

4K-hour Continuous Generation of SOFC & MGT Combined System

Arranged by T. Homma

1. Governmental Measures

(1) MLIT

The Ministry of Land, Infrastructure, Transport and Tourism (MLIT) has investigated making new plans for the “Environmental Action Plans” which were compiled as a midterm green strategy of land, infrastructure and transport. In their plan, sewage works are to operate as hydrogen filling stations for fuel cell vehicles (FCVs) to be introduced into the market in 2015 as an action to create a society with an environmentally-sound cycle. The ministry includes investigations for the demonstrations to make a system to produce and supply hydrogen at sewage works at a low cost in the plan. (Nikkan Jidosha Shimbun, September 17, 2013)

(2) MLIT & METI

MLIT will investigate safety standards for fuel cell (FC) motorcycles. The majority of FC motorcycles are small scooters equipped with FC systems and hydrogen tanks. Motorcycle manufacturers have researched and developed FC motorcycles. With an expectation of market growth, MLIT will prepare safety standards and a type-approval scheme for the vehicles as well as standards for hydrogen tanks with the Ministry of Economy, Trade and Industry (METI). They will work out safety standards and testing methods by examining accident fact-finding surveys and development progress of the advanced technologies of motorcycles. (Nikkan Jidosha Shimbun, September 18, 2013)

(3) METI

METI will add photovoltaic generators and FC to the special supply scheme by the end of this year at the latest. The scheme certifies electricity transfer from generators including cogeneration systems to other consumers through private power lines. The

ministry will revise the certification requirements of the scheme to be able to supply users with electricity of FC or photovoltaic generators equipped with storage batteries or FC through private lines. Since the current certification requirements are unclear, operators have requested that they are changed. The amendment will let those energy providers apply for the scheme who only have contracts with specific power sources to buy required the electricity, which means they do not need their own generators. Also the ministry will institute a “self-power consignment scheme” next April. With the scheme, business operators with their own generators can interchange excess energy within their own management such as a plant and group of firms through the power grid. The ministry will extend the self-power consignment scheme to the lower voltage contracts aiming for full liberalization of small power supplier in 2016. (The Denki Shimbun, September 9 & 20, 2013)

METI will promote an energy management system (EMS) to be established and FC use and investment for energy reduction to be expanded, which would form better energy consumption. Investment in energy saving is expected to accelerate, which would lead to reduction in energy costs and making industries more competitive. New EMS businesses using big data will be supported to be established. With these plans, the ministry aims to build a smart energy consumption structure. In the budget request for FY 2014, over ¥300 billion is allocated for the measure to restructure energy consumption as a part of the energy measures. (The Chemical Daily, September 18, 2013)

(4) Agency for Natural Resources and Energy

The Agency for Natural Resources and Energy of METI will create a database on safety measure of hydrogen filling facilities for FCVs. Retained expertise from demonstrational operations will be systematized and publicized for smooth construction and operation of hydrogen filling stations. To promote hydrogen filling stations, a training program will also be prepared for operators new to hydrogen supply business. The agency requested approximately ¥8.2 billion, double the amount of FY 2013, for hydrogen filling station preparation in FY 2014. (Nikkan Jidosha Shimbun, September 19, 2013)

2. Local Governmental Measures

(1) Hokuriku Green Energy System Society

Consisting of businesses, local governments and universities in the prefectures of Toyama, Ishikawa and Fukui, the “Hokuriku Green Energy System Society” is developing a technology to generate power from aluminum containing waste such as a paper package for food and drink. High purity aluminum is extracted from drink cartons and frozen food packages containing aluminum. Sodium hydroxide is added to the recovered aluminum for the chemical reaction to generate hydrogen. The hydrogen is sent to FC for electrical power generation. A 250 ml drink carton with aluminum coat inside contains 0.6 g of aluminum. 10 kg of aluminum provide 10 kWh of electricity. Separated paper waste from the process is recycled to raw material of pulp, and recovered plastic is processed to heavy oil. (The Chugoku Shimbun, September 2, 2013)

