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R&D Progress on Catalyst for FCs to Replace Platinum

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1. Governmental Measures

(1) METI

On May 18th, the Ministry of Economy, Trade and Industry (METI) announced that a tank for fuel cell vehicles (FCVs) manufactured by Toyota Motor received type approval based on the High Pressure Gas Safety Act. This type approval allows Toyota itself to inspect the container of the approved model and stamp the mark on the container. This is expected to contribute to more efficient FCV production. The Toyota's tank is designed and manufactured to fit to the "Global Technical Regulations (GTRs)" for hydrogen and fuel cells (FCs). (The Denki Shimbun, May 19, 2015; Nikkan Jidosha Shimbun, May 20, 2015)

(2) Agency for Natural Resources and Energy

The Agency for Natural Resources and Energy will compile specifications of next generation hydrogen refueling stations by the end of FY 2017. Unlike liquid fuels, hydrogen gas is a colorless fuel, and explosions are always something to worry about. For self-service refueling stations in the future, the agency plans to develop user friendly specifications by using hydrogen detection and virtual visualization technologies. The aim of the new specifications is to increase locations of hydrogen refueling stations by reducing the worries of neighboring residents and users for faster FCV market growth. (Nikkan Jidosha Shimbun, May 25, 2015)

(3) NEDO

On June 5th, the New Energy and Industrial Technology Development Organization (NEDO) announced that new research and development projects were launched for full FCV market growth. The aim is to drastically improve performance, cost and productivity of FCs. These projects will work on the development of process technology to significantly reduce production time and basic technologies such as investigation of the reaction mechanism of FCs and the creation of new material concepts with Japanese expertize. A total of 15 projects were chosen for either basic or process application technology area. (The Chemical Daily, June 8, 2015)

2. Local Governmental Measures

(1) Amagasaki City

On May 21st, Amagasaki City, Hyogo Prefecture, will hold a symposium on FCVs from 2:00 pm at the Amagasaki City Facility for Small Businesses. The symposium aims to promote FCVs and to advertise hydrogen society. The agenda includes talks by representatives from the Kansai Bureau of Economy, Trade and Industry (METI-Kansai), Iwatani and Toyota to introduce the FCV trend and current issues of hydrogen refueling stations. The city has been chosen as a model to develop a low-carbon city by the Japanese government. In February, they installed a charger for electric vehicles (EVs). A FCV has been used as the official car for the mayor since March. A subsidy scheme started to help FCV purchase in FY 2015. (The Nikkan Kogyo Shimbun, May 12, 2015)

(2) Hokkaido

On May 8th, an exhibition of next generation cars was held at the Red Brick Office of Hokkaido Government, and Toyota's FCV "MIRAI" made its first appearance in Hokkaido. The Hokkaido government held the exhibition aiming to promote low-carbon society. Also plug-in hybrid vehicles (PHVs) and EV "LEAF" were displayed there. (Nikkan Jidosha Shimbun, May 13, 2015)

(3) Tokushima Prefecture

Tokushima Prefecture will work on full use of hydrogen which is spotlighted as a next generation

energy. A hydrogen facility will be installed at the prefectural office by the end of FY 2015, and five FCVs will be purchased as official cars of the prefecture. The prefecture will also encourage businesses to install hydrogen refueling stations. Both FCV purchase and hydrogen filling facility installation of a prefectural office will be the first in Shikoku. The local government included the related expense of ¥347 million in the supplementary budget of the general account for FY 2015, which will be proposed at the scheduled meeting in June of the prefectural assembly. For hydrogen refueling station related budget, a subsidy of ¥121 million is allocated to promote preparation of mobile hydrogen filling facilities using trailers to the private sector. A stationary filling facility will be installed by the entrance of the Tokushima Prefecture office, and it will provide hydrogen produced by splitting water using solar power. The preparation cost of ¥181 million is included in the expense. (The Tokushima Shimbun, May 15, 2015)

