (The Nikkan Kensetsu Kogyo Shimbun, October 11, 2012)

(5) Fukuoka Prefecture, Saga Prefecture, Kitakyushu City

On September 23rd, Fukuoka and Saga prefectures will have a test-drive of five FCVs across northern Kyushu in the cooperation with Kitakyushu city. The longest single travel distance is approximately 170km. All FCVs owned by local governments of Kyushu will run for the experiment. The Fukuoka and Saga prefectures and Kitakyushu city are having test-drive using their hydrogen filling stations, and the test-driving range will be extended later. The experiment is a part of the "Regional Hydrogen Supply Infrastructure Technology and Social Demonstration" of New Energy and Industrial Technology Development Organization (NEDO). (The Nikkan Kogyo Shimbun, October 16, 2012)

3. Technology Development of PEFC Elements

(1) Sophia University

A study group with Prof Masahiro Rikukawa of the Faculty of Science and Technology of Sophia University (Jochi Daigaku) developed an ionomer which is a diblock polymer consisting of hydrophilic and hydrophobic parts. An ionomer is polymer electrolyte in a catalyst layer, and used for supporting a catalyst, bonding a membrane and electrode and conducting proton H^+ generated from reaction. Currently, fluoropolymers are commonly being used as an ionomer, although it is disadvantageously expensive and decreases output under high temperature and low humidity condition. To solve the issues, a hydrocarbon polymer membrane, which is lower in price and better for environment, has been studied intensively. The group developed a polyphenylene-based diblock copolymer composed of a hydrophobic part which helps to dissolve and permeate gas and a hydrophilic part which conducts protons and moves water. Drawback of poor solubility and low fuel gas permeability of conventional ionomer was improved by using a monomer with strong acidic group and controlling the polymer molecule at a nano level. The new material produced twice the output of the conventional hydrocarbon material in a power generation test; it had a specifically better performance under low humidity conditions than a commercial fluorine material. This allowed a polymer electrolyte fuel cell (PEFC) to become smaller by eliminating the need of a humidifier. Also, the product works at a high temperature 100°C or more and any electrolyte membranes can be used. (The Chemical Daily, October 9, 2012)

(2) Ishifuku Metal Industry

On October 9th, Ishifuku Metal Industry announced that NEDO had chosen Ishifuku Metal's "Development of Mass Production Method of Platinum Core-shell Catalyst" for an additional project of "PEFC Commercialization Technology/ Base Technology/ Platinum Reduction Technology Project". Starting from 2008, the project aims to develop a highly active and durable core-shell catalyst by maximizing platinum potential to reduce the amount of platinum in catalyst significantly. The "Development of Mass Production Method of Platinum Core-shell Catalyst" project will develop the platinum reduction technology of the catalyst, which has been already established, to be an industrial production method for commercialization. (Japan Metal Daily, October 10, 2012)

(3) Rikkyo University

A study group of Prof Tohru Wada of the College of Science of the Department of Chemistry of Rikkyo University developed a cobalt complex catalyst which appeared promising in the use of FCs. This new catalyst possibly becomes a cathode which does not produce hydrogen peroxide at reaction without platinum. Hydrogen peroxide causes degradation of cells. The group succeeded in creating a binuclear cobalt complex catalyst using anthracene, which is an organic compound and very stable, as a bridge ligand. After the creation, a catalyst activity of oxygen reduction was confirmed by rotating ring-disk electrode measurement with the dry powder of the

catalyst. Also, no hydrogen peroxide was found at reaction. The group expects that molecular structure affects hydrogen peroxide generation and catalytic activity, and plans to advance the reactivity and to develop the method with other metals such as steel. (The Chemical Daily, October 11, 2012)