On September 25th, the society announced that a commercial technology was established to create hydrogen with separated aluminum from aluminum coated waste and to generate electricity with FC. An originally developed solution is added to recovered aluminum for the chemical reaction to generate hydrogen. The technology successfully allowed the generation of hydrogen by adding water in the solution and avoided the use of additional sodium hydroxide, an expensive material. Alhytec will be ready to roll out the technology on October 1st. (The Denki Shimbun, The Toyama Shimbun, The Hokkoku Shimbun &

The Chemical Daily, September 26, 2013

(2) Kanagawa Prefecture

On September 5th, Kanagawa Prefecture uncovered an outline of “Kanagawa Smart Energy Plan”, a new energy plan. The plan aims to increase the usage of independent generators such as renewable energy, gas cogeneration systems and FCs. The electricity from those facilities is targeted at 45% (9.7% in FY 2010, the base year) of the total electricity consumption in the prefecture by FY 2030. Also targets are set for energy saving; a 10% reduction on that of FY 2010 by FY 2020, and a 15% reduction by FY 2030. (The Nikkan Kogyo Shimbun, September 6, 2013; The Nikkan Kensetsu Kogyo Shimbun, September 10, 2013; Nikkan Kensetsu Sangyo Shimbun, September 13, 2013)

(3) Ikoma City

On September 5th, Ikoma City revealed 29 bills and two reports to be submitted to its scheduled assembly. These show that the figure of subsidy applications for Ene-Farm already reached 41 on August 23rd. Since the number is increasing and getting close to 50, the target, the council plans to add ¥7 million to support another 70 households for the facility. (Nara Newspaper, September 6, 2013)

(4) Kawasaki City

On September 10th, Kawasaki City and Chiyoda Corporation, Yokohama City, submitted their joint proposal, which includes building hydrogen infrastructures to realize a steady energy supply and low carbon society, for the “National Strategic Special District”. The district scheme is newly established to provide substantial deregulation in the certified zone. Chiyoda Corporation successfully developed a method to store and transport large amount of hydrogen at a normal temperature under normal pressure. They will build a supply system of hydrogen from overseas procurement for distribution to large scale users at the coastal area as a business model. Commercial hydrogen power stations will be constructed aiming for the first operation in spring of 2015. The business model is planned to rollout nationwide, and to be expanded to FCV and FC bus as well as hydrogen usage to consumer products such as a stationary FC. The

final target is to sell the model globally to contribute to the economic growth of Japan. (Kanagawa Shimbun, September 11, 2013)

(5) Hyogo Prefecture & Kobe City

On September 11th, the Hyogo Prefecture and Kobe City submitted a total of six projects including a port restructuring and developments of regenerative medicine and related facilities. The proposal includes a “Next Generation Battery Test Center” to observe the deterioration process of FCs which would be built at SPring-8 in Sayo-cho. (The Kobe Shimbun, September 12, 2013)

3. Technological Development of FC Related Elements

(1) Tohoku Steel & Tohoku University

On September 5th, Tohoku Steel and Tohoku University announced that free-cutting electromagnetic stainless steel was jointly developed for polymer electrolyte fuel cells (PEFCs). The university confirmed that “K-M38CS”, a free-cutting stainless steel with titanium carbosulfides (TiCS) dispersed, exhibited the same level of corrosion resistance of “K-M38”, an electromagnetic stainless steel for PEFCs, and could replace K-M38. Tohoku Steel plans to start commercial production of K-M38CS in FY 2014. Being the key steel product of Tohoku Steel, K-M38 is highly resistant to corrosion while maintaining its excellent magnetic property, and largely used for cores of solenoid valves to control the flow of pure water for PEFC’s smooth operation. However, the material does not contain compounds to improve cutting performance due to its highly enhanced property to resist corrosion, and solenoid valve manufacturers want a material with better machinability for larger scale production. In 2001, Tohoku Steel developed a TiCS dispersed free-cutting stainless steel as a lead free material in the cooperation of Tohoku University, the National Institute of Advanced Industrial Science and Technology (AIST) Tohoku and Daido Steel. K-M38 contains no lead and is not free cutting steel, and they also created a TiCS dispersed type K-M38 at the development. Although the new material, K-M38CS, was made to be cut easier than K-M38, the demand for the new steel was too little to