(4) Miyagi Prefecture

Miyagi Prefecture has revealed that a hydrogen refueling station was planned to be installed in Sendai City between February and March, 2016. Also a FCV is planned to be used from the same time. The prefecture is to be the first local government to implement this kind of plan in the Tohoku area, and aims to promote purchase by doing it first. Their plan is to get ¥120 million from the Japanese government out of about ¥170 million for the hydrogen filling facility installation by applying for a subsidy from the Ministry of the Environment (MOE). The local government plans to purchase a "Smart Hydrogen Station" jointly developed by Honda and Iwatani to be installed on its land in Sendai City. (The Nikkei Business Daily, May 26, 2015)

(5) Osaka Prefecture University & Sakai City

On June 2nd, the Osaka Prefecture University and Sakai City launched a "Sakai City Promotional Committee for Hydrogen Energy Society" which is a solidarity organization in cooperation among industry, academia and government for hydrogen to be used as energy such as FCVs. The members are METI-Kansai and 17 private organizations including the Kansai Electric Power Company (KEPCO), Osaka Gas and Iwatani. The committee will work on solving issues to expand the hydrogen market to lead to FCV sales growth for the private sector and a rise in the number of hydrogen refueling stations. FCV test rides for consumers will be held this year, and hydrogen refueling stations are planned to be installed at two locations in Sakai City as an experiment. At the launch meeting, participants exchanged their opinions and information. "Currently hydrogen usage is limited, and production capacity exceeds the use", said Nippon Steel & Sumitomo Metal Corporation. METI-Kansai showed an intention to prepare more hydrogen refueling stations since the number of the facilities is lower in the Kansai area than in the Kanto area. The committee will hold meetings every three months for the first year to sort issues out for hydrogen energy use. They chose Prof. Masaya Matsuoka at the Osaka Prefecture University as the chair. Sakai City has many firms handling hydrogen related business such as Nippon Steel & Sumitomo Metal Corporation, Mitsui Chemicals and Air Water. The local government estimates hydrogen refueling stations would be profitable. Mayor Osami Takeyama said that "we want to invite related businesses and create more jobs by using the industrial complex in the coastal area as a hydrogen supply center. Being designated as a governmental strategic special zone, the city will request deregulation on hydrogen tanks with the Union of Kansai Government. (The Nikkei, June 3, 2015; The Nikkei Business Daily, June 5, 2015)

(6) Tokyo

The Bureau of Environment of Tokyo and Tokyo Environmental Public Service Corporation will start a support scheme of thermal and electric energy management for smaller businesses. This scheme will give assistance to smaller healthcare and welfare facilities to purchase energy creation and saving equipment using energy service companies (ESCOs). Public baths were added to the scheme in FY 2015. Half the cost of equipment installation such as FCs would be subsidized. The maximum amount of subsidy is ¥100 million, and the operators who also apply to the governmental subsidy, will be given up to a half. (The Nikkan Kogyo Shimbun, May 5, 2015)

3. FC Related Element Technology Development & Business Plans

(1) Sumitomo Riko

On May 11th, Sumitomo Riko announced that a venture "Sumiriko FC Seal" was launched to produce FC material. Sumitomo Riko has commercialized a rubber sealing "gasket for cells" for FC stacks of FCVs, and this gasket is used in Toyota's FCV "MIRAI". The FCV market is expected to expand in the future, and FCV core components are likely to be demanded more. Considering the forecast, Sumitomo Riko aims to establish a stable supply system by transferring the production and sales department of the material to the venture in order to expand the business growth. Having started in April, Sumiriko FC Seal is capitalized at ¥495 million solely from Sumitomo Riko. (Nikkan Jidosha Shimbun, May 12, 2015)