4. SOFC Development

Mitsubishi Heavy Industries and Kyushu University will develop a next generation large scale solid oxide fuel cell (SOFC) together. A durable electrode will be jointly researched to bring generation efficiency of a triple combined cycle generation, which consists of liquefied natural gas (LNG) thermal power generation and SOFC, to 70%. MHI will send its engineers to the Next-Generation Fuel Cell Research Center which is going to open in Ito campus of Kyushu University in January. A Verification test is planned for 2014, and commercialization is expected by the fiscal year 2017. (The Nikkei Business Daily, October 22, 2012)

5. Business Plans of Ene-Farm

(1) Sekisui House

In Aichi prefecture, Sekisui House will begin "Smart Town to Stand Disaster and Electricity Shortage" highlighted by smart houses which will be in the market soon with photovoltaic generators, FCs, storage batteries and a home energy management system (HEMS). Also, smart housing plots will be developed in Mie and Gifu prefectures. The smart houses "Green First Hybrid" will be sold with three batteries from October 20th in Nagoya city, Aichi prefecture, and the firm aims for 20% of these smart houses to be in the area. (Jutaku Shimpo, September 25, 2012)

(2) Toyota Home

Toyota Home has showed technologies for "Smart House Giving Effortless Energy Saving Life". Having solar panels, Ene-Farm and storage batteries, the smart house has a quick charger for an electric vehicle (EV) and plug-in hybrid vehicle (PHV), and the charging system is in a verification test to make sure power feeds from the house to car as well as car to house. (The Nikkan Kensetsu Kogyo Shimbun, September 25, 2012)

(3) Panasonic

On October 1st, Panasonic announced that the world's largest (approximately 3 MW) photovoltaic generators and storage batteries would be installed in "Fujisawa Sustainable Smart Town (SST)", where the approximately 19 ha Panasonic Fujisawa plant is as well as 1,000 houses, commercial and public facilities. Also, EV and electric motorbikes will be shared and batteries for electrically assisted pedal cycles will be shared, which would be the first trial in Japan. The houses have two choices either electric power only or Ene-Farm, and come with a photovoltaic (power) generator, light emitting diode (LED) lighting and LiB. (The Kanagawa, October 2, 2012; The Denki Shimbun, October 3, 2012)

(4) The Japan Gas Association

On October 4th, Mitsunori Torihara, Chairman of the Japan Gas Association, revealed that the accumulated installed units of natural gas Ene-Farm reached 25,900 in Japan at the end of September and was expected to be 34,400 units by the end of FY2012. At the end of FY2011 the figure was 19,400 units and 7,700 at the end of the fiscal year FY2010. He also mentioned issues to be solved such as reducing size and cost and preparing the maintenance service structure throughout Japan to achieve "5.3 million units by 2030" in the Japan recovery strategy. (The Denki Shimbun, October 5, 2012)

(5) Toho Gas

On October 12th, Toho gas announced that a SOFC of JX Nippon Oil & Energy would be added in its product lineup. The FC allows a reduction of 70% of electricity purchased and has also a highly efficient back-up water heater as standard feature. The FC effectively uses heat from generation to warm water. The back-up heater provides hot water once the hot water in the hot water tank is used up, which gives users no worries of running out of hot water. Exhaust heat from back-up heater is used to warm water during burning gas. (The Denki Shimbun, October 15, 2012; The Nikkan Kogyo Shimbun, October 16, 2012)

6. Cutting Edge Technology of FCV & EV

(1) Toyota and Panasonic

On September 24th, Takeshi Uchiyamada, Vice Chairman of the board of Toyota Motor announced that 21 hybrid vehicles would be introduced into the market by 2015 as well as the next plan at an environmental technology briefing. They will