commercialize at the time. As K-M38 became popular as a material for cores of solenoid valves later, improvement of its machinability has been requested. To meet the demand, the Tohoku Steel asked Prof. Nobuyoshi Hara of Tohoku University for a performance evaluation of K-M38CS. A corrosion test was carried out and dissolution behavior of the ingredients was assessed in ultrapure water at 80°C, the environment of PEFC. (Japan Metal Daily, September 6, 2013; The Nikkan Kogyo Shimbun, September 13, 2013; The Kahoku Shimpo, September 25, 2013)

(2) JST & NIMS

A group of the National Institute for Materials Science (NIMS) and Japan Science and Technology Agency (JST) succeeded in an in situ observation of electrochemical reaction that an oxide layer grows on a silicon membrane surface in water by applying voltage. The group developed a new measuring system using hard X-rays at SPring-8 and a microcell which is filled with a solution and has a silicon membrane separating it from a vacuum. As well as a wall, the silicon membrane also works as an electrode for electrochemical reaction and a window to let X-rays and photoelectrons through. Previously the X-ray photoelectron spectroscopy (XPS) measurement was only available in a vacuum. By using the new system, the oxide layer growth on the silicon surface was successfully observed as it is by applying voltage to the membrane in water. The interface between solid and liquid is an important place where energy is exchanged for facilities such as storage batteries, FCs and photovoltaic generators, and the results hopefully contribute to material design for the development of energy materials and devices. (The Chemical Daily, September 30, 2013)

4. Professional Purpose FC Developments and Business Plans

(1) MHI

Mitsubishi Heavy Industries (MHI) achieved over 4,000 hour uninterrupted operation of its 200 kilowatt (kW) class pressurized hybrid (combined cycle) power generation system consisting of solid oxide fuel cells (SOFCs) and a micro gas turbine (MGT). This joint research with the New Energy

and Industrial Technology Development Organization (NEDO) proved the combined cycle could provide stable power in summer when demand reaches the peak. Firstly the SOFCs convert chemical energy of natural gas into electricity. Secondly the unreacted gas goes into MGT to generate power to be more energy efficient. Also pressurized air from MGT's compressor is supplied to SOFCs as an oxidant, and the high temperature exhaust gas is sent to MGT to use the thermal energy and pressure with the unreacted gas for generation. (The Nikkan Kogyo Shimbun, September 23, 2013; The Denki Shimbun, The Chemical Daily, September 24, 2013)

(2) Sumitomo Precision

Sumitomo Precision Products will start FC business in FY 2014. In collaboration with Miura, a 5 kW power output SOFC system is under development for smaller business users such as convenience stores aiming to rollout in FY 2014. The system under development with Miura will be tested for its performance in FY 2013 to collect data quickly for commercialization in FY 2014. Sumitomo Precision will install a new line of SOFC's cell stacks for several hundred levels of productions in its main plant, Amagasaki City. Miura will assemble the system. Sumitomo Precision targets ¥10 billion sales of the product by FY 2020. (The Nikkan Kogyo Shimbun, September 24, 2013)

5. Undersea FC Generation

On September 3rd, a research group of Riken and the Japan Agency for Marine-Earth Science and Technology (JAMSTEC) announced that FC successfully generated power using hot water from a hydrothermal vent at a bottom of sea which is a part of Okinawa Trough and located 1,000 m deep. Endless hot water comes out to feed FC as a fuel, and normal temperature seawater water is unlimited for reduction. This environment is suitable for stable energy generation, and the technology can be a significant step for a power supply for research and development deep in the sea with thermal vents. Using an artificial thermal vent for the experiment, the group confirmed the potential difference between hot water from the