(2) NIMS & Tohoku University

A research group of Tohoku University and Dr. Hideki Abe, a principal researcher at the Environmental Remediation Materials Unit of the Environment and Energy Materials Division of the National Institute for Materials Science (NIMS) has developed a catalyst which enables the efficient generation of electricity, without producing toxic gases, from ethanol fuel at normal temperatures and pressures. The material consists of alloy nanoparticles of tantalum and platinum combined, and achieves a current density of over 10 times that of a conventional catalyst. The group aims for the material to be used in polymer electrolyte fuel cells (PEFCs) by increasing the composite yield to several grams, 10 times that of a conventional product. The ethanol fuel produces toxic gases such as CO in the reaction process at high temperatures when it is used in internal combustion. On the other hand, PEFC oxidizes fuel molecules during the breakdown process at a low temperature changing the fuel into CO_2, a relatively harmless gas. Due to the nature of the process producing no toxic gases, ethanol is hopefully used more. However, conventional catalysts cannot efficiently break down carbon-carbon bond for oxidation to make CO_2, and a new catalyst has needed to be developed. The group of Dr. Abe developed $TaPt_3$ alloy to use it as a catalyst in an oxidation test of ethanol fuel. The catalyst exhibited higher current density than conventional catalysts. They also observed the chemical state of molecules adsorbed on the surface by concentrating infrared rays. The results show that the catalyst is capable of oxidizing the carbon-carbon bond to CO_2 at a voltage of 0.35, over 0.1 V lower than that of conventional catalysts. (The Nikkan Kogyo Shimbun & The Chemical Daily, May 22, 2015)

(3) Fuji Electric

The Yamanashi Factory of Fuji Electric, Minami-Alps City, has started to use waste heat coming from FCs and gas engine generation. Their aim is to reduce boiler fuel by using waste heat to make cooling water which is essential for semiconductor production. The Yamanashi Factory already achieved 30% energy reduction to that of FY 2010 by renewing its cleanroom facility. A factory energy management system (FEMS) will maximize the effect of waste heat use by optimizing the operation of the facilities. They now are pursuing a significant energy saving of 40% by adding another 10% reduction. The factory functions as a production base of power semiconductors for industrial purpose such as numerical control (NC) machine tools and automobiles. Since the facility experienced rolling blackouts after the earthquake of Tohoku in March, 2011, it switched to solely supply its own power for more stable operation. Electricity is generated by four units of 100 kW FCs and a gas engine generator. Waste heat from the FCs and gas engine is sent to an absorption chiller to produce cold water. The heat utilization replaced a boiler used to create heat, which cut down boiler fuel. The FCs and gas engine compose a cogeneration system, and supply the factory with electricity and hot water. The whole system improved fuel efficiency by adding waste heat supply. (The Nikkan Kogyo Shimbun, May 26, 2015)

(4) Nisshinbo

Nisshinbo is developing carbon alloy catalyst, and it is a potential non-platinum catalyst to be used for stationary FCs by 2020. On May 26th in the Canadian time, Ballard Power Systems, Canada, announced that a joint research agreement had been signed between Nisshinbo for catalyst development. Ballard aims for 10 to 15% reduction in FC production cost. This means that a new catalyst to replace platinum is more likely to be used for the FCs, though the details of the catalyst have not been disclosed. Nisshinbo plans to commercialize its carbon alloy catalyst with

this agreement in order to sell it for FCVs. Carbon alloy catalyst allows reducing material costs to a sixth to a tenth of that of conventional platinum catalysts. Nisshinbo is developing this type of catalyst in cooperation with Gunma University. According to the research paper published for conferences, the catalyst is produced by applying heat to carbonize iron added polyacrylonitrile. This catalyst which is heated to 1,100 °C shows high generation characteristic of 1A/cm^2 at 0.6 V in generation using air. Other firms are also trying to develop the same catalyst, but the performance of these catalysts stays at 0.4 V in the same conditions. Currently Nisshinbo's catalyst has an advantage. The catalyst would be the second core component supply from Nisshinbo to Ballard after separators. (The Chemical Daily, May 27, 2015)