introduce a small EV "eQ" with new LiB in December, and energy efficiency reached the highest level of 104kWh/km. The EV runs approximately 100 km on a single charge and the maximum speed is 125 km/h. The price is ¥3.6 million. Toyota decided to move into EVs expecting more demand for shorter distance transport than PHVs, although the firm saw PHV as the core product and hesitated to introduce an EV. 100 EVs will be sold to American and Japanese local governments; small sports utility vehicle (SUV) "RAV4" EV will be sold in the US in September. On September 24th, Panasonic announced LiB would be provided for Toyota's eQ. (The Yomiuri Shimbun, The Asahi Shimbun, The Mainichi Newspapers, The Nikkei, The Sankei Shimbun, The Denki Shimbun, The Nikkan Kogyo Shimbun, Nikkan Jidosha Shimbun, The Tokyo Shimbun, The Kobe Shimbun, The Shizuoka Shimbun, The Nishinippon Shimbun, The Chunichi Shimbun, The Hokkaido Shimbun, The Shinano Mainichi Shimbun, Fuji Sankei Business i, The Chemical Daily, The Kahoku Shimpo, The Niigata Nippo, September 25, 2012)

(2) HySUT

On September 25th, the Research Association of Hydrogen Supply /Utilization Technology (HySUT) announced that a feasibility test on FC bus would be carried out to confirm stability of hydrogen provision in the Kansai International Airport. The jointly developed FCHV-BUS by Toyota Motor and Hino Motors will carry passengers between airplanes and the terminal, which will be open on October 28th, for low-cost carriers in the airport, as a test from the opening day to the end of March 2014. The operation will be on Saturdays, Sundays and bank holidays. (The Nikkei Business Daily, September 26, 2012; The Sankei Shimbun, The Chemical Daily, September 28, 2012; Nikkan Jidosha Shimbun, October 1, 2012; The Denki Shimbun, October 4)

(3) Nissan Motor

Nissan Motor is displaying a versatile FCV SUV concept model "TeRRA" in the Paris International Motor Show started on September 27th, showing an intention to extend its business to FCV as well as EV with the four wheel drive vehicle with in-wheel motors. (The Nikkei Business Daily, The Kyoto Shimbun, The Chunichi Shimbun, The Shizuoka Shimbun, The Shinano Mainichi Shimbun, The Kahoku Shimpo, September 28, 2012; Nikkan Jidosha Shimbun, September 29, 2012)

On October 1st, Nissan Motor announced that an EV concept car "NSC (Nissan Smart Car)-2015", which can automatically park in a spot without a driver using camera images and mobile phones, would be displayed in CEATEC Japan. EV Leaf was used as the base of the concept car's development. Having four cameras at front, back and sides, NSC-2015 drives into a parking lot with camera images using its on-board processor without a driver. Also, a smartphone can be used to trigger the operation. After a driver gets off the vehicle and switches the function on through a smartphone, NSC-2015 checks the surrounding, looks for a lot and then parks automatically along the guiding lines. (The Nikkei, October 2, 2012)

(4) Mitsubishi Motors

Mitsubishi Motors plans to recruit more experience electrical engineers. For the fiscal year 2012, 70% more than the fiscal year 2011, 170 engineers will be hired, and this is the largest hiring for the firm in 10 years. The firm will gather engineers with various back grounds such as electronic appliance and information equipment for EV production. Mitsubishi's original integrated control system "MiEV Operation System" will be improved for better regulation of battery and motor, energy saving and a smoother start. An EV and commercial EV "MINICAB-MiEV" are sold from Mitsubishi, and a small electric pickup truck and a PHV version of Outlander, a SUV, will be introduced into the market in the fiscal year 2012. (The Nikkei, October 3, 2012)

(5) Toyota Motor Kyushu

On October 2nd, Toyota Motor Kyushu announced that its FC bus was under a demonstrational experiment. The test was chosen as a "Challenge 25 Community Building Project", which is to reduce greenhouse gases, of the Ministry of the Environment (MOE). The bus carries commuting the workers and the test is to find out a CO_2 reduction effect, profitability and operational safety of hydrogen. The operation is between the Miyata plant and the JR Akama station. Jointly developed FCHV-BUS by Toyota Motor and Hino Motor is lent, Iwatani provides hydrogen. (The Nikkan Kogyo Shimbun, October 3, 2012; Nikkan Jidosha Shimbun, October