vent and surrounding sea water was approximately 520 mV. The hot water contains hydrogen and hydrogen sulfide which easily release electrons to go into the anode. Oxygen and iron oxide in the surrounding water capture electrons from the cathode. In this research, an electron flow from reductive to oxidative substances through electrodes was observed. Then the group made a basic FC by placing a booster circuit and electrodes near the vent and in surrounding water, and the cell successfully created 21 mW. JAMSTEC estimates 2.6 kW for the potential of chemical energy in the vent. (The Nikkan Kogyo Shimbun, September 4, 2013; The Denki Shimbun & The Nikkei Business Daily, September 5, 2013)

6. Ene-Farm Business Plans

(1) NTT Docomo

NTT Docomo will install its home energy management system (HEMS) to each smart house in the Tagonishi area of Sendai City by the end of this year to improve energy self-sufficiency to 80 to 90% from current 71%. Residents will move into the smart houses from October starting full operation of the system. The mobile phone operator will rollout HEMS for smart houses to manage photovoltaic generators, lithium-ion batteries (LIBs), Ene-Farm and storage batteries of electric vehicles (EVs). It is planned that energy self-sufficiency will improve by more efficient operation with cloud computing. (The Nikkan Kogyo Shimbun, September 5, 2013)

(2) Saibu Gas

On September 4th, Saibu Gas announced that a comprehensive showroom "Living Studio Hinata Fukuoka" would be open next spring. The gas provider has made strong efforts to sell Ene-Farm and Ecowill. Since the Great East Japan Earthquake, Ene-Farm sales significantly increased from 47 units for FY 2011 to 89, double the figure, for FY 2012. For FY 2013, the sales are still strong with a figure of 53 units by the end of July. (The Nagasaki Shimbun, September 5, 2013; The Nikkan Kogyo Shimbun, September 10, 2013)

On September 18th, Saibu Gas announced that the accumulated sales unit, an installation figure, of Ene-Farm had reached 2,000. The target of

Ene-Farm for FY 2013 is set of 1,270 which are 340 units more than the previous year's number. The firm can achieve 3,000 units in FY 2013 by adding 50 units to the target with strong sales. (The Denki Shimbun, September 19, 2013; The Nikkan Kogyo Shimbun, September 20, 2103)

(3) Toho Gas

On September 6th, Toho Gas announced that the accumulated sales of Ene-Farm reached 4,000 units on 5th. Since the accumulated sales target was achieved in 54 months, six months earlier than expected, the firm increased the target to 2,100 units which is a 40% rise of the initial target for FY 2013. (Gifu Shimbun, Ise Shimbun, Kumamoto Nichinichi Shimbun & Fuji Sankei Business i, September 7, 2013; The Denki Shimbun, September 9, 2013; The Nikkan Kogyo Shimbun, September 11, 2013; The Chunichi Shimbun, September 18, 2013)

(4) Panasonic

On September 9th, Panasonic announced a domestic PEFC had been jointly developed with a German boiler manufacturer "Viessmann Group". The PEFC will be sold from 2014 in Germany, and the sales are planned to extend to major European countries. Due to high environmental consciousness in these countries, they assess the market for home use PEFC as expandable. The product is the first PEFC to be sold for homes in Europe. Panasonic started FC business in 2009 in Japan, and has over 40% share for domestic FC in the market making it the leader. The FC department targets ¥20 billion, a 54% increase on that of FY 2012, for FY 2015. (The Yomiuri Shimbun, The Asahi Shimbun, The Mainichi Newspapers, The Nikkei, The Sankei Shimbun, The Nikkan Kogyo Shimbun & Dempa Shimbun, September 10, 2013; The Nikkei Business Daily, September 11, 2013; The Denki Shimbun, September 12, 2013; The Chemical Daily, September 13, 2013; The Ibaraki Shimbun, September 20, 2013)