(5) Ishifuku Metal Industry

Ishifuku Metal Industry, Tokyo, has established a commercial production technology of platinum core-shell catalysts. This is NEDO's platinum reducing technology development project, and the firm succeeded to produce 100 g of highly active platinum particles, of which the inside has palladium core-shell structure, per batch. They aim the product to be used in FCVs and Ene-Farm by 2020s by scaling up the production. Platinum takes a large part of platinum catalyst costs, which means mass production does not significantly bring the cost down. For FCV use, conventional platinum catalyst sufficiently reacts in the anode. On the other hand, reactivity and durability of platinum catalyst for cathodes need to be improved. Reactivity of cathode catalysts changes depending on crystal structure and electron state of platinum. Tripling platinum reactivity per mass was achieved by alloying in a previous development. Because only the surface contributes to catalyst reactivity, Doshisha University developed a platinum core-shell catalyst which has an alloy structure inside. They confirmed that the reactivity per mass was up to six times. Ishifuku is now working on scaling up of the production technology of the catalyst. (The Chemical Daily, May 28, 2015)

4. Hydrogen Production, Production, Infrastructure Technology Development and Business Plans

(1) Yachiyo Industry

Yachiyo Industry as an "energy storage manufacturer" has been working on next generation technology development". Currently, a resin composite container with carbon fiber is under development for accumulators of hydrogen refueling stations and compressed natural gas (CNG) for automobiles. The firm plans to establish methods to reduce the cost and to increase the size of accumulator as soon as possible, and it will also work on development to hydrogen tanks for FCVs as hydrogen related business. Using technologies and expertise gained from automobile fuel tanks, they aim to contribute to realizing a low-carbon society. The manufacturer has since 2006 been developing "type 4" resin container which is a resin liner wounded by carbon fiber. This development largely uses their advantage of having technologies of resin fuel tanks, one of their core products, and the firm already developed light-weight composite container for liquefied petroleum gas (LPG) with good durability. The development of this container gave the firm a filament winding technology of carbon fiber. They aim to develop an accumulator using these experience and knowledge. Although one of the issues is cost, type 4 containers can be produced at a lower price than steel or aluminum liner containers, and the technology of the container needs to be established. (The Chemical Daily, May 12, 2015)

(2) Hitachi Zosen

Hitachi Zosen has developed hydrogen production equipment using electricity of renewable energy. Renewable energy such as solar power is a weather dependent, which puts pressure on production equipment due to fluctuation of energy output. The new equipment can adjust operation of its core components depending on power generation amount, which reduces the load to the equipment. The manufacture aims at hydrogen refueling station operators which try to be energy self-sufficient in a community. The equipment electrically splits water to produce hydrogen, and is capable of using renewable energy as its power source. The core components of electrolysis are installed for the adjustable operation. The firm delivered a small-scale experimental equipment producing 1 m^3 of hydrogen per an hour at 0°C and 1 atm to a hydrogen filling facility in Kyushu University. The same performance equipment will sell for around ¥40 million. (The Nikkei, May 16, 2015;

The Denki Shimbun, May 19, 2015)

(3) Osaka City University & Fuji Chemical Industries

Osaka City University & Fuji Chemical Industries, Toyama Prefecture, have developed a technology to produce hydrogen from garbage such as paper waste. The technology uses a reaction similar to photosynthesis of plants working on solar power. This method is more likely to enable cheaper production than conventional methods using water electrolysis. They plan to start a test in five years as a system to produce hydrogen energy by processing waste newspaper and magazines. Hydrogen is currently made from natural gas, which emits CO_2 in the process. Although methods using water electrolysis and microbe are considered, they have issues such as costs of higher electricity use and production of gases other than hydrogen. The team of Prof. Yutaka Amao, the head of the Research Center for Artificial Photosynthesis has focused on photosynthesis when plants create energy from sunlight. Chlorophyll from plant leaves is mixed with carbohydrates produced by the process to dissolve paper waste, and platinum particles are added as a catalyst to promote the chemical reaction. Hydrogen is produced by applying sunlight. 0.2% of the energy conversion rate of sunlight was calculated from the hydrogen production amount. The team aims at 2% of energy conversion which is the level worth a demonstration experiment by working on improvement such as collecting sunlight more efficiently. (The Nikkei, May 18, 2015)