11, 2012; The Nikkei Business Daily, October 17, 2012)

(6) California State

On October 2nd, Mary Nichols, Board Chairman of California Air Resource Board (CARB), showed the board's intention to maintain its ambitious sales target of environmentally friendly vehicles such as EVs and FCVs, and to reduce greenhouse gas emissions in a Bloomberg Government interview. Also, she said a subsidy scheme would be an incentive to install chargers in new building and would expand the EV market. (Fuji Sankei Business i, October 4, 2012)

(7) Daimler

At the Paris International Motor Show, Daimler disclosed that its own FC development for vehicles would be abandoned and the firm would start a joint development with two firms Nissan Motor and Ford of the US. Large cost saving of development and production is aimed for by sharing the effort with two firms. (Nikkan Jidosha Shimbun, October 6, 2012)

(8) NEC

NEC has developed a technology to expand storage capacity of LiB, used for EVs, to more than 30%. Currently, gas is generated inside cells by increasing capacity with higher voltage, which shortens battery life. NEC succeeded in creating an electrolyte and electrode material which does not generate gas with higher voltage. The technology allows increase capacity without rare metals such as cobalt for electrode. Aiming at commercialization within two years, the firm produces LiBs for Nissan Leaf at its Sagamihara plant and has a production ability of over 2 GWh each year. (The Nikkei, October 9, 2012)

(9) Toyota, Nissan, Honda

On October 10th, four automakers Toyota Motor, Nissan Motor, Honda Motor and Hyundai Motor agreed to promote FCV in Scandinavia together. These firms assess large FCV demand in Scandinavia which is environmentally conscious and uses more renewable energy, and they will encourage the governments and related business to prepare infrastructure. The agreement lasts four years from 2014. The four targets countries are Norway, Sweden, Iceland and Denmark. These countries have already been preparing hydrogen supply infrastructure which is used by FCVs for fuel, and are more positive to promote FCVs than rest of the Europe. The infrastructure for EVs costs several million yen. On the other hand, FCV requires disadvantageously larger facilities to supply hydrogen which costs several hundred million yen. (The Nikkei, October 11, 2012; The Nikkei Business Daily, The Nikkan Kogyo Shimbun, October 12, 2012; Nikkan Jidosha Shimbun October 13, 2012)

7. Development of Hydrogen Engine Vehicle

On September 25th, IT Cars, Tokyo, announced that a conversion kit, which allows a gasoline engine car to use hydrogen as well as gasoline, had been developed. The kit was created with the advice of Associate Prof Kimitaka Yamane of Tokyo City University who has studied hydrogen engine cars for 40 years. A pilot car was made with Suzuki Wagon R, a 600cc or less class car, with the conversion kit attached, and revealed to the public. The product can also be applied to larger class cars. The automatic program changes driving mode; for example, an engine uses hydrogen only in its normal condition, but hydrogen and gasoline are used when power is needed such as overtaking. When hydrogen runs out, the car drives on gasoline. The power output and energy efficiency stay after conversion, and it can use hydrogen filling stations. IT Cars will seek cooperation with auto-related firms to target commercialization. (The Nikkan Kogyo Shimbun, Nikkan Jidosha Shimbun, September 26, 2012; The Chemical Daily, September 27, 2012)