Panasonic developed HEMS which stably provides power even during power cuts as long as water is supplied, by managing photovoltaic generator, LIB and Ene-Farm. Previously the system did not take Ene-Farm, but now controls

the facility for more efficient usage of electricity. For an average household, an annual utility bill can be reduced by approximately ¥60,000 compared to conventional systems. The whole system will sell for ¥2,363,550 including an automatic power controller, a storage battery and other peripheral devices. Apart from the package, the system requires a photovoltaic generator and Ene-Farm which supports the HEMS. (The Yomiuri Shimbun, The Asahi Shimbun, The Mainichi Newspapers, The Denki Shimbun, Dempa Shimbun, The Kobe Shimbun, The Kyoto Shimbun & Chiba Nippo, September 11, 2013; The Chemical Daily, September 13, 2013; The Nikkan Kogyo Shimbun, September 18, 2013)

(5) Mitsui Fudosan & PanaHome

Mitsui Fudosan Residential and PanaHome started construction of "Fujisawa SST (Sustainable Smart Town)", a development of a residential estate together. A total of 100 houses will be completed by March 2014. To create and store energy, each house will be equipped with a photovoltaic generator, Ene-Farm and a storage battery working together, and HEMS to control FC, air conditioner and EcoCute, an electric heat pump water heating system, as the standard feature. (Nikkan Kensetsu Sangyo Shimbun, Architectures, Constructions & Engineerings News (Daily) & The Denki Shimbun, September 20, 2013)

7. FCV & EV Cutting Edge Technologies

(1) Nissan

On September 3rd, Nissan Motors announced that its EV "Leaf" would be available in South Africa from October. Leaf will be the first EV sold in the country. (The Nikkei, September 4, 2013)

(2) Promotions for Micro EVs

More and more promotions for micro EVs have been carried out. Micro EVs take one to two people with motors outputting 8 kW or less, and can be used as convenient tools for communities. Being zippy and easily driven, they get attention as short distance transportation devices for elderly people and house wives. MLIT will back up the vehicles to be used widely, and consider deregulation for them. Nissan will provide its certified micro EVs to local governments for short distance travel for tourism

and their operations. The “New Mobility Concept” of Nissan drives approximately 100 km on a single charge, and its maximum speed is approximately 80 km/h taking two people. The price is about ¥1 to 1.5 million. Yokohama City will start a carsharing service for its residents and tourists in October. Also Kitakyushu City and Tsukuba City plans the same service. To collect data of usage on public roads, 150 vehicles will be provided by the end of FY 2013. (The Nikkei, September 5, 2013)

(3) Honda

Honda Motor will start an experiment of its smaller two-seater EV “Micro Commuter” together with Saitama City from January. The vehicles will be used for carsharing service to collect data for optimization of operation and battery capacity as well as safety. The automaker will consider using the vehicle as a storage battery for homes in conjunction with a smart house. (The Nikkei, September 5, 2013)

(4) Hitach

On September 5, Hitach agreed to seek collaborative work comprehensively in the energy field with Lietuvos Energija (LE) which is a public corporation for energy in Lithuania. They will investigate possibilities for the construction of a smart energy network and infrastructure development for EVs. (The Nikkei, September 6, 2013)

(5) Frankfurt Motor Show

Frankfurt Motor Show started on September 10th and will open to the public from 12th. Valuing EVs as an environmental policy measure, Germany announced that the number of EV registration was targeted at 1 million by 2020. This has encouraged European automakers’ sales plans, resulting in a start of full production of EVs this year. Germany-based VW revealed its key EV “e-Golf” for the first time, and four models were introduced including a small car “e-up!” and a plug-in hybrid vehicle (PHV) of Audi, its subsidiary. The EV “e-up!” will be available for €26,000 (approximately ¥3.6 million) this fall in Europe, and introduced into the markets of Japan and US later. VW announced that 14 models including EVs would be released by 2014. It is planned that the number of new models for EV and PHV will increase up to 40.