(4) Mitsubishi Chemical

Mitsubishi Chemical Holdings will start refueling station businesses for FCVs in cooperation of its group members. A hydrogen fuel tank will be produced using Mitsubishi Rayon's carbon fiber and a high density polyethylene (HDPE) and adhesive resin of Japan Polyethylene. Taiyo Nippon Sanso is promoting mobile hydrogen refueling stations and will use the tank in their mobile stations. The tank is also aimed to be used in FCVs which are under development at global automakers, and the certified product will be shipped to Europe from July 2015. Mitsubishi Chemical Holdings plan to get a wide range of business opportunities from tanks to hydrogen supply in the FCV field which is expected to be highly demanded. (The Chemical Daily, May 26, 2015)

(5) Air Liquide Japan

Air Liquide Japan will consider a business in the hydrogen energy field. Their joint venture with Toyota Tsusho operates hydrogen refueling stations. Toyota Tsusho plans to strengthen the tie for entries to oversea markets. The hydrogen supply chain, an upper stream market, is under consideration as a potential business. They are working on technological development and research on hydrogen production using renewable energy and transport. Their eyes are on hydrogen production process using biomass resource, and another possibility for the Japanese market is highly efficient water electrolysis process being researched by the headquarters in France, and FCs as an emergency power source (The Chemical Daily, June 5, 2015)

5. Ene-Farm & Smart House Business Plans

(1) Takasago Thermal Engineering & AIST

Takasago Thermal Engineering and the National Institute of Advanced Industrial Science and Technology (AIST) are working on commercialization of a CO_2 free hydrogen supply system. Hydrogen is produced by an integrated system of water electrolyzer and FC with an alloy hydrogen storage tank, and is directly supplied to FCVs and Ene-Farms and FCs to provide electricity and heat. This development was selected as a technological development project to be used in 2040 by NEDO. An application to an office building will be investigated in the first year, and a small-scale experimental system will be developed in a field test for evaluation. (The Chemical Daily, May 22, 2015)

(2) Osaka Gas, Honda & Toshiba

Osaka Gas, Honda Motor and Toshiba are working together for commercialization of smart house with FCs and a micro EV as core. A joint experiment has started using an environment similar to an ordinary home in Osaka City. For commercialization in the near future, they will examine specifications of the micro EV which is to be charged from excess power of FCs as well as issues of power supply from EV to home (V2H). Each firm will use the results to develop products, and these firms plan to offer a new living environment which is achieved by combining FCs, EV and information technologies in order to promote it as a new product. The system is made of Osaka Gas's solid oxide fuel cell (SOFC) Ene-Farm,

Honda's micro EV and its charging and discharging device, and Toshiba's home energy management system (HEMS) with home appliances to find out issues as a commercial system and adjust the direction of the development. (The Nikkan Kogyo Shimbun, May 25, 2015)

6. Cutting Edge Technology of FCV & EV

(1) Toyota Motor Group

On May 12, seven Toyota Group members including Denso announced their exhibition outlines for 2015 "Automotive Engineering Exposition" held from 20th to 22nd in Pacifico Yokohama, organized by the Society of Automotive Engineers of Japan (JSAE). They will display a wide range of products such as components of Toyota's FCV MIRAI and technologies to improve fuel efficiency. (The Nikkan Kogyo Shimbun, May 13, 2015)

Toyota's FCV "MIRAI" has been delivered to consumers. Because the production capacity is limited to 700 vehicles for the first year, the delivery takes two to three years. Previously the majority of purchasers were corporates, but this will be extended to consumers. (The Nikkei, May 29, 2015)

(2) Hitachi Chemical

Hitachi Chemical will build a plant for the core part of lithium-ion batteries (LIBs) in the US by FY 2018. Having an estimated ¥10 billion level investment, they have been looking into possible sites. California, the USA, will tighten its emission regulations, and the firm estimated that more batteries for EVs to be in demand. The manufacturer produces material for anodes, and leads the global market in value with about 30% share. Currently, the product is made in Japan and China. Once the US production base in operation, the production capacity will be doubled or tripled. Their anode material is used in the battery for EV "LEAF". Panasonic provides major EV producer Tesla with LIBs, and will build a battery plant in Nevada. Hitachi Chemical plans to supply Panasonic with the anode material. (The Nikkei, May 16, 2015)