8. Test Flight with Regenerative FC on Board

On October 4th, IHI and IHI Aerospace announced that the airplane with IHI FC system on had succeeded a test flight as a joint project with Boeing. A regenerative FC which is rechargeable and a hydrogen cylinder were installed on a short range jet airliner 737. Electricity was supplied from the FC and charged to the FC from airplane engines. The performance was checked during approximately five hour flight over Seattle, USA. The firms are targeting the product to be a supplemental power source for airplane cabins. The FC discharges water only, which is environmentally friendly. The water decomposes to hydrogen and oxygen to reuse as fuel. Currently, the power for cabins is from a generator operated by airplane engines, and the electricity level goes down

when engine output is low such as moving on land and descending. However, the power is produced in excess during cruising and ascending, and the excess can be stored in the FC. (The Nikkei, The Sankei Shimbun, The Denki Shimbun, The Nikkan Kogyo Shimbun, The Kobe Shimbun, The Kyoto Shimbun, The Shizuoka Shimbun, The Chugoku Shimbun, The Hokkaido Shimbun, The Shinano Mainichi Shimbun, Fuji Sankei Business i, The Niigata Nippo, October 5, 2012; The Chemical Daily, October 9, 2012)

9. Development of Hydrogen Production and Refining Technology

Assistant Prof Hidehisa Hagiwara and Prof Tatsumi Ishihara of Kyushu University developed a photocatalyst which is 1000 times more effective to produce hydrogen from water than conventional product. Ordinarily conventional products use ultraviolet rays for chemical reaction. On the other hand, the photocatalyst was innovated to use visible rays which are a half the strength of sunlight as well as ultraviolet rays for reaction. Titanium and tantalum oxides are generally used as a material for photocatalyst; however, the new product has tantalum oxide particles coated with an organic coloring matter which absorbs visible rays and is similar to coloring in plants for photosynthesis. The coloring absorbs visible rays, and ultraviolet rays which go through the coloring are caught by the oxides. Several hundred nanometer diameter particles were placed in water and illuminated laboratory light which is approximately 10 times stronger than sunlight. Conventional material particles created approximately 0.05 mL/g of hydrogen gas, whereas the new material generated approximately 50 mL/g which is 1000 times the amount of the conventional material. It was confirmed that the surface of new material's particles was less degraded, although organic matters tend to decompose with ultraviolet ray exposure. The study group aims for the commercialization of the material as a method to produce hydrogen more efficiently with private corporations. (The Nikkei, October 16, 2012)

10. Development & Application of Microbial FC

The University of Tokyo, Tokyo University of Pharmacy and Life Sciences, Panasonic and Sekisui Chemical started developing a system to treat sewage from factories with a microbial FC. Microbes in the FC treat organic matters in water, and generate electricity to operate the facility required. Organisms take organic matter into their body and convert the matter into CO_2 and water. Biogenic energy is gained from electrons separated during the activity passed to the oxygen that the cells have taken in. However, some microbes release electrons which are captured in their body. Prof Kazuhito Hashimoto of the University of Tokyo and Prof Kazuya Watanabe of Tokyo University of Pharmacy and Life Sciences found several types of microbe with that propensity, and made a prototype microbial FC with them. When microbes attached to the surface of metal, which constitutes anode (a negative electrode), are placed in sewage, electrons are detached and start flowing, meaning electric generation. In an experiment, the FC treated 80% of organic matters in six hours and 50 to 100 mW was generated. Targeting a system which processes one ton of sewage in 24 hours, the study group plans a verification test from 2014 and aims to commercialize it in seven to eight years for factories and sewage works. (The Nikkei, October 16, 2012; The Asahi Shimbun, October 17, 2012)

11. DMFC Development

Hitachi developed a technology to reduce by half cost of direct methanol fuel cell (DMFC) by developing electrode materials without expensive platinum. Large saving was made by nitrogen doped carbon and palladium-ruthenium alloy instead of platinum. Nitrogen doped carbon is used for the cathode, and palladium-ruthenium alloy is applied in the anode. The development eliminates the need of platinum which reduces the cost of DMFC's by half, and gives an approximately 45% cost saving. With further development to extend operating life, Hitachi aims at commercialization by 2015. (The Nikkan Kogyo Shimbun, October 10, 2012; The Chemical Daily, October 11, 2012; Nikkan Jidosha Shimbun, October 12, 2012)