Germany-based BMW uncovered commercial EV “i3” whose materials were originally developed. The car will sell for €34,950. A PHV “i8” from BMW is expected to make its debut next year. German-based Daimler unveiled its luxury PHV version of “Mercedes-Benz S Class”. US-based Tesla Motors disclosed that quick chargers would be largely increased for its users in Europe. Watching others’ moves cautiously, Nissan has sold over 70,000 vehicles of its “Leaf” making it the leader in the field. Daimler signed a partnership in the development of FCV with Nissan and US-based Ford in January, and its FCV commercial production in 2017 was announced. (The Nikkei, September 10 and 12, 2013; Nikkan Jidosha Shimbun and The Chunichi Shimbun, September 13, 2013; The Kobe Shimbun, The Ehime Shimbun, Gifu Shimbun, The Yamaguchi Shimbun, The Kitanippon Shimbun, Yamagata Shimbun, Kumamoto Nichinichi Shimbun, Akita Sakigake Shimpo & The To-o Nippo, September 14, 2013; The Mainichi Newspapers, September 15, 2013; The Kyoto Shimbun, Minami-Nippon Shimbun and Chiba Nippo, September 17, 2013; The Nikkei Business Daily, September 18, 2013; Saga Shimbun, September 19, 2013)

VW signed an agreement for research and development of FCV with Ballard Power Systems, a major FC manufacturer in Canada. The agreement will last for four years from this year, and the project will be capitalized up to \$0.1 billion (approximately ¥10 billion) in the cooperation. (The Nikkei, September 14, 2013)

(6) Dongfeng Motor Company

On September 13, Dongfeng Nissan, a joint venture Nissan and Dongfeng Motor, held a test-ride event for Venucia, an EV for the Chinese market, in Dalian, Liaoning. Although the vehicle has been displayed at motor shows, it is the first time the EV was shown being driven. (The Nikkei, September 14, 2013)

(7) China

The Chinese government will extend the period of subsidy for eco car purchases to 2015 to reduce environmental impact. The scheme provides subsidies which are determined by the driving distance just on electricity for EVs and PHV. FCVs,

once commercialized, will be included in the scheme. A maximum of 60,000 CNY (approximately ¥970,000) is allocated for a passenger EV. The number of EVs reached 27,800 at the end of last year. (The Nikkei, September 24; Fuji Sankei Business i, September 26, 2013)

(8) EVEX 2013

The Electric Vehicle Development Technology Exhibition (EVEX) 2013 started on September 25th at Tokyo Big Sight, displaying the latest quick chargers and microcars which are expected to serve as short-distance transportation. More one- to two-seater micro EVs with three or four wheels are showcased this year which is the fourth time of the event. Kyoden, a printed circuit board manufacturer, displays its three-wheeler “Rena X3” as available this year. The car will sell for ¥498,000 which is cheaper than “Coms” of Toyota Auto Body, ¥668,000. IRDC Corporation, Fuji City, displays its “Smartporter”, in which the mileage is managed by smartphone, to start its small EV sales. (The Nikkei, September 26, 2013)

(9) Hino Motors

Hino Motors aims to commercialize its medium size PHV bus with power output function between 2015 and 2016. The bus will be displayed in the Tokyo Motor Show in December. A large FC bus is under development in collaboration with Toyota Motor as a demonstration project of the Ministry of the Environment (MOE), and its limited usage is expected to start in 2016. (Nikkan Jidosha Shimbun, September 26, 2013)

(10) The Bank of Nagoya

The Bank of Nagoya will provide single-seater micro EV “Coms” for “Personal Concierge” dedicated sales staff for personal banking to visit individual houses. On October 2nd, approximately 30 employees will be appointed for the duty, and allocated to major branches in Aichi Prefecture as well as a deployment of a total 12 EVs for branches near housing estates. EVs are flexible and move easily between houses. The bank will install chargers at the branches, and investigate the feasibility for further utilization of the EV. (The Nikkei, September 30, 2013)