(3) Showa Denko

Showa Denko will double the capacity of battery materials by 2016. This Japanese firm has an advantage in highly functional materials same as Hitachi Chemical, and will invest to beat competitors with a larger share. Their production capacity of the anode material will be fortified with ¥1 to 2 billion investments. Currently they produce annual 3,000 tons of the product in Omachi City, Nagano Prefecture, and the plant operates at its full capacity due to demands from Asia including the vigorous Chinese market. Their production centers in Japan will increase the production capacity, and local production in China will be considered. The manufacturer will also increase the production of carbon fiber which is mixed in anode and cathode materials to improve durability. Their facility in Kawasaki City has stopped its production, but will be in operation from late 2015 for the first time in three years to double the capacity to over 200 tons each year. (The Nikkei, May 16, 2015)

(4) FaBSCo

On May 20th, FaBSCo, which sells power generation systems in Fukuoka City, will start a payback service of the electricity fee for EV chargers to EV charger operators. With the advantage of income, they will promote EV charger installation. Currently 200 EV chargers are serviced by them, and they plan to increase the figure to 3,000 with the new service in two years. The product is named "Ene Shop", and the firm will pay back to the charger operators the amount that standby power is excluded from what users charge their cars. Charging operators often don't make any income from charger suppliers, this kind of service offering income to the operators is unusual. The firm aims to install it in restaurants, café and convenience stores. They ask operators to keep their chargers for eight years, and have a maintenance contract. Although their revenue will be reduced by the amount of pay-back, they aim to widen their business by prioritizing growing the number of chargers. (The Nikkei, May 18, 2015)

(5) Eco Cars in China

According to the Ministry of Industry and Information Technology of China, 9060 eco cars, 1.5 times of that of the same month in the previous year, were produced in April, 2015. Including 10 FCVs, EVs and plug-in hybrid electric vehicles (PHEVs) significantly expanded their market. The sales figures of both for consumer and business purposes went over the figure for the same term previously being on a growth path. The details of the sale for consumers were 4,790 EVs, 2.2 times of that of the previous term 1,523 PHEVs, a 92% increase that of the previous term. For business

purposes, the sales were 1,781 EVs, 10 times of that of the previous term, and 956 PHEVs, a double that of the previous term. All the sales are staying at high levels. (The Chemical Daily, May 18)

(6) The University of Tokyo, Toyo Electric Corporation & NSK

The University of Tokyo, Toyo Electric Corporation and NSK succeeded to drive a car with in-wheel motors of which power is sent wirelessly. An in-wheel motor has its driving source inside the wheel, which can be independently controlled. Due to this function, an EV with in-wheel motors can safely drive on slippery roads. However, conventional in-wheel motors are supplied with electricity through wires which can be cut off by effects such as freezing in cold areas. This new technology allows power to go directly to in-wheel motors from power supply coils buried in roads in order to drive EVs. The group plan to increase power output of EVs, and aim to achieve power supply while driving. The new technology was developed by a research team of Associate Prof. Hiroshi Fujimoto at the Graduate School of Frontier Sciences of the University of Tokyo. They use resonant inductive coupling for the system which can send power over a longer range than electromagnetic induction, and succeeded to transmit power between sending and receiving coils placed 10 cm apart. Driving units are stored in in-wheel motors, which give more options for car design. This type of motors can control each wheel, and gives safer drive on slippery roads. Moreover, driving shafts are eliminated by the motors, which reduce by 30 to 40% the weight of driving units. This gives a significant reduction in power consumption. (The Denki Shimbun, May 20, 2015; The Asahi Shimbun, May 23, 2015)

(7) Nissan & BMW

On May 25th, Nissan Motor and BMW announced that a network of charging stations for EVs and PHVs would be jointly prepared in South Africa. The network will offer chargers with sockets for both "Combined Charging System" of Europe and US and "CHAdeMO" of Japan. The world's first commercial EV "LEAF" of Nissan has been available since 2010, and 174,000 vehicles were globally sold. BMW released EV "i3" and PHV "i8" in 2013. (The Nikkei, May 26, 2015)