12. Developments & Business Plans of Hydrogen & FC Related Monitor/Measurement Equipment

(1) Maxim Integrated Products

Maxim Integrated Products revealed its fourth

generation high-voltage sensor for automobile, industrial LiB and FC application. Having Maxim's ISO 26262 ASIL-D-compliant 12-cell daisy-chain device, the product allows extend driving range of EVs and hybrid electric vehicles (HEV) as well as securing safety and reliability of battery and FC. (Nikkan Jidosha Shimbun, September 28, 2012)

(2) The University of Tokyo, Ushio

A study group with the University of Tokyo and Ushio developed a technology to display microscopic liquid flow three-dimensionally. Liquid flow in a channel is captured at μm level with a holographic technology; and this uses interference of light, to photograph three-dimensionally and combine with a microscope. The technology is reportedly useful to analyze change inside a FC and capillary. Microscopic particles are mixed into the liquid to observe, and a digital camera takes a picture of the movement. Information required to reconstruct a three dimensional image is recoded at photographing with the holography technology. At verification test, deionized water with 2 μm diameter polystyrene particles was sent into microscopic paths to confirm the effect. A three-dimensional image was successfully created by taking multiple pictures of a 282 μm length and width 100 μm depth space. (The Nikkei, The Nikkei Business Daily, October 9, 2012)

(3) KRI

KRI, Kyoto, developed a technology to analyze 3 dimensional structures at nano level by combining a high resolution transmission electron microscope (TEM) and a method of computer tomography. The technology leads to discovering a relationship between physical property and structure of a material by analyzing the structure of characteristics quantitatively. Extracting characteristic structure from 3D images at nano level, the firm created an algorithm to analyze a structure of "Block copolymer", which is different polymerized monomers controlled at molecular level, quantitatively. The technology successfully analyzed sequentiality of holes of LiB's separator membrane and porous structure and the metal catalytic particles distribution of a FC electrode and degree of absorption into carrier quantitatively. The firm seeks research contracts from related manufactures. (The Nikkan Kogyo Shimbun, October 17, 2012)

(4) Marubeni Information Systems

Marubeni Information Systems, Tokyo, signed a distributor agreement in Japan with an American inspection system manufacture "Coherix", and started to sell a contactless 3D surface flatness detective "ShaPix" which measures surface form of a machined part with 1 μm accuracy quickly and easily. The price is from ¥38 million. The firm aims for ¥500 million in a year targeting FC, transporting machine and information markets over one year. (Architectures, Constructions & Engineerings News (Daily), October 19, 2012)

13. Platinum Amount

Japan Oil, Gas and Metals National Corporation (JOGMEC) announced that the amount of platinum, palladium and gold reserves was confirmed as a joint research of platinum group metals in northern Bushveld, South Africa, with Platinum Group Metals of Canada. The estimated amount of platinum is approximately 64 tons. (Japan Metal Daily, October 1, 2012)

14. New Ammonia Synthesis Catalyst

A study group with Prof Hideo Hosono and Prof Michikazu Hara of Materials and Structures Laboratory of the Tokyo Institute of Technology developed a highly reactive ammonia synthesis catalyst. This highly efficient catalyst consumes energy only a tenth of a conventional product. Ammonia is made of nitrogen and hydrogen reacted, and the conventional method has an issue in separating the strong bond between nitrogen molecules. The group successfully created ammonia from nitrogen and hydrogen effectively by combining a superconductor " C12A7 ($12CaO \cdot 7Al_2O_3$)" developed by Prof Hosono's team and ruthenium nano particles which is currently used to compose ammonia to make catalyst. The catalyst produced ammonia from nitrogen and hydrogen more efficiently. Electrons move easier with the catalyst because nitrogen molecules break into atoms better, which seems to be a factor of the improvement. Ammonia is used for fertilizer, expected to be utilized for FCs and produced 1.7 billion tons worldwide each year. (The Tokyo Shimbun, The Chemical Daily, October 22, 2012)

— This edition is made up as of October 22, 2012 —