8. Hydrogen Filling Stations’ Demonstrations and

Business Plans

(1) Toyota Tsusho

Toyota Tsusho will start a hydrogen filling station business for FCVs. A joint venture will be established with France-based Air Liquide, an industrial gas supplier, in October. Air Liquide has deployed hydrogen filling stations at 60 places largely in Europe, and has expertise and technologies for hydrogen production, storage and transportation. Toyota Tsusho will work out regulations with the Japanese government as well as controlling expenditure, and two commercial hydrogen filling stations are expected in Nagoya City and Toyota City in Aichi Prefecture in FY 2014. Toyota Tsusho has not participated in experiments in Japan. Because the government introduced a subsidy scheme for the installation of hydrogen filling stations in FY 2013, the trading house decided to install the commercial hydrogen filling stations. Nationwide deployment will be investigated by cooperation with other operators. (The Nikkei, September 23, 2013)

(2) Chiyoda Corporation

Chiyoda Corporation will construct a large supply base of hydrogen in Kawasaki City in FY 2015. With a capital of approximately ¥30 billion, the facility will be able to provide hydrogen for 40,000 FCVs each day, and fuel cost can be reduced by 30%. The engineering firm had the only technology to fix hydrogen to toluene, an organic solvent, to liquefy at normal temperature, and to extract hydrogen from the liquid. As a byproduct of oil-drilling processes, hydrogen is liquefied in oil producing countries for transportation in tankers. The large facility in Kawasaki City will separate hydrogen and toluene with a catalyst. The technology also allows reducing the cost by eliminating the need of liquefaction at a very low temperature for long distance travel. Because hydrogen is presently taken out in the production processes of chemical goods, the high price is unavoidable. However Chiyoda’s technology can bring the cost down from approximately ¥120/m³ to ¥80/m³ with the large supply facility. The firm seeks further improvement of the facility to bring the cost down to ¥60/m³ which is a similar level to gasoline driven range. The base in Kawasaki can provide 600,000,000 m³

each year, and the hydrogen will be compressed or liquefied for delivery to hydrogen filling stations in greater Tokyo area in a dedicated vehicles. (The Nikkei, September 30, 2013)

9. Hydrogen Production and Refining Technology Developments

(1) Saitama Institute of Technology

A research team of Dr. Shunichi Uchiyama, the president of the Saitama Institute of Technology, succeeded in high-speed and efficient production of hydrogen from wooden biomass such as forest thinning with the originally developed microbial electrolysis cell. Hydrogen was generated at the speed 50mL/h from 1 l of wooden biomass extracts on average. “It is a digit change compared to the process of using photosynthetic bacteria which are the conventional production method.” says Visiting Prof. Isoda at the Advanced Science Research Laboratory of Saitama Institute of Technology. The hydrogen conversion efficiency is 1300 mL/g, which is over four times that of the reported figure for glucose hydrogen fermentation. The experiment conditions were superimposed voltage 0.7V and extracts 0.1wt%. Hydrogen was produced from acetic acid at 25 mL/h average speed with 1 l of extract, and the conversion efficiency was 650 mL/g. The energy conversion from wooden biomass to hydrogen is inefficient, which is delaying the method in practical use. The institute plans to establish a method to vitalize the timber industry in Saitama Prefecture by supplying FC with hydrogen. (The Nikkan Kogyo Shimbun, September 4, 2013)

(2) KHI & Obayashi

Kawasaki Heavy Industries (KHI) and Obayashi Corporation plans liquid hydrogen production using geothermal power at Iodake of Iojima which is an island belonging to Mishima Town, Kagoshima Prefecture. The project aims for commercial production in 2019 at the earliest. The firms want FCVs driving around with hydrogen produced in Mishima Town at the 2020 Tokyo Olympics. In the project plan, hydrogen will be produced by splitting water using electricity from a geothermal power plant, which circulates water for energy generation, and liquefied at -250°C . Then

dedicated tanker trucks will deliver the liquefied hydrogen. Iojima is one of few volcanic islands in the world having access to fumaroles releasing 800 to 900 $^{\circ}\text{C}$. This allows shallower drilling to extract high temperature thermal energy. (Minami-Nippon Shimbun, September 27, 2013)