(8) Consumer Electronics Show Shanghai

On May 25th, Consumer Electronics Show (CES) Asia, a home appliance exhibition, started in Shanghai. New technologies and services were showcased there, and US-based Intel and a major home appliance manufacturer Haier revealed their joint product of a "wireless charging service". (The Nikkei, May 26, 2015)

(9) LG Chem

South Korea-based LG Chem will deliver batteries for PHV to Great Wall Motor, a major private automaker in China. LG Chem's plant in Nanjing will fully operate in 2016. The total order has reached over 200,000 units including existing contracts in China. (The Nikkei, May 26, 2015)

(10) Nissan

On May 27th, Nissan Motor announced that 200 EVs would be provided for COP 21 of the United Nations to be held in Paris, France, from November to December in cooperation of French-based Renault, its partner. Four cars, LEAF and business car e-NV200 of Nissan and Zoe and Kangoo Z. E. will carry participants between venues around the clock. In cooperation of a French firm, quick chargers will be installed to supply electricity solely generated from renewable energy at over 50 locations. (The Nikkei, May 28, 2015)

On June 3rd Nissan and Yokosuka City announced that a partnership agreement was signed between them for EV promotion. The agreement is mainly to promote chargers installed in car parks of apartments and office buildings for residents and workers through deregulations. Nissan produces EV "LEAF" in Oppama Plant, Yokosuka City, and aims to increase the number of EVs owned in the city to 10% by FY 2020 with the public and private sectors' cooperation. (The Nikkei, June 4, 2015)

(11) GLM

Ventures in the Kansai area have been seeking more funds. GLM, Kyoto, succeeded in receiving a large amount of funds of approximately ¥800 million to strengthen the global sales of its originally developed electric sports car "Tommykaira ZZ". The investment is from global investors including a sovereign wealth fund of Saudi Arabia and University of Tokyo Edge Capital (Bunkyo, Tokyo) as well as business operators such as Kyoto Tool, also known as KTC, and Yuasa

M&B (Osaka City). (The Nikkei, June 3, 2015)

(12) BYD

On June 4th, BYD, a major Chinese automaker, announced that a maximum 15 billion CNY (approximately ¥301 billion) will be raised by allocating new shares to third parties to develop eco cars such as EVs. The new shares will all be A-Shares in CNY on mainland China. (The Nikkei, June 5, 2015)

(13) VW

On June 3rd, Volkswagen (VW) announced that partnership would be expanded in research on the EV field with Shanghai Automotive Industry Corporation (SAIC) of China. The aim is to gradually move to full local production in China. The Anting Plant of Shanghai Volkswagen Automotive (SVW), their joint venture, will be producing over 15 models including PHVs and EVs in four years. Research will also be strengthen for FCVs and PHVs (The Nikkan Kogyo Shimbun, June 5, 2015)

7. Hydrogen Refueling Station Business Plans

(1) JX Nippon Oil & Energy

JX Nippon Oil & Energy will construct a shipping facility for high pressure hydrogen in Negishi Refinery, Yokohama City, and the shipping will start in FY 2016. Using 45 MPa filling pressure, they can transport over double the amount of hydrogen compared to conventional methods. Their hydrogen energy business is planned to concentrate on FCVs. They are working on technological developments for supply chains using methylcyclohexane (MCH) as the carrier. However the high pressure hydrogen method is used for now, and they will then move on to the MCH method in the future. They target a 40% share in the automobile fuel market for FCV hydrogen. (The Chemical Daily, May 15, 2015)

(2) HySUT

JX Nippon Oil & Energy, Iwatani and Tokyo Gas will cooperate for operation of hydrogen refueling stations for FCVs. Their manuals and problem information will be shared for efficient management and simplification of facilities. Installation and operation of hydrogen refueling stations are five times more expensive than gasoline refueling stations, and these firms will help each other to back up the FCV market growth. The Research Association of Hydrogen Supply/Utilization Technology (HySUT) is a private organization consisting of 19 hydrogen related businesses and organizations including utility firms and automakers such as Toyota, and they have developed an information sharing system. The system collects issues and problems from the commercial hydrogen refueling stations of JX and Iwatani, and gives members access to actual use at commercial stands; for example, check points of pre- and post-dispensing periods and solutions to dispensing units with problems. The members will seek improvement of facilities and components by studying collected information. For example, this system allows improvements of usability of dispenser or efficient piping layout in refueling stations. The organization believes the system is useful to request changes to the regulations related to refueling station operation such as the High Pressure Gas Safety Act to the government. The system has already collected some information on experimental refueling station. Information will be sent to the system from the commercial refueling station to be installed at 100 locations nationwide in FY 2015. HySUT plans to store over 200 cases of information each year. The hydrogen fuel cost for FCVs is double that of gasoline and nearly triple that of hybrid vehicles (HVs). JX and Iwatani currently sell hydrogen at low prices without profit. Installation and operation costs of refueling station take over 60% of the hydrogen price, and a reduction in the costs will back up FCV growth. The Japanese government plans to bring down the hydrogen price for FCVs to the level of HV fuel cost by 2020. For the target, installation and operation costs are aimed to be reduced to half by relaxing regulations by the same time. (The Nikkei, May 16, 2015)

(3) Toho Gas

On May 15th, Toho Gas started the operation of a hydrogen refueling station at Nishidamen, Umemori-cho, Nisshin City, Aichi Prefecture. This is the sixth hydrogen refueling station in the prefecture, which makes the prefecture the leader in the number of hydrogen refueling stations overtaking Tokyo which has five. (The Chunichi Shimbun, May 16, 2015)

On May 25th, Toho Gas announced that its second commercial hydrogen refueling station "Shinkomei Hydrogen Station (provisional name)" would be

constructed. The construction will start in August, and the station is planned to operate from the first half of 2016. The utility firm is developing a smart town as a model area of total energy business in a piece of land in the Komei area, and the refueling station will be built in the northwest. Using an off-site system, hydrogen will be transported from a production plant to the station in cylinders stored in racks, and will be compressed to be stored in accumulators before being dispensed. On the same premises, the firm will build natural gas dispensers which can fill large transit buses and tracks and LPG dispenser as a refueling base for taxis for the community. (The Denki Shimbun, May 26, 2015)

(4) Iwatani

Iwatani will construct hydrogen refueling stations for FCVs at 18 locations by investing ¥8.1 billion in the financial year ending in March, 2016. If the plan goes smoothly, they will hit their preparation target of 20 locations with three established stations by the end of the financial year. Hydrogen refueling station costs a lot and the operation rates of the stations are expected to be low with the current FCV sales. This makes it difficult to manage the business for a while. Iwatani as a hydrogen supplier aims to help the FCV market growth by preparing infrastructure ahead of the FCV market growth. (The Nikkan Kogyo Shimbun, June 1, 2015)

8. Measuring/Observing Technology Development & Business Plan

On May 18th, Toyota Motor announced a new method to examine platinum behavior of FC catalysts on a real time basis. Although platinum is essential to promote the chemical reaction of hydrogen and oxygen to generate electricity, it was previously difficult to look at the transition of the performance loss continuously by change of platinum particles at the level of a couple of nano meters. The automaker developed a micro pseudo-FC to simulate a generation state, and succeeded to analyze it through a transmission electron microscope by simulating a generation state. Test will be carried out repeatedly to improve the life span of FCs and reduce the amount of platinum. The voltage of FCs goes down on a proportional basis as FCV operates longer. One of the reasons for this is reduction in the reactivity of platinum particles of the catalyst. Conventional methods allow analyzing fixed points such as the initial state or a period of voltage reduction to compare the data, but do not give continuous data to know how the characteristics change. Toyota was working on developing and putting into practical use the new analysis method for three and a half years in cooperation of the Japan Fine Ceramics Center. (Nikkan Jidosha Shimbun & The Nikkei Business Daily, May 19, 2015)

— This edition is made up as of June 8, 2015 —