10. Hydrogen Transportation and Storage Technology Development

(1) JAEA & Tohoku University

On September 19th, a study group of Hiroyuki Saito, a senior scientist of the Condensed Matter Science Division at Japan Atomic Energy Agency, announced that a new aluminum-based hydrogen storage alloy was successfully synthesized in collaboration with the Institute for Materials Research and the Advanced Institute for Materials Research of Tohoku University. Hydrogen occupied interstitial sites of metal lattices of the aluminum-copper alloy by direct reaction at a high temperature under high pressure, which made an interstitial hydride. The synthesis conditions were quickly discovered in the experiment at high temperature under high pressure by detailed observation using X-rays. This study is expected to improve performance of FCVs. (The Nikkan Kogyo Shimbun, September 20, 2013; The Nikkei Business Daily & The Chemical Daily, September 24, 2013; The Denki Shimbun, September 25, 2013; Nikkan Jidosha Shimbun, September 27, 2013)

(2) Bio Coke Lab & Others

On September 19th, Bio Coke Lab, Ekotsu and Zero One Zero LLP, Gifu City, announced the start of their business of magnesium hydride (MgH_2), a solid hydrogen storage medium. A tablet of MgH_2 was developed as a “ MgH_2 Tablet” to capture, store and transport hydrogen safely in large volume, and will be available from October. Also a “ MgH_2 Portable Generator” will be sold from the same time. (Gifu Shimbun & The Chemical Daily, September 20, 2013; The Denki Shimbun, September 25, 2013)

(3) KHI

Kawasaki Heavy Industries (KHI) will develop tankers to import liquid hydrogen from Australia in 2017. With a capital of ¥60 billion, the project will start with experimental scale import from the state

of Victoria in southern Australia. Hydrogen is flammable and there is a risk of fire during transportation. To improve insulation, KHI will make tanks for liquid hydrogen double walled, and the gap between the walls vacuumed. This technology has already been used to tanker trucks for hydrogen transportation, and will be applied for tanker. KHI will build two smaller ships which could carry 2,500 m³ at a time. The total shipment would be 2,700 tons annually, which is an amount to fill 35,000 FCVs. The hydrogen will be sold to hydrogen filling stations for FCVs in cooperation with gas suppliers and marine transportation operators in Japan. The firm plans two larger ships which can carry 160,000 m³ of hydrogen by 2030, after further improvement of safety and sales' channel being made. The total amount of hydrogen would supply 3,000,000 FCVs. Australian hydrogen is cheaper and extracted from lignite which contains higher amount of water. According to KHI, the import price is ¥29.8/m³. This makes approximately ¥60/m³ including distribution costs, which is half the value of hydrogen extracted from liquefied natural gas, the common product in Japan at the moment. (The Nikkei, September 28, 2013)

Also the Japanese government backs up the import. MILT will establish an investigative commission to work on safety standards early October. They will take up subjects for the standards such as thermal insulation performance of a tank and non-flammable materials to be used for a ship. The standards will be drawn up with experiment results in FY 2014. (The Nikkei, September 28, 2013)

11. Business Plans of Private Organizations

(1) Furukawa

Furukawa Co. started the construction of a second plant at Iwaki Plant of Furukawa Denshi, a subsidiary, to meet the expanding demand for coils for automobiles. The investment in the facility is estimated at approximately a couple of ¥100 million. The sales of their coils have increased since the rising popularity of eco cars, such as EV. The expectation of further demand for PHVs, EVs and FCVs encouraged Furukawa Co. to build the

second plant. (Japan Metal Daily, September 3, 2013)

(2) NOK

NOK Corporation will expand its business of FC related products for automobiles. Carrying out the research and development, the Shonan Development Center, Fujisawa City, will start to create a production process for large scale. Also mass production technologies and production lines will be prepared for cell seals, a composition of PEFC cell stacks. By the earlier investment, the manufacturer aims to build up its products for automobiles to expand its business. (The Chemical Daily, September 25, 2013)

— This edition is made up as of September 30, 2013 —